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DEPARTMENT OF THE AIR FORCE

SUPPORTING DATA FOR FISCAL YEAR 1981 BUDGET ESTIMATES

SUBMITTED TO CONGRESS JANUARY 1980

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DESCRIPTIVE SUMMARIES

RESEARCH, DEVELOPMENT, TEST AND EVALUATION.

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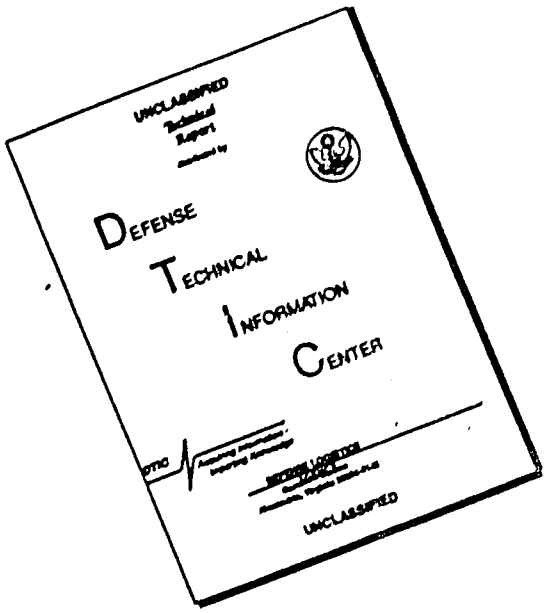

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DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS OF
THE DEPARTMENT OF THE AIR FORCE RESEARCH AND DEVELOPMENT PROGRAM
FY 1981
JANUARY 1980

INTRODUCTION AND EXPLANATION OF CONTENTS

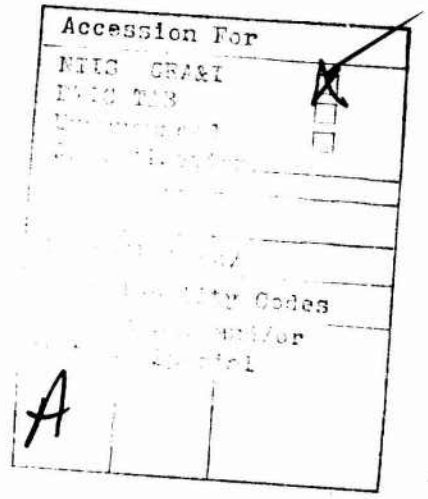
This document has been prepared to provide information on the United States Air Force (USAF) Research, Development, Test and Evaluation (RDT&E) Program to Congressional Committees during the Fiscal Year 1981 hearings. This information is in addition to the testimony given by DoD witnesses.

A descriptive Summary is provided for each program element within the USAF FY 1981 RDT&E Program. Also included are Descriptive Summaries of projects requiring $5 million or more within an element in FY 1981. A Test and Evaluation section is provided for major weapon systems.

The formats and contents of this document are in accordance with the guidelines and requirements of the Congressional Committees insofar as possible. The RDT&E funding information contained in the Descriptive Summaries is consistent with data contained in a separate document entitled, "Justification of Estimates for Fiscal Year 1981 RDT&E, AF."

The "RESOURCES" portion of the Descriptive Summaries includes, in addition to RDT&E funds, procurement funds and quantities, Military Construction Appropriation funds on specific development programs, and where applicable, Department of Energy (DoE) costs.

Classified pages bear the appropriate security classification. Classified data is bracketed [thus].



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FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 61101F
OSD Mission Area: Defense Research, #510

Title: In-House Laboratory Independent Research
Budget Activity: Technology Base, #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,200	9,000	10,200	11,600	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This effort is spread among thirteen research and development laboratories and provides discretionary funds to the Laboratory Directors to pursue new work of high promise or importance. The program is personally reviewed annually by the Assistant Secretary for Research, Development and Logistics. No higher headquarters approval or justification is required prior to starting the work, which is usually a one-time effort to initiate activities on time-critical ideas.

BASIS FOR FY 1981 RDT&E REQUEST: To provide the Laboratory Directors discretionary funds to pursue new high-promise work in a timely manner.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #61101F
OSD Mission Area: Defense Research, #510

Title: In-House Laboratory Independent Research
Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This program provides discretionary authority to Laboratory Directors of the Air Force Systems Command for new research work judged to be of high promise or importance. The Air Force has set up and administered this program in strict compliance with the intent that it would be unencumbered by restrictive reviews and procedures or justifications and documentation prior to beginning work. Laboratory Directors meet annually with the Assistant Secretary of the Air Force for Research, Development and Logistics to account for their research projects.

RELATED ACTIVITIES: Efforts accomplished through this program are of significant importance and are an integral part of the total work being done in the Air Force Laboratories. Usually funds are used to start or expand particularly promising work and continue for one year or until the work is transitioned to the regular program. The responsibility for insuring against unwarranted duplication of efforts rests with the Laboratory Directors. Similar programs are funded by the Army and Navy.

WORK PERFORMED BY: Numerous small and moderate size contracts are placed with universities and industry each year, in conjunction with directly related in-house laboratory efforts, to investigate promising new areas of Research and Exploratory Development. Directors of the Air Force in-house Laboratories are supported by and participate in this program. The ten major contractors were: Boeing Co., Seattle WA; Hughes Aircraft Co., Canoga Park CA; McDonnell Douglas Astronautics Co., St Louis MO; McDonnell Douglas Corp, Long Beach CA; Northrop Corp, Rolling Meadows IL; Systems Research Laboratories Inc., Dayton OH; Thikol Chemical Corp., Huntsville AL; University of Dayton, Dayton OH; Utah State University, Logan UT; Vought Corporation Advanced Tech. Center Inc., Dallas TX. There are 107 additional contractors doing work under 109 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Developed an aircrew oxygen mask that provides emergency protection up to altitudes of 60,000 feet. The uniqueness of this mask is that it provides for easier breathing and will fit 95% of the aircrew population with a minimum number of different sizes. A device capable of reflecting aircraft landing light illumination back to the pilot to provide glide slope information was developed and fabricated. This device can be used as a night time back-up to the Visual Approach Slope Indicator in case of power failure or for primitive landing strip operations. Developed and demonstrated an experimental battery cell comparator unit that provides warning of potential thermal runaway occurring in nickel cadmium aircraft batteries. Thermal runaway has resulted in battery destruction and fires aboard aircraft. Developed and tested Computer Assisted Instruction authoring procedures. During this testing, the course preparation time did not change; however, the course material presentation was significantly improved. A method was developed for selectively removing thin film infrared coatings without removing other optical thin films and without damaging the substrate. This procedure eliminates the necessity to repolish. Developed a long wave infrared (LWIR) imaging sensor to obtain target and background signatures in support of future LWIR aerospace vehicle detection systems. Developed a technique for growing high purity gallium arsenide crystals for application in the microfabrication of semiconductor devices. These high pur[illegible] crystals do not degrade

during annealing. Developed a technique for creating superplastic formed aluminum structures for application in producing lower cost aluminum airframe parts. Demonstrated the feasibility of using a low cost hybrid sustain rocket motor to meet the low thrust propulsion requirements typical of the sustain mode of WASP mini-missile concepts. A major improvement was made in containing exudation in general purpose bombs by replacing the standard asphalt liner with a polyurethane liner, in addition to identifying the hazardous situations caused by mach dash flight missions that create melt conditions. Completed the design of a passive, self-calibrating electro-optical tracker using stereometric sensors which will provide range and range rate data, operating in a covert mode to the pilot, thereby reducing his workload. Reduced the densification processing time of carbon/carbon rocket nozzle materials by 40%.

2. FY 1980 Program: The distribution of $9.0 million was approved by the Assistant Secretary of the Air Force for Research, Development and Logistics. Participating Laboratory Directors will again select projects of high promise to be supported.

3. FY 1981 Planned Program: The program will continue as in FY 1980. Individual tasks will be determined during the year at the discretion of the Laboratory Directors, who will be participating in this program.

4. FY 1982 Planned Program: The program will continue with individual tasks being determined during the year at the discretion of the Laboratory Directors, who will be participating in this program.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data: Not applicable. No change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Defense Research Sciences
Budget Activity: Technology Base #1

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	96,825	110,000	134,100	159,900	Continuing	Not Applicable
2301	Physics	10,100	10,200	12,510	14,790		
2303	Chemistry	9,325	11,000	13,470	16,060		
2304	Mathematics	9,500	10,700	13,210	15,700		
2305	Electronics	10,500	12,100	14,730	17,530		
2306	Materials	14,300	16,200	19,670	23,600		
2307	Mechanics	14,700	16,500	19,770	23,700		
2308	Energy Conversion	7,200	8,500	10,490	12,360		
2309	Terrestrial Sciences	1,600	1,800	2,220	2,740		
2310	Atmospheric Sciences	6,200	7,400	8,980	10,740		
2311	Astromony and Astrophysics	4,000	4,400	5,340	6,280		
2312	Biological and Medical Sciences	4,500	5,400	6,550	7,900		
2313	Human Resources	4,900	5,800	7,160	8,500		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is the funding base for a continuing program to stimulate and support the advances in scientific knowledge required to provide alternatives for future development, prevent technological surprise, and assist in the solution of technical problems which limit Air Force mission area operational capabilities. This program maintains in-house scientific expertise for immediate availability when needed by the Air Force.

BASIS FOR FY 1981 RDT&E REQUEST: This is a level of effort program to provide the scientific and technical advancements required by the Air Force to maintain technical excellence and, thus, operational superiority.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Defense Research Sciences
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This element is the total Air Force basic research program. It supports both extramural and in-house investigations of scientific areas in which technological progress is essential to improving Air Force capabilities. Promising research is focused on areas relevant to the Air Force mission and mature efforts are transitioned to Air Force development activities. The scientific program includes activities in Physics, Chemistry, Mathematics, Electronics, Materials, Mechanics, Energy Conversion, Terrestrial Sciences, Atmospheric Sciences, Astronomy and Astrophysics, Biological and Medical Sciences, and Human Resources. These scientific areas are focused into the following Technology Areas: Life Science, Propulsion and Power, Aerospace Vehicles, Materials, Geophysics, Electronics and Weaponry.

RELATED ACTIVITIES: Program coordination among government agencies is achieved through annual interagency meetings and data exchange with the Army, Navy, National Science Foundation, Department of Energy, National Aeronautics and Space Administration, Federal Aviation Administration, Defense Advanced Research Projects Agency, Defense Nuclear Agency, and other Federal research activities. Other means of coordination include annual briefings to the Under Secretary of Defense for Research and Engineering, attendance at technical symposia and topical reviews covering research areas of common interest, and triservice activities such as the Joint Service Electronics Program. In addition, particularly effective coordination is accomplished on an informal basis among individual Air Force program managers and their counterparts in other agencies or with scientists whose research is supported by other government sources.

WORK PERFORMED BY: The Air Force Basic Research Program is conducted predominately under extramural grants and contracts with academic institutions and industry. The entire Air Force research program, extramural and in-house, is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. Research is now underway in-house at the Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, OH; Air Force Armament Laboratory, Elgin AFB, FL; Air Force Weapons Laboratory, Kirtland AFB, NM; Air Force Rocket Propulsion Laboratory, Edwards AFB, CA; Air Force Geophysics Laboratory, Hanscom AFB, MA; Air Force Human Resources Laboratory, Brooks AFB, TX; Aerospace Medical Division, Brooks AFB, TX; Frank J. Seiler Research Laboratory, USAF Academy, CO; and the Rome Air Development Center, Griffiss AFB, NY. The ten major contractors are: University of California primarily at Berkeley and Los Angeles, CA; Massachusetts Institute of Technology, Cambridge, MA; Stanford University, Stanford, CA; Systems Research Laboratories Inc., Dayton, OH; University of Southern California, Los Angeles, CA; University of Texas, Austin, TX; SRI International, Menlo Park, CA; Polytechnic Institute of New York, Brooklyn, NY; Rockwell International Corp., Thousand Oakes, CA; and Georgia Institute of Technology, Atlanta, GA. In total there are 354 contractors with 1,224 contracts.

PROGRAM ACCOMPLISHMENTS AND FURTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: See individual project descriptive summaries.

2. FY 1980 Program: See individual project descriptive summaries.

Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Defense Research Sciences
Budget Activity: Technology Base #1

3. FY 1981 Planned Program: To maintain superiority of the operational Air Force over any potential adversary, a strong scientific research program is required for the scientific solution of military problems, the anticipation of technological surprise, the provision of technological alternatives, and the continuous innovative support of Air Force development activities. New thrusts or expanded areas of research emphasis planned for FY 1981 are described in the following sentences; however, more detailed information is contained in the individual project descriptive summaries. Particle beam research will be expanded significantly in FY 1981 in the area of pointing and tracking, neutralization of charges, and source emittance. Effort related to chemical lasers will be focused on shorter wave length systems dependent for operation on electronic energy transitions. Increased effort will also be directed toward studies of the kinetics of molecular and ionic processes characteristic of the upper atmosphere. Major emphasis will be placed on integrating empirical software testing methodologies and a new effort instituted in multidimensional digital filter techniques which relate to image processing. Electronics research will increasingly emphasize research in hybrid optical/digital systems, advanced techniques for active and passive terminal guidance, solid state components for microwave applications and microwave tube science. Materials science programs in nondestructive evaluations, powder metallurgy and joining techniques will continue to undergo a moderate expansion. Gallium arsenide research will be progressively redirected from solid state microwave devices to high speed logic for Air Force electronic systems. Additional funds available for mechanics research will be used to expand studies of three-dimensional and unsteady transonic aerodynamics. Increased funding will also permit growth in aerodynamics research, particularly in the ground-jet interference area. Energy conversion research will use additional resources to expand fuel-air explosion studies, increase efforts in the diagnostics and instrumentation program, and initiate thermal energy storage research. Direct field measurement and analysis of earth displacement and rotation in different geologic regions and over a wide range of frequencies will be continued to optimize Air Force weapon system deployment and enhance operational capability. Continued emphasis will be placed on studying phenomena related to spacecraft environment and ionospheric factors such as charged particles affecting communications. A thrust will begin to study and correlate the effects of multiple stress on human physiologic performance. New research initiatives will be directed at solving problems in areas such as human performance in operator-machine systems, the use of simulators for training aircrews, and human information processing and decision making.

4. FY 1982 Planned Program: See individual project descriptive summaries.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Defense Research Sciences
Budget Activity: Technology Base #1

7. Comparison with FY 1980 Budget Data: ($ in Thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	87,700	96,700	113,184	124,100	Continuing	Not Applicable
2301	Physics	9,700	9,400	11,300	12,421		
2303	Chemistry	9,000	9,700	11,200	12,139		
2304	Mathematics	8,700	9,300	11,300	12,421		
2305	Electronics	9,500	11,200	12,300	13,456		
2306	Materials	13,000	14,300	16,500	18,537		
2307	Mechanics	13,300	15,000	17,384	19,275		
2308	Energy Conversion	6,400	7,000	8,700	9,504		
2309	Terrestrial Sciences	1,300	1,500	2,000	2,070		
2310	Atmospheric Sciences	5,200	6,500	7,300	7,998		
2311	Astronomy and Astrophysics	3,800	4,100	4,700	5,081		
2312	Biological and Medical Sciences	3,800	4,100	5,000	5,364		
2313	Human Resources	4,000	4,600	5,500	5,834		

The $3.184 million reduction in FY 1980 as compared to last year's request was accomplished through prorated reductions in all the projects. The FY 1981 increase over last year s request is due to increased cost of the predominantly extramural grant and contract program with academic institutions and industry; increased civilian pay as a result of the 1 October 1979 pay raise; and allowance for some real growth in the program. These cost increases are factored throughout the projects.

Project: #2301 Title: Physics
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The research program in physics provides needed scientific information to the technology base to help solve Air Force problems in nuclear weapons effects, new weapon systems development, electromagnetic countermeasures, nondestructive testing and new materials development. To provide the necessary scientific knowledge, work is supported in optical physics, plasma physics, electricity and magnetism, atomic and molecular physics, quantum physics of matter, shock and detonation physics, and particle beam technology.

RELATED ACTIVITIES: Program coordination among government agencies is achieved through annual interagency meetings involving the Army, Navy, Department of Energy, Defense Advanced Research Projects Agency, Defense Nuclear Agency, and the National Science Foundation; annual program briefings to the Under Secretary of Defense for Research and Engineering; formal and informal discussions among scientists and engineers in the Services; and by attendance at symposia and topical reviews covering research areas of common interest. In addition, the Air Force research program in physics is related to other Air Force programs through discussion with laboratory personnel at annual technical reviews and through participation in various technology planning meetings.

WORK PERFORMED BY: Research in Physics is conducted predominantly under extramural grants and contracts with academic institutions and industry. The entire Air Force research program, extramural and in-house is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. In FY 1980, physics research is being performed in-house at Air Force development laboratories and through contracts with universities and commercial institutions. The ten major contractors are: University of Arizona, Tucson, AZ; SRI International, Menlo Park, CA; Massachusetts Institute of Technology, Cambridge, MA; Stanford University, Stanford, CA; Texas Tech University, Lubbock, TX; Boston University, Boston, MA; University of Michigan, Ann Arbor, MI; Columbia University, New York, NY; Battelle Memorial Institute, Columbus, OH; and Rutgers University, New Brunswick, NJ. In total there are 94 contractors with 153 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A technique has been developed for measuring molecular processes to one-picosecond (one trillionth of a second) which will improve understanding of processes in a wide range of materials from electronic to biological. This same project with its picosecond laser pulses discovered an acoustic response, and led to the successful demonstration of a photoacoustic microscope. This type of microscope can detect very small amounts of substances and has such diverse applications as finding impurities in integrated circuits (constructed on a microscopic scale) and uncommon elements in human tissue. Both examples have many implications for increasing understanding and control of processes and functions. A study has been completed which shows it is possible to design tunable laser devices with highly accurate specifications. These lasers are important in areas such as optical countermeasures and remote sensing. Coherent Anti-Stokes Raman Scattering, a new optical diagnostic process for measuring temperature and species concentration in molecular gases, e.g., plumes, has been

developed. This gives an increase of nearly one thousand in sensitivity compared to other processes and will allow an eventual understanding of the processes taking place in the gas. Ultrahigh-power microwave sources have been developed with relativistic electron beam technology. Using these sources, a record power level of 10 megawatts at submillimeter wavelengths has been demonstrated and a power level of 3 gigawatts (3 billion watts) was achieved at a longer wavelength of 10 centimeters. These power levels represent factors of ten or more increase over that obtained from conventional sources and may substantially increase our capabilities in radar and electronic countermeasures. A method of active stimulation of aurora plasmas has been developed under laboratory conditions. This is expected to be extended to field conditions and thus produce artificial auroras which could control radar transmissivity in that area. A new photocathode material has been developed for X-ray detectors which provides forty times greater sensitivity and three times greater energy resolution than conventional materials. This will improve our capability to diagnose plasma X-ray sources being developed to simulate nuclear weapons effects.

2. FY 1980 Program: The plasma physics and particle beam task will be expanded by the addition of a multiple investigator program in pulsed power technology, an important ingredient in these systems. Research will continue exploring new laser sources and techniques. This will improve understanding and lead to better designs and techniques for high energy lasers. A new subtask will be started in the area of countermeasures to particle beam systems.

3. FY 1981 Planned Program: The particle beam research will be expanded significantly in FY 1981 in aiming, beam generation, particle sources and other areas seeking knowledge in these important components of the task. The FY 1980 level of effort will be continued in atomic and molecular physics, continuing the search for understanding of molecular processes and the effect of radiation upon them. In optical physics, studies will increase in the spectral region important to laser countermeasures and imaging radar.

4. FY 1982 Planned Program: Pulsed power funding will remain constant while studies in certain aspects of propagation will increase, both areas addressing components for effective particle beams and other systems. Various uses of lasers to assist particle beams will be explored. Funding in atomic and molecular physics will remain constant. The optics program will demonstrate all the factors necessary to develop high-power, high-efficiency free electron lasers. A program in laser detection of very small amounts of materials will be emphasized. This capability has innumerable applications in understanding materials and reactions.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Project: #2301
Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Physics
Title: Defense Research Sciences
Budget Activity: Technology Base #1

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	10,100	10,200	12,510	14,790	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

Project: #2303 Title: Chemistry
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: Included in the chemistry research program are: (1) energy processes fundamental to high energy gas laser development; (2) synthesis and characterization of inorganic and organic materials for application in structural composites, lubricants, sealants, fluids, and fuels; (3) new analytical techniques related to detection and nondestructive testing; (4) atmospheric chemistry influencing operational Air Force environments; and (5) electrochemical processes important for improved batteries and fuel cells as well as corrosion limiting service life of aircraft.

RELATED ACTIVITIES: The Air Force chemistry program is coordinated through a federal interagency panel which includes participation by the Army, Navy, Department of Energy, National Science Foundation, National Institutes of Health, National Aeronautics and Space Administration, and the Environmental Protection Agency. Coordination is also achieved through triservice programs or special topical reviews of the Under Secretary of Defense for Research and Engineering. In addition, particularly effective coordination is accomplished on an informal basis among individual Air Force program managers and their counterparts in other agencies or with scientists whose research is supported by other government sources.

WORK PERFORMED BY: Research in chemistry is conducted predominatly under extramural grants and contracts with academic institutions and industry. The entire Air Force research program, extramural and in-house, is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. Research is now underway in-house at the Frank J. Seiler Research Laboratory, USAF Academy, CO; the Air Force Materials and Aero Propulsion Laboratories, Wright-Patterson AFB, OH; the Air Force Weapons Laboratory, Kirtland AFB, NM; the Air Force Geophysics Laboratory, Hanscom AFB, MA; and the Air Force Rocket Propulsion Laboratory, Edwards AFB, CA. The ten major contractors are Massachusetts Institute of Technology, Cambridge, MA; University of Southern California, Los Angeles, CA; University of Florida, Gainesville, FL; Cornell University, Ithaca, NY; Battelle Memorial Institute, Columbus, OH; State University of New York, Buffalo, NY: University of Texas, Austin, TX: Stanford Research Institute, Menlo Park, CA; Harvard University, Cambridge, MA; and Stanford University, Stanford, CA. In total there are 114 contractors with 164 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Air Force research has provided a continuous record of achievement in discovery of chemical laser systems and their optimization based on detailed understanding of the molecular energy exchange processes basic to their operation. The first example, the very first chemical system, was the hydrogen fluoride laser first demonstrated in 1966. More advanced concepts, with light emission based on changes in electronic energy, yield output radiation at higher frequencies. The first such device, also an Air Force accomplishment (in 1977), is based on activated oxygen and iodine. Subsequent research on processes fundamental to the operation of this system has permitted, up to now, a series of improved devices, each with higher power output. Construction of a large scale demonstration model is now scheduled. Closer to final realization in the area of

structural components is an advanced composite material which is structurally self-reinforced by internally dispersed bundles of stiff, rod-like molecules. The prospect of high strength, environmental resistance, and low processing cost is based on laboratory confirmation of properties of specific polymers whose molecular structure and composition were selected in advance for optimum properties. In addition, a more conventional two-phase composite has been synthesized by impregnating porous glass with plastic. The product is light weight, transparent, and fracture resistant. Applications foreseen include advanced microelectronic devices as well as high strength transparencies for aircraft canopies.

2. FY 1980 Program: Technical emphasis is placed on the five areas of dynamics, synthesis, structural chemistry, analysis, and surface chemistry. Research in dynamics considers processes whose control is required for optimization of gas laser systems. Also, an increased share of resources is devoted to research on kinetics and spectroscopy characteristic of rocket exhaust plumes and the chemistry of the atmosphere. The program in synthesis seeks new, more economical methods for making structural polymers, sealant elastomers, high temperature fluids, adhesives, propellant ingredients, refractory composites, and electro-optical materials. Research in structural chemistry seeks the underlying causes in molecular design responsible for observed strength, stability, and processibility of polymers, in particular, thermosetting epoxy binders and self-reinforced molecular composites. Nearing completion are efforts on processing chemistry of refractory carbon-carbon composite materials to determine and control the microscopic structural defects which limit strength in service in rocket nozzles. Analytical research seeks new more reliable, widely applicable means to measure composition, structure, and temperature in reacting systems; also investigated are electrochemical systems critical to new, improved batteries. Surface chemistry seeks understanding of interfacial processes critical to performance of lubricants, protective coatings, and adhesives. An increasing fraction of resources will be invested, throughout the program, in the powerful new capital equipment necessary for effective research.

3. FY 1981 Planned Program: Major shifts in emphasis from the previous year are not planned. However, some trends established earlier will continue while other program components will be maintained at stable levels. Research in dynamics will continue to increase emphasis on atmospheric phenomena and exhaust plume characterization. The emphasis in the effort related to chemical lasers will be on prospective, shorter wave length systems dependent for operation on electronic energy transitions. Research in carbon-carbon composites will shift from the chemical basis of defects to fully characterizing the resultant consequences in mechanical properties. Increases in surface science will concentrate on the molecular basis for advanced adhesives. Major real growth will be dedicated to large-scale programs in microprocessing of glass and ceramics and in the kinetics of molecular and ionic processes characteristic of the upper atmosphere.

Project: #2303 Title: Chemistry
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

4. FY 1982 Planned Program; Research will continue in the principal areas of program emphasis. The specific content will change somewhat as successful accomplishments are transitioned to development, unsuccessful efforts discontinued, and new opportunities recognized. Nearing completion will be processing research on carbon-carbon and self-reinforced composites. Of increased importance will be synthesis of high temperature fluids and elastomers and advanced, highly processible composite binders. Major real growth will be in large-scale programs on polymer microprocessing for electronic applications and on the molecular kinetics of combustion reactions.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	9,325	11,000	13,470	16,060	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

Project: #2304 Title: Mathematics
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The objective of the research program in the mathematical sciences is to produce new analytical and numerical methods needed to solve mathematical problems occurring in all areas of Air Force research, technology, and operations. Mathematical research results contribute to advances in control systems for missiles and aircraft engines; aerodynamic design of aircraft, missiles, and weapons; command, control, computers and communications; surveillance and reconnaissance; systems reliability and maintainability for Air Force systems; and resource allocation systems for logistics and operational activities.

RELATED ACTIVITIES: The coordination of this program among government agencies is achieved through annual interagency meetings involving the Army, Navy, Department of Energy, and the National Science Foundation; annual program briefings to the Under Secretary of Defense for Research and Engineering; formal and informal discussions among scientists and engineers in the services; and by attendance at symposia and topical reviews covering research areas of common interest. In addition the Air Force program in mathematical research is tied to other Air Force research and development programs through participation in planning activities, and through coordination with Air Force laboratory personnel at annual technical reviews of programs.

WORK PERFORMED BY: The Air Force mathematics research program is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. It is performed under contracts and grants to industrial and university laboratories as well as in-house at six Air Force laboratories, where it is closely coupled with their own research and development programs. The ten major contractors are: Stanford University, Stanford, CA; Brown University, Providence, RI; University of Michigan, Ann Arbor, MI; University of Maryland, College Park, MD; New York University, New York, NY; Florida State University, Tallahassee, FL; University of California, Berkeley, CA; University of Texas, Austin, TX; University of Southern California, Los Angeles, CA; and Northwestern University, Evanston, IL. In total there are 123 contractors with 262 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: First experiments to define limitations of an improved software verification technique have been completed. New research results in software verification indicate that as many as 25% of existing errors may still remain even though all logical paths in the program have been tested. These results will serve as new research directions for further investigations into software verification. A new nonlinear optimal filter has been developed for navigation systems used on satellites. It provides as much as 50% improved precision. New algorithms for the numerical computation applicable to fluid flow have been developed which greatly improve codes which are used to calculate problems in aerodynamics. These techniques will influence the design of these multicomponent processing computers. New theoretical studies have been developed which improve our understanding of instabilities occurring in generation of laser pulses. New statistical techniques have been developed to improve the detection, analysis and reconstruction of signals contaminated with random noise. These

methods represent an improvement over existing models and will find application in many signal processing techniques. A new programmable integrated circuit on a chip has been developed which greatly improves the flexibility in the design of digital communications systems. Such a technique should find application in design of future communications systems. New techniques dealing with the reliability of multi-state and degradable systems have been developed. These results will make it possible to evaluate performance and reliability of such systems in a more satisfactory manner. Such techniques will also improve the analysis of existing systems. New techniques for wage inflation forecasting in aerospace industries of the U.S. and European countries involved in the F-16 program were developed.

2. FY 1980 PROGRAM: Major efforts will continue to investigate methods of design for software in computer systems and to study the architecture of computing systems with a number of processors. In control systems research adaptive control systems will be investigated with the objective of expanding their application to Air Force systems. In numerical analysis research will be carried out on the solution of differential equations which model flow fields and aircraft-type structures. New analytical techniques will be investigated in nonlinear mathematics, computer aided symbolic analysis and modeling of composite materials. In statistics the major thrust will be in the areas of reliability theory and multivariate statistical analysis. In the general area of stochastic processes a major program will be initiated. In system science new programs in distributed decision programs which hold promise of application to command, control and communications theory will be initiated. Additional investigations concerning transonic flows will be carried out and numbered methods will be examined with the aim of solving certain aerodynamic boundary layer problems. New research efforts related to the architecture of highly survivable distributed processing computer network for avionics will be undertaken. These techniques may have application to the very high speed integrated circuit program. Continued effort will be made to assist in-house Air Force scientists and engineers in solving problems related to mathematics. Additional funds provided this year will be used to support new research activities in command, control and communications theory, software and computer sciences.

3. FY 1981 Planned Program: New investigations of distributed control systems to provide a solution to the problem of controlling large scale systems will be pursued. Major emphasis will be placed on integrating empirical software documentation with the formal methods of proof-of-correctness to obtain more efficient ways of verifying software. Continued emphasis will be placed on computationally efficient methods of solving the equations which govern behavior of structural designs, aerodynamics, and electromagnetic systems. New analytical theories will be investigated concerning the chaotic solutions of nonlinear problems. Continued emphasis will be placed on the reliability and multivariate anlaysis areas along with investigations of stochastic processes. A new effort will be instituted in multidimensional digital filter techniques as related to image processing. Continued effort will be made to assist in-house Air Force scientists and engineers in solving problems related to mathematics. Additional funds provided this year will be used to support new activities in software, reliability, nonlinear mathematics and system science.

Project: #2304 Title: Mathematics
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

4. FY 1982 Planned Program: It is planned to emphasize software reliability techniques, statistical communication theory, advanced numerical and nonlinear techniques and distributed processors. Continued effort will be placed on making advanced mathematical techniques available to in-house Air Force scientists and engineers engaged in solving problems occurring in aerodynamics, command and control, communications and various Air Force operational problems. Additional funds provided this year will be used to support new activities in communication theory, computer science, nonlinear mathematics and distributed processing.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	9,500	10,700	13,210	15,700	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

Project: #2305 Title: Electronics
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The Air Force electronics research program is directed toward electronics technologies judged vital for sensing, tracking and airborne weapons guidance functions and for the communication and processing of Air Force command and control information. The program of electronics research includes efforts leading to more reliable, less costly electronic components and systems concepts for future Air Force weapon systems. Specific areas of emphasis include fundamental studies of microwave and signal processing devices for secure communication systems; microwave tube science; optical terminal guidance electronics; electromagnetic propagation; electromagnetic and electro-acoustic devices; antennas; target signatures; integrated optical devices; nuclear radiation hardening; real time signal processing for command, control, and communications; and advanced gyroscopic techniques for inertial navigation.

RELATED ACTIVITIES: Electronics research is coordinated through the program reviews of the Under Secretary of Defense for Research and Engineering (USDRE) including the USDRE Technical Coordinating Paper on Electronics. Coordination with other research agencies is obtained through data exchange with the Office of Naval Research, the Army Research Office, and the National Science Foundation. The programs of Air Force electronics research are internally coordinated with development programs through the Electronics Research Planning Board of the Air Force Systems Command. The Joint Service Electronics Program is funded within this project and is managed by a Technical Advisory Committee with one representative from each service and a Technical Review Panel with representatives drawn from the three services.

WORKED PERFORMED BY: The electronics research is performed under contracts and grants to industrial and university laboratories as well as at the Rome Air Development Center, Griffiss AFB, NY; and the Air Force Avionics Laboratory, Wright-Patterson AFB, OH. The Air Force Office of Scientific Research, Bolling AFB, DC, provides overall program management for Air Force electronics research in addition to serving as an administrator of extramural electronics research. The ten major contractors are: University of Southern California, Los Angeles, CA; Polytechnic Institute of New York, Brooklyn, NY; University of California, Berkeley, CA; University of Texas, Austin, TX; Stanford University, Stanford, CA; Massachusetts Institute of Technology, Cambridge, MA; Cornell University, Ithaca, NY; Varian Associates, Palo Alto, CA; Ohio State University, Columbus, OH; and Carnegie-Mellon University, Pittsburgh, PA. In total there are 92 contractors with 124 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The capability of Surface Acoustic Wave filters to separate and process signals in the ultra high frequency range has been improved with regard to temperature stability over the military temperature range by the theoretical discovery and laboratory confirmation of a quartz orientation that is temperature compensated in two orthogonal directions. The signal retention capabilities of delay lines using Charge Coupled Devices (CCD's) was improved by a factor of 100 by sampling the stored charge and refreshing it from an external charge reservoir. CCD's are semiconductor microcircuits that store and transfer charge as a means of processing electronic signals. The applications for the improved device include moving target indicators

for radar and post detection integrators for jam-resistant communication. Two building blocks required to perform parallel optical signal processing were demonstrated for the first time; namely, a digital-to-analog converter operating in real time and a circuit for summing binary optical images. Potential applications include reconnaissance and terminal guidance. Optical signal processing has the potential for hundred-fold increases in processing speed over conventional digital signal techniques when the signals to be processed are two dimensional, as in imagery. A ring laser gyroscope was demonstrated in which the laser was outside a passive fiber optic resonator. This approach promises greater sensitivity than conventional ring laser gyroscopes for navigation and guidance with the increased ruggedness and compactness of a solid state laser instead of a gas laser.

2. FY 1980 Program: The fundamental research program for the current year extends that of the previous year with increased emphasis in the areas of signal processing and communications science. Emphasis is being placed on devices and systems suitable for communication in high electronic countermeasures environments such as convolvers, surface wave filters, optical correlators, and holographic elements. Research in the science underlying optical and nuclear gyroscopic techniques for potential low cost inertial sensors will be continued. Research on ultra-submicron electronic devices will be expanded to increase our information handling capability in airborne and satellite systems. The microwave tube program will continue to expand the research base in support of this device of importance to radar, countermeasures and communication systems. Funding increases are dedicated to expansion of programs in ultra-submicron electronic devices, optical and nuclear gyroscopes, and digital systems design methodology.

3. FY 1981 Planned Program: The Air Force electronics research program for FY 1981 will increasingly emphasize research in hybrid optical/digital systems for real time computation, innovative processing science for fabrication of future signal processing systems, advanced techniques for active and passive terminal guidance, solid state components for microwave application, and microwave tube science for high power amplification and ultra-submicron electron device properties. Funding increases will be applied to maintain all of the above areas with special emphasis on signal processing design theory and ultra-submicron electronic properties.

4. FY 1982 Planned Program: The electronics program for FY 1982 will expand the program areas above, while seeking to stimulate fundamental innovative science in areas of smart sensors, high speed information processing, target identification and terminal guidance, inertial guidance, and communications.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Project: #2305
Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Electronics
Title: Defense Research Sciences
Budget Activity: Technology Base #1

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	10,500	12,100	14,730	17,530	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

Project: #2306 Title: Materials
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The Air Force materials research program is directed toward improvements in cost, reliability, and performance of Air Force weapon systems. The program includes research on a broad range of materials properties such as strength, fatigue resistance, and corrosion resistance of aircraft frame, skin, and turbine engine materials, as well as the science of nondestructive evaluation of material flaws. Materials research in support of avionic and optical systems is directed toward the development of materials for components employed in communication, surveillance, weapons guidance, and electromagnetic weaponry.

RELATED ACTIVITIES: Materials research is coordinated through the Under Secretary of Defense for Research and Engineering (USDRE) Materials Technology Coordinating Paper, program reviews of USDRE and the Interagency Materials Coordinating Group which includes the National Science Foundation, Department of Energy, National Aeronautics and Space Administration and the military services. The programs of Air Force materials research are internally coordinated with development programs through the Materials Research Planning Board of the Air Force Systems Command.

WORK PERFORMED BY: Materials research is performed under contracts and grants to industrial and university laboratories as well as in-house at the Air Force Materials Laboratory and the Air Force Avionics Laboratory, Wright-Patterson AFB, OH; and the Rome Air Development Center, Griffiss AFB, NY. The Air Force Office of Scientific Research, Bolling AFB, DC, provides overall program management of Air Force materials research in addition to serving as the major administrator of extramural materials research. The ten major contractors are: Systems Research Laboratories, Dayton, OH; Stanford University, Stanford, CA; Massachusetts Institute of Technology, Cambridge, MA; Rockwell International Corporation, Thousand Oaks, CA; University of Southern California, Los Angeles, CA; Battelle Memorial Institute, Columbus, OH; Cornell University, Ithaca, NY; Hughes Research Laboratory, Malibu, CA; Westinghouse Electric Corporation, Pittsburgh, PA; and University of Illinois, Urbana, IL. In total there are 122 contractors with 188 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Improved high temperature yield strength and creep resistance have been obtained in nickel based superalloys by the addition of up to six weight percent rhenium metal. Increased life and reliability of aircraft turbine engines may result from this research advance. New powder processed aluminum alloys have maintained their high yield strength after 1000 hours at temperatures in excess of 450 degrees F. These materials may replace costly titanium alloys in high temperature portions of airframes. A new radiographic technique was discovered for nondestructive evaluation of carbon-carbon composite structures. This will allow previously undiscovered cracks to be located rapidly and with high confidence. A mechanism by which high energy protons may cause errors in very large scale integrated circuits has been identified. The increased knowledge of these interactions will aid the design for nuclear hardness of the next generation of integrated circuits for high

speed computation. A simplified mathematical method has been developed for calculating propagation modes in fiber optic waveguides of arbitrary cross section. This analytic tool will speed the design of improved waveguides and couplers for secure communications systems.

2. FY 1980 Program: Structural materials research will concentrate on life limiting fatigue, corrosion, and cracking properties of high temperature materials to reduce life cycle costs. Increasing emphasis will be devoted to the science of materials processing and joining. The research program in nondestructive evaluation of metals and ceramics will be directed toward improved sensitivity in the detection of subcritical flaws and in improved noncontacting transducers. Materials research basic to passive optical components for the infrared and ultraviolet regions of the electromagnetic spectrum will be continued. The program of research on materials basic to microwave and acoustic signal processing applications will continue to be emphasized. Materials for infrared sensing and for airborne power systems will continue at current levels. Funding is being increased for expanded materials processing, nondestructive evaluation, submicron dimensional electronic device materials, and electronic materials for high speed signal processing.

3. FY 1981 Planned Program: The Air Force materials research program for FY 1981 will continue to direct research toward those materials with potential for innovative impact on high temperature gas turbines and airframe components as well as on the electronic materials needed for improved command, control, and communications. The programs in nondestructive evaluation, powder metallurgy, and joining sciences will continue to undergo a moderate expansion. Synthesis of high temperature ceramics by chemical vapor deposition and synthesis and characterization of high temperature superconductors for advanced electrical power systems will continue to be pursued. Research in synthesis and characterization of gallium arsenide will be progressively redirected from solid state microwave devices to high speed logic for Air Force electronic systems. Research in electromagnetic materials for advanced components in digital signal processing, optical storage, optical processing and electro-optics will be continued. Ceramic materials, nondestructive evaluation and submicron electronic materials science will receive increased funding.

4. FY 1982 Planned Program: The Air Force materials research program for FY 1982 will continue to support the technologies vital to reliability and advanced performance of Air Force equipment. The synthesis and characterization of metals and ceramics promising long life time and a high degree of resistance to high temperature and corrosive environments will be supported. Semiconducting, superconducting and acoustic materials research will continue as a basis for components with enhanced performance and high reliability to meet the communications and power handling requirements of Air Force systems. Funding emphasis will continue to be placed on powder metallurgy, joining and forming, nondestructive evaluation and submicron electronic materials science.

Project: #2306 Title: Materials
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	14,300	16,200	19,670	23,600	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

Project: #2307 Title: Mechanics
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: Mechanics research provides fundamental knowledge pertaining to aerodynamics and structural principles required for improving the efficiency, effectiveness, and safety of current and future Air Force aerospace vehicles. Investigations are conducted in fluid mechanics, solid mechanics and flight dynamics. The results of this work provide the generic aerodynamic and structural technologies with new insights and concepts necessary to assure the design and production of superior aerospace weapon systems.

RELATED ACTIVITIES: The Technology Coordinating Paper on "Structures" published by the Under Secretary of Defense for Research and Engineering (USDRE) and the USDRE topical reviews provide overviews of the solid mechanics research of the three services. Overall project coordination takes place in annual triservice reviews to USDRE. Informal coordination occurs at meetings of professional societies. Meetings of special interest are also held involving the National Aeronautics and Space Administration; Army Research Office; Army Materials and Mechanics Research Center; Office of Naval Research; National Materials Advisory Board; Council on Structures, Design and Materials; as well as with universities and industries.

WORK PERFORMED BY: Research in mechanics is conducted predominantly under extramural grants and contracts with academic institutions and industry. The entire Air Force research program, extramural and in-house, is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. Research is now underway in-house at the Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, OH; Frank J. Seiler Research Laboratory, USAF Academy, CO; Air Force Armament Laboratory, Eglin AFB, FL; Air Force Rocket Propulsion Laboratory, Edwards AFB, CA; and Air Force Weapons Laboratory, Kirtland AFB, NM. The ten major contractors are: Massachusetts Institute of Technology, Cambridge, MA; California Institute of Technology, Pasadena, CA; Princeton University, Princeton, NJ; Texas A&M, College Station, TX; Stanford University, Stanford, CA; University of Texas, Austin, TX; Systems Research Laboratories, Inc., Dayton, OH; University of Washington, Seattle, WA; Georgia Institute of Technology, Atlanta, GA; and University of Pittsburgh, Pittsburgh, PA. In total there are 135 contractors with 211 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A theoretical method for designing advanced airfoil shapes to provide shock-free flow over a wing section at supercritical transonic speeds has been developed. This method has been demonstrated to apply to both two and three-dimensional wing shape design. The physical mechanisms that cause a fluid jet to resonate has been correctly isolated and analyzed with previous models of this phenomenon proven false. This analysis will be used to evaluate the vibrational loads subjected on large rockets during lift off. Improved flow visualization techniques along with new data collection and analysis techniques have provided new insight into the classification and structure of turbulence and the effect these factors have on drag, mixing and combustion processes. A theory for the microstructure of multiconstituent materials that incorporates arbitrary constituent geometry, anisotropy, and interface debonding has been developed to model carbon-carbon materials;

this theory is also applicable to other structural materials of interest to the Air Force; e.g., reinforced concrete. A better method for evaluating the stress concentrations and stress-strain relationships at joints and fasteners, typical of the nonlinear problems that face aircraft designers, has been developed.

2. FY 1980 Program: Research in transonic aerodynamics will continue with some redirection toward three-dimensional effects especially as they are associated with wind tunnels. A new program of research associated with very short take-off and landing aircraft will be launched with a study of thrust recovery from highly deflected, energetic jets. Unsteady flow fields in rotating turbomachinery will be studied theoretically and experimentally, as also will basic mechanisms in turbulence. Turbulence modeling, however, will be maintained at a low level. Efforts exploring the structural and material mechanics of composite materials will continue with some redirection of emphasis into carbon-carbon and metal-matrix areas. Nondestructive evaluation techniques will decrease with a corresponding increase in research in nonlinear constitutive relations to establish the essential elements of the mechanical response to advanced structural materials.

3. FY 1981 Planned Program: Additional resources will be used, in part, to expand research in three-dimensional and unsteady transonic aerodynamics. The effort in two-dimensional transonic flows can be expected to decrease. Increased funding will permit growth in aerodynamics research, particularly in the ground-jet interference area. Depending on the results of studies expected to be completed in FY 1980, a new effort pertaining to the structural and fluid dynamic optimization of complete air breathing engines may be initiated. Solid mechanics research can be expected to emphasize nonlinear three-dimensional stress-strain relationships, to provide realistic design models for the three-dimensional structures of interest to the Air Force.

4. FY 1982 Planned Program: Two-dimensional transonic flow research should all but disappear in favor of three-dimension unsteady efforts. The properties of highly deflected, energetic jets, as they apply to aircraft performance, will be studied at an accelerated pace. Flows through passages with complex geometries along with turbine cooling methods may dominate compressor aerodynamics in the internal aerodynamics program. Depending on results, the turbulence program could transfer its thrust from experiments to modeling. Increased resources will be used to expand efforts in metal-matrix composites, fracture mechanics, engine optimization and supersonic aerodynamics.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Project: #2307 Title: Mechanics
Program Element: #6110F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	14,700	16,500	19,770	23,700	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

Project: #2308 Title: Energy Conversion
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project is concerned with energy transformation and conversion to useful forms. The areas in which new knowledge is being sought include: (1) combustion and ignition phenomena associated with rocket and aircraft engines, both present and future; (2) fundamental energy property data, thermophysical and kinetic, needed to advance propulsion, materials, and weapons technologies; and (3) solid and gaseous detonation mechanisms associated with advanced conventional weapons and with improved safety in the use of energetic material. The goal is to reduce the cost and to increase the flexibility and effectiveness of future Air Force systems through the application of research results to the technologies of propulsion, power generation, and conventional and electromagnetic weapons.

RELATED ACTIVITIES: This research is actively coordinated within the Department of Defense by annual triservice reviews by the Under Secretary of Defense for Research and Engineering and within the Air Force through extensive participation of user organizations in both planning and evaluation. Coordination with other government agencies includes participation in such formal mechanisms as the Interagency Advanced Power Group and the Joint Army-Navy-National Aeronautics and Space Administration-Air Force Propulsion Committee, as well as less formal but fairly continuous contact with the National Science Foundation, the National Research Council, and the Department of Energy.

WORK PERFORMED BY: Research in energy conversion is conducted predominantly under extramural grants and contracts with academic institutions and industry. The entire Air Force research program, extramural and in-house, is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. Research is now underway in-house at the Air Force Armament Laboratory, Eglin AFB, FL; the Air Force Rocket Propulsion Laboratory, Edwards AFB, CA; and the Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, OH. The ten major contractors are: Princeton University, Princeton, NJ; Georgia Institute of Technology, Atlanta, GA; Atlantic Research Corporation, Alexandria, VA; Stanford University, Stanford, CA; Massachusetts Institute of Technology, Cambridge, MA; Purdue Research Foundation, Lafayette, IN; SRI International, Menlo Park, CA; Sheffield University, Sheffield UK, England; Jet Propulsion Laboratory, Pasadena, CA; and University of Illinois, Urbana, IL. In total there are 63 contractors with a total of 79 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In the area of fuel-air explosions, very high turbulent flame speeds with attendant strong blast waves have been accomplished in fuel-air mixtures normally considered inert. This is accomplished through the generation of large scale turbulent structures within the mixture. Previous understanding of reaction chemistry modeling required chain branching reactions before a reaction could increase to detonation. It has now been determined that non-chain branching reactions can progress to detonation. This will allow new modes of combustion instability not considered before. In rocket propulsion, progress has been made in characterizing the processes of decomposition dynamics of HMX, a new high energy high density solid rocket motor fuel. This

understanding is now available for use in developing future high energy smokeless propellants. The production and reaction of aluminum particles within a rocket combustion chamber must be understood to evaluate the performance of aluminum loaded solid rocket propellants. In situ measurements on this process have been difficult to make. New data on the combustion behavior of aluminum and aluminum oxide particles as they flow through the combustion chamber and exit nozzle have been obtained. This data will be used to improve the performance and stability characteristics of solid propellants containing aluminum.

2. FY 1980 Program: The air breathing combustion program will continue to expand efforts related to unconfined fuel-air explosions, especially as they address near term future weapons. A new program concerned with diagnostic methods and instrumentation applicable to combustion experiments will be started. This will involve initiation of a single large university contract concerned with advanced instrumentation and diagnostic methods applicable to combustion phenomena in both air breathing and rocket systems. The dynamics of high speed chemically reacting flows will be investigated theoretically and experimentally with emphasis placed on processes and phenomena occurring in rapid expansion combustors. Research in the oxidation and high temperature decomposition of hydrocarbons will seek information necessary to the synthesis of future fuels. Efforts will continue to explore the phenomena associated with rocket motor combustion to provide knowledge needed to improve rocket performance for a variety of Air Force tactical, strategic and space propulsion systems. Physical and chemical reactions in rocket plumes along with certain radiation phenomena will be studied in Air Force laboratories and through contract. Thermodynamic and transport property data measurements and evaluation and efforts relating to rocket combustion dynamics will be continued at about the same rate as in FY 1979. A new in-house program of research in direct thermal energy storage may be started and funded with increased resources. An increase in efforts pertaining to the combustion of new "alternative" fuels and high energy, high density fuels; to ramjet combustion instability; to ducted rocket and supersonic and dual mode combustion is also planned.

3. FY 1981 Planned Program: Fuel air explosion research will be expanded in anticipation of needs driven by developing weapon systems. Additional resources will also be used to support adequate growth in the nonintrusive diagnostics and instrumentation program. Additional resources will be used to expand the thermal energy storage program. Because of its potential application to space, this program will eventually become the focal point for other efforts associated with advanced space propulsion and power concepts. A decrease is planned in efforts associated with thermophysical and thermochemical properties and combustion kinetics program.

4. FY 1982 Planned Program: Fuel air explosion research will probably remain constant. Some growth is expected in efforts pertaining to new fuels and high energy/high density fuels, to ramjet combustion instability, to ducted rocket and possibly supersonic and dual mode combustion.

5. Program to Completion: This is a continuing program.

Project: #2308
Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Energy Conversion
Title: Defense Research Sciences
Budget Activity: Technology Base #1

6. Milestones: Not applicable.

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds	7,200	8,500	10,490	12,360	Continuing	Not Applicable

8. Comparison with FY 80 Budget Data: See program element descriptive summary.

Project: #2309 Title: Terrestrial Sciences
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project supports Air Force requirements in missile system guidance, control, and delivery; advanced guidance component testing; missile site selection; detection and identification of underground nuclear explosions; and surveillance. Research in geodesy is required to determine the exact position of targets with respect to missile launch silos. Research in gravity is required to determine its effect on missile guidance systems. Research in seismology is required to determine the effects of earthquakes, nuclear explosions, and other natural or system-generated noise on missile guidance systems degradation.

RELATED ACTIVITIES: Complementary research is conducted by the Army, Navy, National Aeronautics and Space Administration, National Science Foundation, and the U.S. Geological Survey. Coordination with the Army and Navy is accomplished through the Environmental Sciences Technology Coordinating Paper and Under Secretary of Defense for Research and Engineering annual reviews. Other coordination is accomplished through Interagency Geophysics Discussion Group, proposal evaluation meetings, and scientific and technical symposia.

WORK PERFORMED BY: Research in Terrestrial Sciences is conducted predominantly under extramural grants and contracts with academic institutions and industry. The entire Air Force research program, extramural and in-house, is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. Research is accomplished in-house by the Air Force Geophysics Laboratory, Hanscom AFB, MA. Additional research is performed under contract. The ten major contractors are: Systems, Science and Software, La Jolla, CA; University of Colorado, Boulder, CO; Boston College, Chestnut Hill, MA; Stanford University, Stanford, CA; University of Maryland, College Park, MD; Columbia University, New York, NY; Nova University, Fort Lauderdale, FL; Massachusetts Institute of Technology, Cambridge, MA; C.S. Draper Laboratory, Cambridge, MA; Ohio State University, Columbus, OH. In total there are 16 contractors with 18 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Air Force terrestrial sciences research has made significant contributions in areas such as: satellite radar altimetry, lunar laser ranging, development of absolute gravity measuring instrumentation, and techniques for combining various types of gravity data into earth gravity models which have enabled the Air Force to improve ballistic missile accuracies and to calculate precision orbits for military satellites. Data from borehole tiltmeters and other near-surface geophysical instruments have been analyzed to determine the tidal and long-period earth deformations. An earthquake simulation code developed in-house has been successfully used to predict ground motion effects on structures in specific regions of interest to the Air Force. The second generation portable absolute gravimeter has yielded results of higher precision and reduced field measurement time by a factor of ten. Seismic risk studies were completed for three military facilities in the western United States to determine design response spectra in different geologic regimes. The earthquake effects on the guidance system for the Minuteman III Wing in Wyoming were analyzed and explained. Two prototype instruments for measuring extremely small changes in gravity, using cryogenic superconducting techniques, have been

assembled and tested. Tiltmeters were installed in deep bedrock to obtain accurate measurements of small ground motions and tilts near missile silos.

2. FY 1980 Program: Intercontinental distance measurements and lunar-satellite laser ranging data will be compared to determine the variations of earth rotation rate so that missile launching azimuths can be improved. Satellite altimetry data combined with other terrestrial gravity data will result in improved global and regional gravity models for use in missile trajectory programs. A new global vertical datum for the unification of height measurements will be derived. The development of earth rotation sensors will be continued. Studies of long-period deformation in Wyoming and Montana and the deformation effects on Air Force systems will be completed. Improved ocean tide models derived from satellite altimetry will be investigated to determine the accurate tidal forcing function for earth tilts and gravity changes at selected missile sites. Research in seismology will further reduce the effects of earthquakes and other natural or system-generated noise on missile guidance systems required for the advanced missile systems. Increased funding will be used to start a new program to determine the use of Navy Navigation Satellite System to improve location and surveying techniques between missile launch sites and targets.

3. FY 1981 Planned Program: The FY 1980 efforts will continue. A large passive ring laser will be assembled and error sources will be determined for direct measurement of earth rotation and a selection will be made for a precise geodetic instrument. The data components of gravity models required for the mid-1980s will be identified. To improve knowledge of the gravity field and techniques for measuring gravity, various configurations of satellite-to-satellite tracking will be studied. Direct field measurement and analysis of earth displacement and rotation in different geologic environments and over different time periods will be continued to optimize Air Force weapon system deployment and enhance operational capability. The prototype cryogenic gravity gradiometers will be field tested.

4. FY 1982 Planned Program: Techniques will be developed for predicting the nature and magnitude of ground motions which can be expected from earthquakes and distant nuclear attacks on the sites for advanced missiles. The automated azimuth measurement system will be field tested to determine the effects of earth motions on the accuracy of the measuring system. This will define the attainable limits of missile launching azimuth. Gravity mapping improvements will be made possible by research programs in earth-to-satellite and satellite-to-satellite tracking techniques, satellite altimetry, mobile gravity gradiometry, geodesy theory and computer software and hardware. This information is needed to improve guidance, control and delivery of advanced missile systems.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Project: #2309
Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Terrestrial Sciences
Title: Defense Research Sciences
Budget Activity: Technology Base #1

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	1,600	1,800	2,220	2,740	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

Project: #2310 Title: Atmospheric Sciences
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The design and operation of Air Force aerospace systems are affected by such atmospheric properties as density, optical transmission, winds, temperature, precipitation and infrared emissions. The research program in atmospheric sciences involves the study of the earth's environment from earth's surface to satellite orbit altitude. Particular attention is focused on cloud and aerosol (e.g., haze, dust, etc.) properties impacting on optical and infrared weapons guidance and delivery systems, and on weapon prediction. The dynamics of the upper atmosphere and the properties of the ionosphere are other major research thrusts; they are directed at enhancing communications and surveillance systems capabilities.

RELATED ACTIVITIES: Complementary research programs in atmospheric sciences are conducted by the Army, Navy, and many Federal agencies. The work is coordinated within the Department of Defense through the Environmental Sciences Technology Coordinating Paper and annual triservice reviews, with other Federal agencies through the Committee on the Atmosphere and Oceans, and the Office of the Federal Coordinator for Meterology.

WORK PERFORMED BY: Research in atmospheric sciences is conducted under extramural grants and contracts with industry, academic institutions, and not-for-profit institutes as well as in-house at the Air Force Geophysics Laboratory, Hanscom AFB, MA. The entire Air Force research program is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. The ten major contractors are: Massachusetts Institute of Technology, Cambridge, MA; University of Missouri-Rolla, Rolla, MO; University of Massachusetts, Amherst, MA; Boston College, Boston, MA; University of California, San Diego, CA; Utah State University, Logan, UT; University of Lowell, Lowell, MA; Stanford Research Institute, Menlo Park, CA; University of Wisconsin, Madison, WI; and Physical Sciences, Inc., Woburn, MA. In total there are 50 contractors with 72 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: During FY 1979 evaluations of energy available to influence atmospheric dynamics from the atmosphere's moist processes, e.g., cloud and precipitation formation and evaporation, were completed permitting more accurate representations of the atmosphere's moist processes in operational numerical weather prediction models. These results, important to weather forecasting support to the worldwide Air Force mission, are of ever increasing importance as the capabilities to forecast on battlefield scales are improved. In ionospheric dynamics research, the 1979 solar eclipse provided the unique opportunity to document the response of the ionosphere to sudden changes in radiation intensities. Such responses directly influence the performance of Air Force communications/detection/surveillance systems. In another area of high altitude research, an instrument to study atmospheric infrared emissions, trace gases and high resolution remote sensing techniques was designed and built for use during high-altitude balloon flights. This effort and rocket measurements to map the brightness of the atmosphere above the earth's surface, as viewed from a space platform, are crucial to the generation of a data base applicable to advanced Air Force space detection, surveillance and defense systems. A unique radar facility at Poker Flats, Alaska, has been partially completed and is yielding a continuous measure-

ment of winds up to 70 kilometers altitude. Measurements of this type, heretofore unavailable, are vitally important to understanding and modeling motion in the high atmosphere, ionospheric responses to tidal motion, auroral heating and other factors which influence earth and spaceborne communications and surveillance systems.

2. FY 1980 Program: Five efforts in atmospheric sciences will be initiated or substantially upgraded: the effort to document and understand meso-scale (1 to 500 kilometers) meteorological processes for application to numerical modeling of battlefield scale weather effects will be increased; the development of a third generation cloud physics chamber to facilitate development and evaluation of numerical models of cloud and fog droplet behavior and of optical/infrared (IR) transmission through fogs and clouds will receive increased funding to start basic construction of the main facility; analysis of radar observed winds up to 70 kilometers will be completed for input to modeling upper atmospheric motion and its relation to lower atmospheric processes; the possibility of using a satellite platform to map the spatial distribution of electrons in the ionosphere to generate, for the first time, a picture of the horizontal variability of the ionospheric electron population; and, in a complementary effort, to aid in modeling the effects of ionospheric auroral zone variations on high frequency radio and surveillance systems, the latitudinal variations of ionospheric electron densities and auroral energies will be studied using radar data from facilities in Massachusetts and Alaska. The measurement and analysis of atmospheric particulates (ice, snow, cloud droplets, dust, etc.) and their effects on optical/IR signal propagation will continue; this information is necessary for design and performance evaluation of optical/IR weapons and communications systems, nosecone erosion studies, and aircraft icing. Laboratory and field measurements of optical/IR emissions by atmospheric constituents, aurora, and airglow will continue for input to improvement of models of radio and radar propagation, optical/IR backgrounds, and high altitude density irregularities; data from the 1979 solar eclipse will be used to study ionospheric response to the effective "stopping" of ionizing radiation during the eclipse and the subsequent "restart"; i.e., like turning the sun "off" and "on." These efforts expand the ionospheric properties data base and are directly applicable to Air Force systems for surveillance, target detection, and communications systems. Increased funding for FY 1980 is concentrated in intensified efforts in the development of the cloud physics facility and in efforts to improve medium scale forecasting capabilities.

3. FY 1981 Planned Program: A high-latitude rocket measurement program will be conducted to enable generalization of existing nighttime ionospheric chemistry models for solar particle influences to daytime and twilight conditions. These models are important as approximations of the effects of nuclear detonations on ionospheric properties and, in turn, surveillance and communications systems. In support of the development of spaceborne optical/infrared surveillance systems, laboratory measurements of IR emissions will add to the documented emission spectra of atmospheric constituents and enhance understanding of IR background radiation sources. Closely related rocket measurements will add to models of aurora and airglow radiation spectra. A cooperative measurement program with a new European ionospheric radar facility in Norway and in National Science Foundation's existing Chatanika facility in Alaska will begin. Increased funding levels will permit extension of this effort to U.S. participation in the "European Energy Budget Campaign" to intensively document ionospheric-auroral interaction using

aircraft and rocket measurement platforms. These efforts will add to our understanding of ionospheric behavior and its importance to surface weather forecasting and Command Control Communication system performance. The cloud physics research chamber begun during FY 1980 will receive additional funding and will be completed. Remote sensing capabilities to measure specific and detailed cloud physics parameters will be reviewed and evaluated for potential development. New instruments to measure total weather content in clouds will be developed and flown to investigate cloud structure and the aircraft icing problem. To improve numerical weather prediction capabilities, numerical model efficiencies by advanced mathematical techniques will be evaluated. Optimizing techniques to select the optimum grid size for a given data base will be developed for incorporation into operational models; and small scale atmospheric forcing parameters, e.g., heat and moisture transport will be modeled and analyzed for incorporation into numerical models.

4. FY 1982 Planned Program: In-depth cloud particle physics and optical/infrared propagation studies will begin utilizing the precision cloud chamber facility developed over the preceding two years. This research effort will be multi-service and will add significantly to the understanding of cloud processes important to cloud dynamics and the dependence of radiation transmission upon the continuously changing natural state of atmospheric particulates (water, ice, solid, etc.). The results of these efforts will be most critical to the continued development, refinement or evaluation of optical, infrared or microwave systems for target acquisition and surveillance, and weapons guidance. For the application of these laboratory results to the atmosphere, airborne particulate measurements will continue in order to expand the data base of naturally occurring particulate size distributions, concentrations, and physical states. Continued satellite, rocket, radar and laboratory measurements of atmospheric constituent, aurora and airglow radiative emissions will be necessary to parallel infrared sensitivity and sophistication of earth and spaceborne detection, surveillance and communication systems. Increases in funding levels will be concentrated in expanding the range of investigation into optical, infrared and microwave transmission for evaluation of guidance and communication systems. Results from previous medium range forecasting studies will be evaluated for development of comprehensive battlefield forecasting models, and analysis of the joint U.S.-European "Energy Budget Campaign" will be emphasized for application to the ionospheric influence-communications impact modeling effort.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	6,200	7,400	8,980	10,740	Continuing	Not Applicable

Project: #2310
Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Atmospheric Sciences
Title: Defense Research Sciences
Budget Activity: Technology Base #1

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

Project: #2311 Title: Astronomy and Astrophysics
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: Space environmental conditions produced by radiation and atomic particles can endanger the mission and degrade the performance of military spacecraft, disrupt the detection and tracking of missiles and satellites, distort communications and interfere with surveillance operations. This research project provides basic knowledge of the space environment for the design and calibration of advanced Air Force systems. The project also supports the Air Weather Service by improving observing and forecasting techniques that support operational military systems. Experimental and theoretical means are used to study: (1) methods to improve space surveillance systems; (2) solar outbursts and their travel to the earth where they affect communications and satellite systems; (3) composition of the space environment in which Air Force systems operate and changes caused by natural and man-made disturbances; and (4) the response of spacecraft systems and operations to the space environment.

RELATED ACTIVITIES: The Navy, National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration, and National Science Foundation have complementary research. Coordination is accomplished during the writing of the environmental Sciences Coordinating Paper and during reviews by the Under Secretary of Defense for Research and Engineering. Cooperative programs include Air Force and NASA particle sensors flown on Air Force satellites and quarterly Space Forecasting Workshops to support AWS requirements.

WORK PERFORMED BY: Research in astronomy and astrophysics is conducted under extramural grants and contracts with industry, academic institutions, and non-for-profit institutes as well as in-house at the Air Force Geophysics Laboratory, Hanscom AFB, MA. The entire Air Force research program is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. The ten major contractors are: Emmanuel College, Boston, MA; Regis College, Weston, MA; Northeastern University, Boston, MA; University of California, LaJolla, CA; Rice University, Houston, TX; University of Arizona, Tucson, AZ; University of Utah; Salt Lake City, UT, Johns Hopkins University, Laurel, MD; State University of New York, Albany, NY; and Environmental Research Institute of Michigan, Ann Arbor, MI. In total there are 41 contractors with 50 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Instruments to analyze the properties of charged particles have been developed for the Defense Meteorological Satellite Program (DMSP) spacecraft, are now in operation and providing exceedingly useful scientific data to the Air Weather Service on conditions in the ionosphere which can degrade defense satellite operations. DMSP observations also have been utilized during periods of disturbance in the near-earth space to study the longitudinal distribution of ionospheric irregularities, in which a higher frequency of occurrence was found in the American than in the Asian sector, which can affect the performance of communication and surveillance systems. For the first time a new method being developed to produce high resolution images of astronomical objects has obtained a measurement of a faint satellite, which will contribute to ground based optical surveillance systems. A daily variation of the size of the auroral oval, where auroral phenomena tend to occur, which affect radar and radio transmissions in the polar regions, has been discovered.

Project: #2311
Program Element: #61102F
Dod Mission Area: Defense Research, 510

Title: Astronomy and Astrophysics
Title: Defense Research Sciences
Budget Activity: Technology Base #1

2. FY 1980 Program: A new system to process and analyze photographs of space objects for use in satellite surveillance will become operational and tests will be begun in an attempt to identify earth orbiting satellites. Instrumentation will be developed for a coordinated series of rocket flights into the auroral ionosphere to investigate the energy input from the magnetosphere to understand communication problems and radio and radar propagation. The Measurements of electrons acquired by satellite will be analyzed and the accuracy and reliability of predictions of protons from the sun will be improved to specify and predict the space environment to improve the reliability and communications of Air Force systems. Selection and measurement of faint stars will continue in order to improve the detection and tracking of faint objects in space by ground based optical surveillance systems. Additional funds will be used to advance ground based observations of space objects for the surveillance and tracking of satellites and spacecraft.

3. FY 1981 Planned Program: The analysis of satellite data will continue in order to determine the behavior of the space environment in which Air Force satellites operate. Theoretical studies will test the absolute accuracy of currently available geomagnetic field models for use in the specification and prediction of storms in space which degrade Air Force communication and satellite systems. Detectors to be flown on space vehicles will be prepared for launch. An auroral rocket mission will be accomplished and the data analyzed to aid in understanding communications through the ionosphere. Multi-mirror telescope observations of satellites and astronomical objects will be obtained and a full scale adaptive optics device will be built. Solar flare precursor data will be incorporated into prediction models of solar disturbances that can propagate to the earth and change the radio and radar transmission characteristics of near-earth space. Additional funds will be used to study the interaction of large space structures and the space environment for future Air Force surveillance and communication systems.

4. FY 1982 Planned Program: Solar magnetic, velocity and flare data obtained from space observations will be analyzed to specify and predict solar outbursts which travel to the earth and adversely affect the Air Force communication systems. An active optics device will be completed to aid in ground based surveillance and tracking of spacecraft and satellites. Auroral and polar cap electric field studies will be completed for the analysis of high latitude disturbances which affect Air Force radar and radio propagation. Laboratory testing of instrumentation for spacecraft wake and sheath investigations will begin. Analysis of the electron measurements from satellite observations will be completed and the methods developed to improve the accuracy of measuring solar protons will be incorporated into real time prediction techniques for use by the Air Weather Service. Studies of celestial background radiation and imaging through the turbulent atmosphere which affects the detection and surveillance of space objects will continue. Additional funds will be used to expand the study of the interaction of the space environment and large structures and to develop techniques to mitigate adverse interaction effects on Air Force spacecraft.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Project: #2311
Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Astronomy and Astrophysics
Title: Defense Research Sciences
Budget Activity: Technology Base #1

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	4,000	4,400	5,340	6,280	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

Project: #2312 Title: Biological and Medical Sciences
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This program provides fundamental knowledge in biotechnology required in the development and operation of effective manned weapon systems. Toxic materials such as Air Force unique fuels and propellants as well as electromagnetic radiations are studied to assess their potential hazard and to devise corrective measures. Research in physiology and biomechanics provides knowledge for improving personnel protection and performance in varied stress environments encountered during flying. Research in aerospace medicine provides the basis for selection, retention, health maintenance, and projections of career expectancy of Air Force personnel. Biological research seeks knowledge of natural analogs of command, control, and communications systems which may lead to new technologies or models. Research is conducted in environmental quality to assess, measure, and control Air Force generated pollutants to meet national environmental concerns while maintaining the operational flexibility necessary to conduct development, test, and operational activities.

RELATED ACTIVITIES: The Air Force Biological and Medical Sciences program is coordinated through several interagency panels and groups which include participation by the Army, Navy, Federal Aviation Administration, National Aeronautics and Space Administration, Defense Advanced Research Projects Agency, Environmental Protection Agency, National Institutes of Health, Food and Drug Administration, and Department of Agriculture. Coordination is also achieved through Triservice program or special topical reviews and the Technical Coordinating Paper on Medicine and Biological Sciences of the Undersecretary of Defense for Research and Engineering. In addition, particularly effective coordination is accomplished through contractor reviews and on an individual basis among Air Force program managers and their counterparts in other agencies or with scientists whose research is supported by other government sources.

WORK PERFORMED BY: Research in the Biological and Medical Sciences is conducted predominantly under extramural grants and contracts with academic institutions and industry. The entire Air Force research program, extramural and in-house, is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. Research is now underway in-house at the Air Force School of Aerospace Medicine, Brooks AFB, TX; the Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH; and the Air Force Avionics Laboratory, Wright-Patterson AFB, OH. The ten major contractors are University of California, Irvine, CA: University of California, Los Angeles, CA; Ohio State University, Columbus, OH; University of Kentucky Research Foundation, Lexington, KY; University of Connecticut, Storrs, CT; University of California, Riverside, CA; Monsanto Research Corporation, Dayton, OH; University of Texas, Austin, TX; Montefiore Hospital and Medical Center, New York, NY; and University of Rochester, Rochester, NY. In total there are 49 contractors with 75 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A study of hydrazine dispersals in aquatic environments revealed that insignificant concentrations of hydrazine remained in the water after two days and that accumulation in the tissues of aquatic organisms was negligible. Under the conditions of this study, hydrazine appears to have little impact

on aquatic environments. Research has determined that hydrazine causes profound structural changes in mammalian cell surfaces. Studies on the effects of microwaves on behavioral thermoregulation have demonstrated the stimulation of sensors deep within the body by microwaves. Research suggests that changes in thermoregulatory behavior triggered by absorbed microwaves result from stimulation of internal heat sensors whereas responses to infrared radiation result primarily from stimulation of thermal sensors in the skin. This internal heating by microwaves occurs at power densities previously thought not to produce thermal effects in animals. Research on convulsive responses to monomethyl hydrazine, a missile propellant, indicates that this compound acts by inhibiting nerve impulses and may provide new means of treatment for humans. It has been demonstrated that the olfactory discrimination of dogs can be enhanced up to 50% for periods of at least 80 days by the oral administration of the compounds to be tested. Compounds tested to date that have been found to increase odor discrimination are phenyl and propyl acetate as well as compounds of interest to the Department of Defense Dog Training Center. This finding could lead to significant improvement in the performance of military working dogs. A system has been developed for producing bird hazard risk maps for Air Force bases in North America using bird banding data in a manipulative computer program. A closed circuit television-image intensifier system for detection of migrating birds has been developed and correlated with radar sightings. The results of this basic research show great potential for reducing bird/aircraft strike hazards. A method was developed that demonstrates the windblast forces imposed on a pilot following ejection from an aircraft. The mathematical equation that describes these forces was modified to account for the separation of the arms and legs due to the air stream and for the timing sequence of these events. A report of the resistive properties of human long bone joints as a function of joint position has been completed and published. Biomechanical tests on vertebral units and segments have been completed and a report published. Studies on the interaction of acceleration with nerve and pressure control mechanisms of the heart indicate that the anti-gravity suit (G-suit) cannot maintain blood pressure without normally functioning pressure receptors in the blood vessels. The mechanics of lung function during the inflation of the anti-gravity suit was described. Three possible hormonal risk factors have been identified for coronary heart disease, and studies will clarify the association of these hormone levels in patients with known coronary artery occlusion and in those with aftereffects of heart attacks compared with normal men. These could prove valuable as additional risk factors for coronary heart disease. Preliminary studies have shown brain cell damage due to sleep deprivation in an animal model. Animal studies have shown that common prescription drugs are effective in changing the cycle of the body clock and have potential in minimizing or alleviating the effects of jet lag. Data has been collected to compare the temperature regulating ability of men and women following specific regimens of physical training. Analysis of these data will provide guidance for the optimal training regimens and utilization of men and women in the Air Force.

2. FY 1980 Program: Research on limb flail injury and impact tolerance will expand to include and correlate bone/ligament/tendon/joint mechanical properties and injury tolerance data. The analytic predictions of aerodynamic forces expected during ejection will be refined and validation begun. The role of hormones in the incidence of coronary heart disease will be continued to further substantiate their involvement as risk factors. The brain pathology of sleep deprivation will be further described in animals. Additional selected drugs will be

tested for the ability to alter the effects of jet lag. A new thrust will begin to develop and evaluate various physiological/biochemical parameters that can be used to describe an objective end point to stress and fatigue in human subjects exposed to a controlled stress environment. The exploration and definition of lung and heart function will continue. Research will be continued to determine the fundamental pathways by which Air Force chemicals are absorbed, distributed, and excreted in humans. Studies to determine the cellular mechanisms of action of these compounds will be emphasized. Research to determine the environmental fate and biological consequences of Air Force chemicals in soil ecosystems will be initiated to support and complement ongoing research in aquatic systems. A new program to examine the biological effects of exposure to low level electromagnetic radiation will begin by examining microwave effects on immune responses, heart cells, and mechanisms of learning and memory.

3. FY 1981 Planned Program: The assessment of pilot workload will continue. Studies will be expanded in the evaluation of the physiologic and psychologic effects of high-intensity, stressful workloads during Air Force operations. Research will continue to describe and differentiate cardiovascular control mechanisms. The biodynamics of mechanical forces efforts will be continued. A thrust will begin to study and correlate the effects of multiple stress on physiologic performance, representing an increase over FY 1980 funding. Studies to determine the mechanisms of interactions of electromagnetic radiation with biological systems will be expanded. Work will continue to determine the environmental fate and biological consequences of Air Force chemicals. Studies on cellular effects of toxic chemicals will be emphasized. Research leading to the development of biochemical countermeasures against toxic agents will be pursued.

4. FY 1982 Planned Program: The planned program is essentially a continuation of the FY 1981 program with expanded emphasis in the area of toxic and electromagnetic radiation hazards and environmental protection. This program will be expanded to include two new thrusts in the toxicology of new Air Force synthetic fuels and the pharmacology of Chemical Defense. Research will begin on the fundamental aspects of brain cell activity to study the mechanisms of memory storage and mechanisms of cell to cell information transfer.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	4,500	5,400	6,550	7,900	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

Project: #2313 Title: Human Resources
Program Element: #61102F Title: Defense Research Sciences
DoD Mission Area: Defense Research, 510 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This program provides the knowledge required to insure that Air Force personnel are fully prepared to develop, operate, maintain, and manage current and future weapon systems. Specific objectives include: development of an improved manpower and personnel system, advanced education and training methods, techniques for the most economical uses of decreasing manpower resources, and definitions of the role of the operator in the design and operation of increasingly complex operator-machine systems. Research is conducted to increase job motivation and enrichment, work productivity and organizational effectiveness and to define physical standards for Air Force occupations. Research on new training technologies and on the design of systems, displays, and controls will improve operational efficiency and reduce the life-cycle costs of aeronautical systems. Major concentrations of efforts are allocated to the following areas: (1) the development and evaluation of manpower models employing demographics and labor market characteristics, (2) quantitative measures of workload, (3) human operator performance requirements in advanced aerospace systems, (4) studies to advance the use of simulation in flying and technical training, (5) visual processing in simulation training and in system design, (6) information processing/decision aiding in command and control context.

RELATED ACTIVITIES: The Air Force Human Resources program is coordinated through several interagency panels and groups which include participation by the Army, Navy, Federal Aviation Administration, National Aeronautics and Space Administration, and the Defense Advanced Research Projects Agency. Coordination is also achieved through Triservice program or special topical reviews and the Technical Coordinating Paper on Human Resources of the Undersecretary of Defense for Research and Engineering. In addition, particularly effective coordination is accomplished through contractor reviews and on an individual basis among Air Force program managers and their counterparts in other agencies or with scientists whose research is supported by other government sources.

WORK PERFORMED BY: Research in Human Resources is conducted predominantly under extramural grants and contracts with academic institutions and industry. The entire Air Force research program, extramural and in-house, is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. Research is now underway in-house at the United States Air Force Academy, Colorado; the Air Force Human Resources Laboratory, Brooks AFB, TX; and the Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH. The ten major contractors are Virginia Polytechnic Institute and State University, Blacksburg, VA; University of Houston, Houston, TX; Perceptronics, Inc., Woodland Hills, CA; New Mexico State University, Las Cruces, NM; Texas Tech University, Lubbock, TX; University of Illinois, Urbana-Champaign, IL; Dalhousie University, Nova Scotia, Canada; Massachusetts Institute of Technology, Cambridge, MA; Canyon Research Group, Inc., Westlake Village, CA; and Decision Sciences, San Diego, CA. In total there are 62 contractors with 85 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A computerized mathematical model was developed for explaining and demonstrating the impact of manpower changes on base operating support workload indicators. This can enhance the

capability for managing manpower resources. The basis for a theoretically and scientifically based classification of tasks was developed which may allow economical computer simulations of human performance requirements and capabilities in advanced operator-machine systems. The feasibility of a three-dimensional body size and shape measurement system for use in computerized modeling of advanced crew system configurations applicable to dynamic (buffeting/vibration/acceleration) situations was demonstrated. Tasks requiring heavy/very heavy work in the 230 Air Force specialty codes were identified for validation by means of new physical measurement procedures. Technologies have been developed to evaluate how much detail and fidelity are required of computer generated imagery to result in the most effective flight training and to communicate this and other relevant training information to personnel responsible for the design of flight simulators. A new concept defining allocation of human information processing skills which allows concurrent task performance without decrease in the efficiency of accomplishing each task has been proposed. The differential effects of various instructional strategies on trainee performance have been described. These large differences in ability appear to result from specific differences in visual experience implying that flight simulator visual displays can be designed to enhance the pilot's ability to detect m[illegible] objects.

2. FY 1980 Program: Research is underway to computerize evaluations of Air Force selectees, to develop algorithms for cross specialty movement concerned with reassignment and career progression, to develop standardized measures of physical job requirements, to quantitatively measure and enhance worker and organizational productivity, to model and predict the impact of human factors data on aerospace system design and life-cycle cost, to assess and predict crew workload capacities in advanced aerospace systems, to determine the visual cues which must be incorporated into aircrew training devices and flight simulators, to determine the optimal strategies for enhancement of acquisition and retention of maintenance skills, to provide effective methods for training decision skills and efficient multiple task strategies, to define the limits of human sensory and cognitive abilities, to define unique visual simulations to teach tactical flying skills, and to develop means of practicing critical combat skills. Increased funding over FY 1979 will be primarily concentrated in research concerned with more effective use of simulation devices to teach tactical flying skills and to practice critical combat skills.

3. FY 1981 Planned Program: This program will include continuation of many FY 80 efforts as well as new work initiatives directed at improving our understanding of visual scene requirements for flying training simulation, the sensory and perceptual factors important in the learning of aircrew skills, the concept of networks of tactics development simulators which permit practice of tactical skills and analysis of the learning state, the development of psychophysiological technologies to improve design and operation of complex operator-machine systems, the further definitions of physical work standards, the improvement of operator-computer interactions, the development of characteristics of human visual and auditory processing capabilities, biocybernetic analysis of the learning state of the trainee with feedback to computers which select optimal instructional materials, and human information processing and decision making. Increased funding over FY 1980 will be used primarily to increase our research efforts in human information processing and decision making during accomplishment of complex tasks.

Project: #2313
Program Element: #61102F
DoD Mission Area: Defense Research, 510

Title: Human Resources
Title: Defense Research Sciences
Budget Activity: Technology Base #1

4. FY 1982 Planned Program: Work will continue the development of objective and valid measurement methodologies and criteria for computerized selection, assignment, training, and career progression of Air Force personnel; biocybernetic analysis of human performance during training and for critical mission design and operation of advanced aerospace systems; the incorporation of basic training principles and knowledge about human sensory, perceptual, and information processing factors into the design and use of simulators within a total training system; and the most effective training strategies. The increased funds will allow us to concentrate more research effort on the nature of the learning process in the highly skilled individual and further research in enhancement of information processing in command and control context.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in Thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
RDT&E Funds:	4,900	5,800	7,160	8,500	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: See program element descriptive summary.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 62101F
Title: Geophysics
DoD Mission Area: Environmental and Life Sciences #522
Budget Activity: Technology Base #1

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	25,876	27,600	32,100	35,400	Continuing	Not Applicable
06DK	Laboratory Operations	16,500	16,600	18,100	18,400		
4643	Aerospace Radio Propagation	1,300	1,500	1,600	2,100		
6670	Meteorological Development	1,300	1,500	1,600	2,000		
6687	Stratospheric Environment	600	800	900	1,000		
6690	Upper Atmosphere Technology	1,100	1,300	1,500	1,600		
7600	Missile Geophysics	400	500	600	800		
7601	Magnetospheric Effects on Space Systems	800	1,000	1,100	1,500		
7659	Aerospace Probes	500	700	700	800		
7661	Spacecraft Charging	1,100	1,300	1,700	2,300		
7670	Infrared Properties of the Environment	2,276	2,400	4,300	4,900		

BRIEF DESCRIPTION OF ELEMENTS AND MISSION NEED: To develop the technology necessary to specify and predict those geophysical phenomena (e.g., earth motions, weather, optical infrared backgrounds, ionospheric scintillations, upper atmosphere density) which impact on the capability of proposed or existing Air Force systems and operations (e.g., missile guidance systems, aircraft launch and recovery operations, surveillance satellite systems, communications satellite systems, space vehicle tracking systems). The technology developed will assist Air Force system designers and operators in mitigating as well as exploiting, where possible, the effects of the geophysical environment. This program also provides for the operation and management of the Air Force Geophysics Laboratory, Hanscom AFB MA.

BASIS FOR FY 1981 RDT&E REQUEST: These funds are used to investigate those elements of the geophysical environment critical to the successful design, deployment and operation of Air Force weapons systems.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element # 62101F _ Title: Geophysics
DoD Mission Area: Environmental and Life Sciences #522 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to develop the technology needed to assist Air Force system designers and operational decision makers in mitigating and/or exploiting the effects of the geophysical environment on existing, proposed, and future Air Force electronic, space, missile, and aeronautical systems. For example: Increased Intercontinental Ballistic Missile (ICBM) accuracy is limited by incomplete knowledge of variations in gravity along missile trajectories; the use of precision-guided munitions requires the development of techniques to predict non-conventional weather elements; the optimum design of infrared surveillance and space defense systems requires detailed earth, atmosphere and celestial background infrared emission data; radio frequency communication and surveillance systems are disrupted by the occurrence of rapid fluctuations in the ionosphere; space vehicle orbit and reentry predictions are influenced by variations in upper atmosphere density; and operational satellites are adversely affected by energetic protons and electrons released in solar storms. To meet the increasingly stringent requirements for improved AF systems, i.e., greater reliability, higher accuracy and survivability, extended remote coverage and minimum life cycle cost, the geophysical environment is being addressed as an integral and interacting part of the systems themselves. The program in geophysics is concentrated in five areas: Space Effects on AF Systems, Optical/Infrared System Technology, Upper Atmosphere Interaction with AF Systems, Terrestrial Effects on AF Operations, and Weather Effects on AF Operations. This program element, in addition to being the primary technology base exploratory development effort in geophysics, provides technical support to other Air Force and DOD agency programs and receives reimbursement for the services provided.

RELATED ACTIVITIES: Programs in the broad area of geophysics are conducted by the Army and Navy and other non-military federal agencies such as the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Agency (NASA). When applicable to AF requirements, information gathered by others is used in the AF program. In addition to such complementary programs, joint or coordinated programs are conducted with other agencies when mutual interests exist. The work within this program element is coordinated (1) at the annual triservice briefings to the Office of the Undersecretary of Defense for Research and Engineering, (2) through the NASA/Air Force Space Research and Technology Interdependence Working Group, (3) with NOAA and other federal agencies engaged in geophysical sciences through committees of the Federal Council for Science and Technology and the Federal Coordinator for Meteorological Services and Supporting Research, and (4) through working groups set up by the Air Force Geophysics Laboratory (AFGL) in such areas as space environment forecasting and satellite meteorology. Examples of joint or coordinated programs are: Joint Doppler Operational Program, a program with the NOAA to test the utility of Doppler radar for reliable severe storm detection; Spacecraft Charging and Spacecraft Environment Interactions, joint programs with NASA to determine causes and means of controlling undesired electrical charge buildups on satellites and to develop environmental specifications for satellite design; Atmospheric Transmission, a coordinated program with the Army and Navy to develop the capability to predict the obscuring effect of the atmosphere on optically and infrared (IR) guided weapons; and ICBM Accuracy, a coordinated program with the Defense Mapping Agency to develop techniques and geophysical instrumentation to improve ICBM targeting accuracy.

WORK PERFORMED BY: Work performed under this line item is conducted and managed by Air Force Geophysics Laboratory, Hanscom AFB MA. Off base field sites are: Sagamore Hill Radio Observatory, Hamilton MA; Weather Radar Site, Maynard MA; Weather Test Facility, Otis AFB MA; Goose Bay Ionospheric Observatory, Goose Bay, Labrador; and Balloon Launch

Detachment, Holloman AFB NM. There were approximately 65 contractors doing work under 129 contracts utilizing FY 1979 62101F funds. The 10 major contractors were: Boston College, Boston MA; Utah State University, Logan UT; Northeastern University, Boston MA; RDP, Inc., Waltham MA; Bedford Research Associates, Bedford MA; University of California, San Diego CA; Emanuel College, Boston MA; Systems and Applied Sciences Corp., Riverdale MD; Logicon, Inc., Torrence CA; Panametrics, Inc., Waltham MA.

1. FY 1979 and Prior Accomplishments: The Air Force Geophysics Laboratory (AFGL) technique that provides the required real-time correction of the ionospheric-caused time delay in radio frequency signals for the Global Positioning System (GPS) high navigation accuracy user, was verified with field measurements at Vandenberg AFB. Data handling and processing techniques to supply ionospheric characteristics to the Initial Operational Test and Evaluation of the OTH-B surveillance radar were developed in preparation of the CY 80 system tests. Radar software providing three dimensional, real-time identification and tracking of severe storms was completed and tested as part of the Joint Doppler Operational Program in Oklahoma; this software significantly improves severe storm forecasting, including reduced numbers of false severe storm alarms. An improved computer model was developed to assess the environmental impact of the Air Force operations in the stratosphere and was used to demonstrate that the operation of the High Altitude High Speed Target vehicles would not adversely affect the environment. A model of the expected atmospheric properties to be encountered during reentry of Advanced Ballistic Reentry System (ABRES) test vehicles at the Kwajalein Missile Range was developed and furnished to the joint requesters Space Division/ABRES and Army Ballistic Missile Defense System Command (BMDSC). In a special unplanned quick response effort, upper atmospheric density data from an experimental sensor on board an AF satellite were obtained and analyzed in real-time to help the AF Air Defense Command (ADCOM) predict the reentry time and location of Skylab for National Aeronautics and Space Agency (NASA). Rocket-borne instruments were developed and flown to provide validation measurements for the remote density sounding experimental sensor on a newly-launched Defense Meteorological Satellite Program (DMSP) satellite. Missile launch region gravity model studies were completed; these studies substantiated the need to continue development of an airborne gravity gradient measuring instrument to support projected MX launch region requirements. A model which uses regional geology and topography was developed to study the susceptibility of missile silos to distant natural or man-made seismic events. Satellite sensors that monitor this information is required by the AF Air Weather Service for their operational support of AF Command, Control and Communication Intelligence (C^3I) systems. A satellite-borne positive ion and electron emitter system was developed and successfully flown, demonstrating for the first time that deleterious electric charge buildups on AF satellites could be effectively controlled by such systems. A first-of-its-kind, operational method for predicting periods during which charging of AF spacecraft will occur was developed in response to a request of the Air Weather Service, the AF organization responsible for forecasting "space weather." The AFGL-developed,DOD standard computer code used for predicting atmospheric transmission of visible and infrared radiation in Electrooptical/Infrared (EO/IR) weapon systems design, testing, and operation, was significantly improved to predict transmission under the low visibility conditions which frequently prevail in the North Atlantic Treaty Organization (NATO) Central European area. Unique vertical profile measurements of the infrared radiation emitted by the atmosphere were obtained from a rocket probe looking at the earth limb; these measurements are critical to the design of this Nation's Space Defense system. Benchmark calculations were provided to AF Space Division Air Defense Command for validation of a computer code that simulates the effect on surveillance systems of the optical/infrared radiation produced by atmospheric nuclear bursts.

Program Element # 62101F
DoD Mission Area: Environmental and Life Sciences #522

Title: Geophysics
Budget Activity: Technology Base #1

2. FY 1980 Program: Variations in the intensity of solar radio wavelength emissions during solar storms will be investigated to improve the forecasting of onset times of disruptions to Command Control and Communication Intelligence (C^3I) systems caused by such storms. A technique to use signals from the Global Positioning System satellites to determine ionospheric conditions for AF radio frequency propagation assessments will be initiated. Airborne, ground-based, and satellite ionospheric measurements and subsequent analyses will be made during tests of the ionosphere-dependent Over-the-Horizon (OTH) surveillance radar to determine if ionospheric variability precludes effective employment of this system. A self-calibrating, two-frequency Doppler severe storm warning radar with quality assurance and automatic fault location capabilities will be fabricated and used as a hardware and software test bed in the Air Force's Advanced Weather Radar (AWR) acquisition program. Specification for a special radar system suitable for the remote and timely warning of sudden and hazardous changes in wind encountered by landing aircraft will be developed. A program to develop weather sensors appropriate for use in a tactical combat environment will be undertaken to meet a critical AF need. The present one-dimensional computer model of the stratosphere will be expanded to two horizontal dimensions to provide improved environmental assessments of AF operations. Rocket measurements of the solar ultraviolet (UV) radiation impinging on the earth's atmosphere will be made at the time of maximum solar UV energy output during the current 11-year solar cycle; this knowledge is fundamental to accurate AF satellite orbit predictions. A satellite-borne laser "radar" system will be designed to remotely sense upper atmospheric density for improved Intercontinental Ballistic Missile (ICBM) targeting accuracy. The Air Force Geophysics Laboratory (AFGL) Absolute Gravity Measuring System will be used at key U.S. sites for establishing calibration ranges for high precision relative gravimeters which are used for ICBM launch site gravity determinations. Geophysical and missile performance data will be used to determine small motion seismic risk criteria for pre-launch guidance system initialization of both Minuteman and MX. High energy solar proton and electron radiation dosages experienced by electronic components on board satellites will be determined from dosimeters flown on AF operational satellites. Software will be developed to provide the AF Air Weather Service (AWS) with data from the AFGL ground station network which monitors in real-time, changes in the earth's magnetic field; these data will considerably enhance AWS's capability to predict AF communication-disruptive solar storms. Experiments for using ion and electron beam ejection systems on the Space Shuttle to study the effect of the space environment on charged particle beam propagation and the effect of such beams on the environment, will be designed. Using data from the January 1979 launched AF Spacecraft Charging at High Altitudes (SCATHA) R&D satellite, average and worst case statistics on the fluxes of electrons and ions, densities, temperatures, and electrical currents encountered at synchronous altitudes will be prepared for use in satellite design. A computer code for detailing the complex electrical interaction between future large space structures and the space environment will be developed. A cryogenic high resolution interferometer sensor will be designed for flights on the Space Shuttle in 1983/4 to make detailed measurements of the spectral and spatial variability of atmospheric infrared emission for use in designing advance surveillance and space defense systems. A millimeter-wave spectrometer will be developed for the AFGL KC-135 aircraft for measuring characteristics of atmospheric transmission, target signatures, and earth backgrounds at millimeter wavelengths to determine if this wavelength region is feasible for military application. European measurements at visible and infrared wavelengths of atmospheric transmission and scattering properties will be analyzed to develop a North Atlantic Treaty Organization (NATO) area climatology of environmental parameters affecting Electrooptical/Infrared (EO/IR) weapons delivery. A technique for launching large balloons from aircraft for use as platforms to carry atmospheric R&D sensors or tactical communication and reconnaissance systems will be flight tested.

3. FY 1981 Planned Program: Worldwide statistics on ionosphere-caused, changes in the phase of radio frequency signals transmitted through the ionosphere will be obtained as needed inputs for the design and operation of ground- and space-based surveillance radars. A coordinated rocket, satellite, aircraft and ground-based experiment will be conducted to assess the feasibility of specifying the ionospheric parameters affecting AF Command, Control and Communication Intelligence (C^3I) systems, through satellite remote sensing of atmospheric optical emissions. Data on equatorial ionosphere variability caused by natural events will be studied to determine its applicability in simulating ionospheric conditions following nuclear bursts. Measurements from the AFGL-instrumented C-130A flying cloud physics laboratory will be made to characterize the cloud particle environment encountered during laser tests from the Air Force Airborne Laser Laboratory, Visible Infrared (IR) and near-IR imaging satellite data will be used to formulate computer codes for estimating the probability of cloud-free line-of sight and other visibility parameters needed to support electrooptical (EO) weapons delivery systems. Analytical models of the weather variations over distances of 10 to 100 km for various regions of the world will be developed for use in Air Force tactical planning and execution. A program to measure stratospheric turbulence will be conducted to evaluate the effects of turbulence layering on high energy laser propagation. A new comprehensive three-dimensional computer model of the outer upper atmosphere will be developed for use in predicting variations in environmental properties affecting AF systems operating in or through this region. A spectrometer to measure from the Space Shuttle, ultraviolet emissions from the earth's horizon for AF surveillance/navigation system design, will be developed. A surveying system utilizing signals from Global Positioning System satellites and low-cost miniature radio receivers will be tested; this system has the potential for unprecedented improvements in the accuracy, frequency, and costs of missile silo geodetic position determinations. Seismic measurements will be made at proposed MX "racetrack" locations to determine whether covertly-placed seismic sensors could be used to determine exact MX missile locations. Expected radiation dosages to be encountered by future AF satellites will be developed and furnished to the AF Space Division for spacecraft design. A comprehensive model based on measurements of solar electrons in space will be developed for operational use by the AF Air Weather Service for predicting the location of the circumpolar high-latitude area where disruptions in AF radio frequency communications occur. Conditions under which inherent instabilities in the space plasma medium can be triggered by particle beam ejection systems will be studied. Techniques for the optimum control of deleterious electrical charging of orbiting AF spacecraft using controlled ejection of ions and electrons will be developed. Elements of the data base needed to support the preparation of environmental impact assessments for the use of high power/large dimension satellites will be identified. The DoD standard, AFGL-developed LOWTRAN code for specifying the atmospheric transmission of radiation at different wavelengths will be substantially improved at wavelengths less than 4 micrometers by incorporating a capability to account for scattering of solar energy. Models of long wavelength infrared background radiation emitted by dust in the zodiacal plane, celestial bodies, and the earth limb will be significantly updated using data obtained from rocket probes, and made available for designing the next generation DoD surveillance systems. Tests of an infrared spectrometer for viewing small atmospheric fields and targets of low radiant intensity over long atmospheric paths typical of required detection ranges from an airborne platform, will be conducted. A reliable parachute system will be developed for use in recovering atmospheric sensors flown on rocket probes.

Program Element #62101F
DoD Mission Area: Environmental and Life Sciences #522

Title: Geophysics
Budget Activity: Technology Base #1

4. FY 1982 Planned Program: The time development of active radio frequency emitting regions of the sun will be studied to obtain better precursors for predicting those solar flare bursts that eventually cause disruptions to AF Command, Control and Communication Intelligence (C^3I) systems. Existing data on changes in amplitude and phase of radio frequency signals transmitted through the ionosphere - so-called amplitude and phase scintillations - will be used to develop global scintillation models needed for designing and operating AF systems. An airborne lidar system will be developed and used to remotely sense cloud properties important to predicting missile nosecone erosion. A two-year study of the attenuation of radio frequency energy by different forms of precipitation will be completed and be available for designing electronic systems operating at microwave and millimeter wave frequencies. Procedures will be developed and tested which integrate fine scale meteorological satellite data and conventional larger scale weather forecasts. The composition of stratospheric aerosols important to accurate environmental impact statements, will be determined with a newly-developed instrument that identifies aerosols at the time they are sampled, before they have a chance to chemically change. An accelerometer to measure the Space Shuttle acceleration environment on Orbital Flight Test 4, and also to determine upper atmospheric density variability will be developed and flown in a joint AF National Aeronautics and Space Agency (NASA) program. The response characteristics of advanced inertial missile guidance systems to earth motions, particularly during azimuth initialization, will be evaluated in operational environments. Space Shuttle experiments will be designed to simultaneously measure the incoming solar energetic proton and electron levels, and satellite electric component performance. Construction of a rocket payload to test a new ion/electron beam ejection system and to study the interaction of the beam with the environment will be completed. Work on quantifying physical processes in the space environment that could be "system-limiting" and on developing techniques for countering these limitations will be initiated. Diagnostic concepts for controlling space environment-induced satellite charging for the Air Force's Space Based Radar will be developed. A ground-based laser "radar" system will be integrated in AFGL's Atmospheric Optics Mobile Laboratory and used to determine low-level vertical aerosol profiles for developing Electrooptical/Infrared (EO/IR) weapons weather prediction techniques. An advanced cryogenically-cooled sensor will be used to extend the long wave celestial IR background data base into the far infrared (30 to 100 micrometers) region. Methods to make possible in-flight evaluation and control of atmospheric-sensing payloads on sounding rockets will be studied.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

Program Element #62101F
DoD Mission Area: Environmental and Life Sciences #522

Title: Geophysics
Budget Activity: Technology Base #1

8. Comparison with FY 1980 Budget Data: ($ in Thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	26,800	25,000	27,600	29,200	Continuing	Not Applicable
06DK	Laboratory Operations	17,500	15,900	16,600	16,800		
4643	Aerospace Radio Propagation	1,200	1,400	1,500	1,750		
6670	Meteorological Development	1,400	1,300	1,500	1,600		
6687	Stratospheric Environment	800	600	800	850		
6690	Upper Atmosphere Technology	1,300	1,300	1,300	1,400		
7600	Missile Geophysics	420	400	500	700		
7601	Magnetospheric Effects on Space Systems	700	700	1,000	1,200		
7659	Aerospace Probes	600	500	700	700		
7661	Spacecraft Charging	800	1,000	1,300	1,600		
7670	Infrared Properties of the Environment	2,100	1,900	2,300	2,600		

Changes are reflected in the FY 1981 program primarily due to the additive costs of the 1 Oct 79 civilian pay raise, revised estimates of reimbursement for support provided to other programs and agencies, and the goal to achieve five percent real growth in total Air Force Exploratory Development Program. The major change in FY 1980 and FY 1981 programs is the initiative of the Cryogenic Infrared Radiance Instrumentation for Shuttles (CIRRIS) effort in Project 7670 to measure the atmospheric infrared emission variability in support of advanced surveillance and space defense systems. Another change is in the effort to gather the data base essential to the development of high power/large dimension satellites such as space based radars.

Project: #06DK
Program Element: # 62101F
DoD Mission Area: Environmental and Life Sciences #522

Title: Air Force Geophysics Laboratory Operation
Title: Geophysics
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides for operation of the Air Force Geophysics Laboratory (AFGL), Hanscom AFB MA, including pay and related costs of civilian scientists and support personnel, travel, transportation, rents, communications, and utilities costs, procurement of supplies and equipment, and contractor support services. The AFGL performs research and exploratory development in the geophysical sciences, i.e., geodesy, geokinetics, meteorology, optical physics, ionospheric physics, upper atmosphere physics, and space physics in support of the immediate or potential needs of Air Force operational systems.

RELATED ACTIVITIES: This project supports and complements all of the technical projects under this program element.

WORK PERFORMED BY: The program is managed by the Air Force Geophysics Laboratory, Hanscom AFB MA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: Plans and accomplishments are discussed in the overall program element which is included in this submission.

1. PROGRAM TO COMPLETION: This is a continuing program.

2. MILESTONES: Not applicable.

3. RESOURCES: ($ in thousands)

FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
16,500	16,600	18,100	18,400	Continuing	Not applicable

4. COMPARISON WITH FY 1980 BUDGET DATA: Primarily due to 1 Oct 1979 civilian pay raise.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62102F
DOD Mission Area: Engineering Technology (ED), #523

Title: Materials
Budget Activity: Technology Base, #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	32,200	34,200	39,100	43,500	Continuing	Not Applicable
06DS	Laboratory Operations	13,500	13,300	14,200	14,400		
2417	Thermal Protection Materials	2,000	2,300	3,100	3,600		
2418	Metallic Structural Materials	4,300	4,600	4,900	5,800		
2419	Nonmetallic Structural Materials	3,900	4,300	4,600	5,500		
2420	Aerospace Propulsion Materials	2,000	2,300	3,100	3,500		
2421	Fluid, Lubricants and Fluid Containment Materials	1,800	2,200	2,800	3,300		
2422	Protective Coatings and Materials	2,200	2,400	2,900	3,400		
2423	Electromagnetic Windows and Electronic Materials	2,500	2,800	3,500	4,000		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops new and improved materials which increase the performance, reliability and survivability of current and future aerospace systems. The program also provides management and operational support for the Air Force Materials Laboratory, Wright-Patterson AFB OH, the central Air Force agency concerned with all aspects of materials research and development.

BASIS FOR FY 1981 RDT&E REQUEST: The FY 1981 funds will be used to continue programs which increase performance, reliability and durability in all of the materials development areas. These projects will highlight advanced carbon/carbon composite and metal-matrix composite materials; new and improved alloys and metal forming techniques; turbine engine and rocket nozzle materials; lubricants, polymers, adhesives, and organic matrix composites; improved, reliable nondestructive testing; fluids, seals and sealants; protective coating systems; and electronic and electromagnetic materials including infrared and laser windows. Reduced cost acquisition, operation and maintenance will be emphasized for each of the projects.

OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Military Construction (3300)	0	0	0	12,770	0	12,770

Program Element: #62102F Title: Materials
DOD Mission Area: Engineering Technology (ED), #523 Budget Activity: Technology Base,#1

DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to develop new or improved aerospace materials; provide reliable materials property design data for the new materials; better utilize existing materials; and provide Air Force Materials Laboratory (AFML) an opportunity to consult on operational materials problems, materials processing and materials failure analyses. The areas of materials development applicable to aerospace systems are structural, propulsion, electromagnetic, elastomeric, and thermal protection materials as well as lubricants, hydraulic fluids and protective coatings. The technology developed through this program will satisfy the requirement for aerospace materials resistant to hostile environments of high temperature, mechanical erosion, chemical corrosion, laser radiation and nuclear effects; electromagnetic materials used in infrared detectors, lasers and semiconductor devices; lighter weight structural materials of high reliability with resistance to sudden failure; materials to meet long life lubricant requirements for space systems and aircraft; and more thermally and chemically stable seals, sealants, and hydraulic fluids. This program element is not only the primary technology base materials exploratory development effort in the Air Force, but also it provides technical support to other Air Force and DOD agencies and is partially reimbursed by those agencies for the services rendered. AFML is fully reimbursed for basic research efforts by PE 61102F. The project break reflects the best estimate considering these anticipated reimbursements, but may require adjustment to the degree that reimbursements are actually earned.

RELATED ACTIVITIES: All three military services, Defense Advanced Research Projects Agency (DARPA), the National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), and industry through the Independent Research and Development (IRAD) program carry out research and development programs in materials. Coordination is provided by joint agency technical committees, exchange of planning documents, and technical symposia. During the development of joint planning meetings, the specialized materials requirements of each Service are brought into clear focus to define the unique materials needs of each of the three Services. These materials coordination activities are determining factors in the formulation of complementary, nonredundant materials R&D programs. This program receives specific input from PE 61102F, Defense Research Sciences, and provides technical output to other program elements such as PE 63211F, Aerospace Structures and Materials; PE 78011F, Manufacturing Technology; and PE 63311F, Advanced Ballistic Reentry Systems.

WORK PERFORMED BY: The Air Force Materials Laboratory (AFML), Wright-Patterson AFB OH,is the organization responsible for the management of this program. The ten major contractors in FY 1979 were: General Dynamics, St Louis MO; United Technologies, Sunnyvale CA; University of Dayton Research Institute, Dayton OH; General Electric, Schenectady NY; Rockwell International, El Segundo CA; Hughes, Culver City CA; McDonnell Douglas Corporation, St Louis MO; Systems Research Laboratories, Beavercreek OH; Honeywell, Minneapolis MN; and Avco Corporation, Greenwich CT. In addition to the above, there are 54 other industrial contractors, 29 non-profit contractors and a total of 239 contracts.

Program Element: #62102F
DOD Mission Area: Engineering Technology (ED), #523

Title: Materials
Budget Activity: Technology Base/#1

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Fine weave carbon/carbon materials were developed for use in shape stable reentry vehicle nosetips. Superplastic forming/diffusion bonding techniques for working titanium were refined and transitioned into advanced development. Programs for subscale development of laser hardening concepts for satellite subsystems to meet near term hardening concepts were transitioned into full scale development programs. Performance and reliability of turbine engines were significantly advanced by improved materials for discs, turbine blades and vanes, fans and compressors, bearings, and gas path seals. Nonflammable hydraulic fluids, high adhesion fuel tank sealants, and the degradation limits of lubricants in spacecraft use were developed to increase aircraft safety and spacecraft reliability. Infrared window materials were developed for use with high power lasers and infrared sensor systems. New paints of visual and infrared camouflage were successfully formulated and applied to developing systems.

2. FY 1980 Program: Comprehensive efforts on critical Air Force systems needs for thermal protection, primary and secondary structural materials, aerospace propulsion materials, lubricants, sealing materials, protective materials and coatings, and electromagnetic window and electronic materials will continue. The program will emphasize erosion resistant carbon/carbon materials development and processing for thermal protection and rocket nozzles; structural materials repair, powder alloy technology, process modeling for integrated computer aided manufacturing; moisture resistant resins, fuel tank sealants, quantitative inspection and nondestructive evaluation of carbon/carbon and ceramics; coatings, reliable ceramics, and life prediction techniques for propulsion system materials; and lubricants and seals for cruise missiles. Development of infrared and laser window materials, as well as new infrared sensor materials, will continue in order to meet developing systems' performance and reliability needs.

3. FY 1981 Planned Program: The FY 1981 program will build on the accomplishments of the FY 1980 program and will continue to emphasize the technology thrusts in carbon/carbon and metal-matrix composite technologies. Highlighted areas include aluminum alloys with greatly improved mechanical properties, powder titanium processing, silicon and mercury cadmium telluride infrared detector materials for both space and tactical imaging systems, materials for long life space traveling wave tubes and high voltage power supplies, and materials for heat shields on advanced ballistic reentry vehicles. Nondestructive evaluation techniques will continue to be developed with emphasis on increasing capability, reliability, and applicability to new materials and structures. Life prediction techniques for lubricants, organic matric composites, propulsion system materials, and structural components will be refined. Efforts to improve the performance and reliability, while reducing cost, of electronic and electromagnetic materials will continue.

4. FY 1982 Planned Program: Developments discussed in FY 1981 planned program will continue, with changes in emphasis dependent upon results obtained during FY 1980 and FY 1981. Potential areas of emphasis are life prediction of composite materials, ceramic materials for small engines, materials hardened to pulsed laser effects, and advanced metal alloys and forming techniques.

Program Element: #62102F
DOD Mission Area: Engineering Technology (ED), #523

Title: Materials
Budget Activity: Technology Base/#1

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Comparison with FY 1980 Budget Data: ($ in thousands)

Project	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	30,690	31,700	34,200	36,300	Continuing	Not Applicable
06DS	Laboratory Operations	13,390	12,900	13,700	14,000		
2417	Thermal Protection Materials	2,000	2,000	2,200	2,600		
2418	Metallic Structural Materials	3,900	4,300	4,600	4,800		
2419	Nonmetallic Structural Materials	4,300	4,100	4,300	4,500		
2420	Aerospace Propulsion Materials	1,800	1,900	2,200	2,600		
2421	Fluid, Lubricants and Fluid Containment Materials	1,800	1,800	2,100	2,300		
2422	Protective Coatings & Materials	1,600	2,200	2,300	2,500		
2423	Electromagnetic Windows and Electronic Materials	1,900	2,500	2,800	3,000		

The increase of $2.8 Million reflected in the FY 1981 program is due to the 1 October 1979 civilian pay raise, revised estimates of reimbursement for support provided to other programs and agencies, and the goal to achieve five percent real growth in the total Air Force Exploratory Development Program. This increase will be applied to all technical areas within the program element. The Deputy Undersecretary of Defense for Research and Advanced Technology's initiatives in erosion resistant carbon/carbon composites and metal-matrix composite materials will receive added emphasis in FY 1981; as will powder metal technology, eddy current nondestructive evaluation, structural adhesives, and low outgassing materials for use in contamination sensitive space sensor systems.

Project: #06DS
Program Element: #62102F
DOD Mission Area: Engineering Technology (ED),#523

Title: Air Force Materials Laboratory Operations
Title: Materials
Budget Activity: Technology Base,#1

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the support activities required to operate the Air Force Materials Laboratory (AFML) and includes the pay and related costs of civilian scientists, engineers and supporting personnel, travel, transportation, rents, communications, and utilities cost, procurement of supplies and equipment, and contractor support services. AFML is responsible for the Air Force exploratory and advanced development programs in the area of materials technology, a portion of the basic research program in materials, and for the Air Force Manufacturing Methods Program. The laboratory provides technical support to current and future systems programs and maintains a quick reaction capability to respond to operational problems involving technology, materials application, and failure analysis.

RELATED ACTIVITIES: This project supports and complements all of the technical projects under this program element as well as all other projects and programs managed by AFML.

WORK PERFORMED BY: The AFML, Wright-Patterson AFB OH, is the organization responsible for management of the project included under the Materials program.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: Plans and accomplishments of Air Force Materials Laboratory (AFML) are discussed in the descriptive summary for the overall program element.

1. Program to Completion: This is a continuing program.

2. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	13,500	13,300	14,200	14,400	Continuing	Not Applicable

3. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	13,390	12,900	13,700	14,000	Continuing	Not Applicable

FY 1981 increased results from revised estimates of reimbursement for support provided to other programs and agencies, and the 1 October 1979 civilian pay raise.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62201F
Title: Aerospace Flight Dynamics
DOD Mission Area: Engineering Technology (ED), #523
Budget Activity: Technology Base #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	47,075	49,000	56,800	62,500	Continuing	Not Applicable
06DF	Laboratory Operations	24,933	25,500	27,100	27,500		
2401	Structures and Dynamics	5,906	6,000	7,300	8,500		
2402	Vehicle Equipment	4,208	4,400	5,500	6,400		
2403	Flight Control	5,128	5,600	7,000	8,100		
2404	Aeromechanics	6,900	7,500	9,900	12,000		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a continuing exploratory development program to develop the flight vehicle technology required for the design and development of future aerospace vehicles and for the improvement of current aerospace vehicles. It encompasses the technical areas of structures, aerodynamics, aerothermodynamics, flight performance analysis, vehicle dynamics, flight control, crew station design, crew escape and recovery, environmental control, mechanical subsystems, survivability/vulnerability, and technology integration. The program also includes the operational support and management of the Air Force Flight Dynamics Laboratory (AFFDL), Wright-Patterson AFB OH.

BASIS FOR FY 1981 RDT&E REQUEST: This request is for funds to continue or initiate efforts in the advancement of aerospace vehicle technology in order to improve performance; reduce costs of development, acquisition and operation; increase safety; decrease vulnerability; and aid in the solution of technical problems for weapons systems and associated equipment.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #62201F
Title: Aerospace Flight Dynamics
DOD Mission Area: Engineering Technology (ED), #523
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The work covers many scientific disciplines and technical domains. The Structures and Dynamics area includes the use of metallic, nonmetallic, and composite materials; processes and techniques for fastening, joining, and bonding; load analysis and testing; fracture and fatigue investigations; aeroelasticity, flutter, vibration, and acoustics. Vehicle Equipment includes landing gear components; pivots and bearings; environmental control systems; survivability/vulnerability; crew accommodation, protection and escape; and aerodynamic decelerators and parachutes. The Flight Control area involves flight control systems, control augmentation, all-weather operation, cockpit configuration and displays, and flight and ground simulation. Aeromechanics deals with aerodynamics, agility, aerodynamic heating, aircraft and propulsion system integration, wind tunnel testing, configuration research, and technology integration. The ultimate objective of all efforts inthese areas is to provide the advanced flight vehicle technology which forms the base for developing effective, efficient, and economical weapon systems to perform the Air Force mission. This program element, in addition to being the primary technical base exploratory development effort in flight vehicle technology, provides technical support to other Air Force and DOD agencies and receives partial reimbursement for the services provided. In the case of basic research accomplished by the laboratory, full reimbursement is provided from Program Element (PE) 61102F, Defense Research Sciences. The project break reflects the best estimate considering these anticipated reimbursements, but may require adjustment to the degree that reimbursements are actually earned.

RELATED ACTIVITIES: This program receives inputs from In-House Laboratory Independent Research (PE 61101F), Defense Research Sciences (PE 61102F) and from Materials (PE 62102F), as well as from the products of other national and international research and development activities. In turn, the output of this program is applied to Flight Vehicle Technology (PE 63205F), Aerospace Structures & Materials (PE 63211F), Aircraft Nonnuclear Survivability (PE 63244F), Advanced Fighter Technology Integration (PE63245F), and other advanced development, engineering development, and system development programs. Joint and cooperative projects are conducted with other laboratories, other Air Force organizations, the Army, the Navy, NASA, and foreign countries. Coordination and avoidance of duplication of effort is accomplished with these agencies, academic institutions, and industry through exchanges of information, coordinating and advisory groups, technical reviews and seminars, professional societies and meetings, and in the preparation of formal Department of Defense documents such as Technology Coordinating Papers.

WORK PERFORMED BY: Work under this program is performed in-house by the Air Force Flight Dynamics Laboratory and under contracts managed by that laboratory. The laboratory makes use of nine major in-house facilities, such as the Structures Test Facility, Landing Gear Test Facility, and the 50-Megawatt Electrogasdynamic Facility, as well as many minor in-house facilities and other Air Force, Government, and industry facilities. The ten major contractors are: Rockwell International, Los Angeles CA; General Dynamics, Fort Worth TX; McDonnell Douglas, St Louis MO; Grumman, Bethpage NY; Boeing, Seattle WA; Honeywell, Minneapolis MN; University of Dayton, Dayton OH; Northrop, Hawthorne CA; Science Applications, La Jolla CA; Hughes, Culver City CA. Currently there are 57 total contractors and 186 total contracts.

Program Element: #62201F
DOD Mission Area: Engineering Technology (ED), #523

Title: Aerospace Flight Dynamics
Budget Activity: Technology Base #1

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Recent significant accomplishments include: (1) developed and transitioned to the production line new fastener hole drilling procedures that will reduce cost and improve structural durability of airframes, (2) developed and demonstrated repair procedures for large area damage in advanced composite structures, (3) established and experimentally validated design criteria for the protection of flight vehicle subsystems against high energy projectiles, (4) published a critical analysis of survivable fuel system designs for application to future combat aircraft, (5) developed and successfully flight tested in a SAC operational KC-135 a Boom Operator's Head-Up Display which demonstrated increased aerial refueling safety, reduced refueling time, and its use as an aid in training boom operators, (6) designed, fabricated, and bench tested an electromechanical flight control actuation unit (power-by-wire), and (7) used a mini remotely piloted vehicle (XBQM-106) to test a Millimeter Wave Contrast Seeker.

2. FY 1980 Program: New starts in the metallic structures area include initial quality determination of advanced structural joining concepts and development of damage tolerance guidelines and handbooks. New starts in the composite structures area include development of special fasteners, and devising analysis procedures for determining the remaining life of damaged composite structural components. In vehicle equipment, the conceptual design of an aircraft radial tire is continuing with a view toward eventual savings in logistics, maintenance, and life cycle costs. Lightning hazards and selected ballistic combat threats to air vehicles are being characterized in the interest of flight safety and combat survivability. In the flight control area, emphasis is being placed on missile control technologies and integrated aircraft and subsystems control. This will maximize use of on-board sensors through digital data processing and time-sharing of information displays, and thus increase pilot effectiveness, reduce crew station complexity, and avoid proliferation of cockpit displays and devices. Aeromechanics efforts will continue on the integration of aircraft airframes with propulsion systems, weapons and lasers. Innovative aircraft concepts and designs are being developed and their performance relative to the Air Force mission is being evaluated.

3. FY 1981 Planned Program: Work will continue on the development of structural life analysis methods for advanced structural concepts using new materials and new joining and manufacturing methods. New starts in the structural area include the determination of aircraft sink speed data for updating military specifications, and examining the use of flight simulators as a means for obtaining structural parameters of new aircraft configurations. Studies, design, and laboratory evaluation of candidate concepts will continue for the cryogenic cooling of superconductor power sources and missile-borne infrared sensing systems. Development will progress on environmental control systems for cruise missile avionics bays. A major emphasis will be on flight control tasks to achieve a one-man, night/all-weather tactical weapon delivery capability. Engineering flight simulation will be upgraded to provide the capability to synthesize full tactical air-to-air and air-to-ground combat missions. Effort will continue on life cycle cost estimating and design methodology, as well as on the design, analysis, and wind tunnel testing of advanced conceptual air vehicle models. Supersonic weapons carriage and missile/aircraft separation at high speeds will be investigated.

Program Element: #62201F
DOD Mission Area: Engineering Technology (ED), #523

Title: Aerospace Flight Dynamics
Budget Activity: Technology Base #1

4. FY 1982 Planned Program: Efforts will include exploitation of the latest developments in powdered metal and metal matrix techniques for structural application and the exploration of design concepts for large space structures. Work will be done in improving the quality and serviceability of aircraft landing gear, brakes, and tires, as well as environmental control system components. Baseline technology for second generation digital flight control systems will be established, and development will be undertaken on an air mass reference system with all sensor components confined to the aircraft skin for reduced radar cross section and clean aerodynamic shape. Investigations will continue on aerodynamic reentry vehicle technology and aerodynamic cruise and maneuver technology.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Comparison with FY 1980 Budget Data: ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	45,295	46,700	49,000	51,900	Continuing	Not Applicable
06DF	Laboratory Operations	22,978	23,800	25,800	26,100		
2401	Structures and Dynamics	5,102	5,900	6,000	6,700		
2402	Vehicle Equipment	4,138	4,300	4,400	4,900		
2403	Flight Control	5,826	5,600	5,600	6,200		
2404	Aeromechanics	7,251	7,100	7,200	8,000		

The FY 1981 increase results from the 1 October 1979 civilian pay raise, revised estimates of reimbursement for support provided to others, and the goal to achieve 5% real growth in the total Air Force Exploratory Development program.

Project: #06DF
Program Element: #62201F
DOD Mission Area: Engineering Technology (ED), #523

Title: Air Force Flight Dynamics Laboratory Operations
Title: Aerospace Flight Dynamics
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the support activities required to operate the Air Force Flight Dynamics Laboratory (AFFDL), Wright-Patterson AFB OH. The mission of AFFDL is to plan and execute the USAF exploratory development, advanced development and selected research and engineering development programs in aerospace flight vehicle aerodynamics, aerothermodynamics, structures, performance, vehicle dynamics, flight control and control displays, crew station design, crew escape and recovery, environmental control, mechanical systems, and associated flight vehicle areas including configuration research, experimental simulation, and flight techniques. The laboratory also provides technical support within its mission areas to other Air Force organizations, the Army, the Navy, other Department of Defense agencies, NASA, and other government agencies. This project covers pay and benefits of civilian scientists and engineers and supporting personnel, travel, transportation, rents, communications, and utilities costs, procurement of supplies and equipment, and contractor support services.

RELATED ACTIVITIES: This project supports and complements all of the technical projects under this program element, as well as all other projects and activities managed or conducted by AFFDL. Other programs supported include Program Element (PE) 63205F, Flight Vehicle Technology; PE 63211F, Aerospace Structures & Materials; PE 63244F, Aircraft Nonnuclear Survivability; PE 63245F, Advanced Fighter Technology Integration; PE 64212F, Aircraft Equipment Development; and PE 63428F, Space Surveillance Technology.

WORK PERFORMED BY: The Air Force Flight Dynamics Laboratory, Wright-Patterson AFB OH, is responsible for management of this project and other projects included under the Aerospace Flight Dynamics program.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: Plans and accomplishments of AFFDL are discussed in the Descriptive Summaries for the program element and technical projects.

1. Program to Completion: This is a continuing program.

2. Milestones: Not applicable.

3. Resources:

($ in thousands)	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	24,933	25,500	27,100	27,500	Continuing	Not Applicable

Project: #06DF
Program Element: #62201F
DOD Mission Area: Engineering Technology (ED), #523

Title: Air Force Flight Dynamics Laboratory Operations
Title: Aerospace Flight Dynamics
Budget Activity: Technology Base #1

4. Comparison with FY 1980 Budget Data:
($ in thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	22,978	23,800	25,800	26,100	Continuing	Not Applicable

FY 1981 funding has been increased due to the 1 October 1979 civilian pay raise and revised estimates of reimbursement for support provided to others.

Project: #2401 Title: Structures and Dynamics
Program Element: #62201F Title: Aerospace Flight Dynamics
DOD Mission Area: Engineering Technology (ED), #523 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The purpose of this project is to develop and demonstrate structural mechanics and vehicle dynamics technology which will result in lower cost, lower weight, improved performance, and assured design life for advanced flight vehicles. The project includes three major goals: (1) Effective application of advanced materials to achieve lighter weight, lower cost vehicle structures that will realize their full design life in the mission environment without degradation of performance or mission capability of aircraft, missiles and space vehicles. (2) Generating new basic structural and dynamic criteria, techniques and concepts that will facilitate the application of advanced materials and structures technology to the design and development of weapon systems. (3) Maintaining the technical capability and unique facilities to attain the preceding goals and providing the expertise and audit capability required for structures and dynamics technical support to other organizations. The work includes testing for structural integrity, flutter, fatigue, and vibration.

RELATED ACTIVITIES: This project receives inputs from Defense Research Sciences (PE 61102F), from Materials (PE 62102F), and from the Manufacturing Technology Program (PE 78011F), as well as from the products of other national and international research and development activities. In turn, the output of this project is applied to Flight Vehicle Technology (PE 63205F), Aerospace Structures & Materials (PE 63211F), other advanced development, engineering development, and system development programs. Joint and cooperative efforts are conducted with other Air Force Systems Command laboratories, other Air Force organizations, the Army, the Navy, NASA, and foreign countries. Coordination and avoidance of duplication of effort is accomplished with these agencies, academic institutions, and industry through exchanges of information, coordinating and advisory groups, technical reviews and seminars, professional societies and meetings, and in the preparation of formal Department of Defense documents such as Technical Coordinating Papers.

WORK PERFORMED BY: Work under this project is performed in-house by the Air Force Flight Dynamics Laboratory and under contracts managed by that laboratory. Use is made of in-house facilities, such as the Structures Test Facility and the facilities of other Air Force organizations, other government organizations, industry, and foreign countries. The ten major contractors are: General Dynamics, Fort Worth TX; Rockwell International, Los Angeles CA and Tulsa OK; Northrop, Hawthorne CA; Grumman, Bethpage NY; Vought Aeronautics, Dallas TX; Anamet Laboratories, Berkeley CA; University of Dayton, Dayton OH; McDonnell Douglas, St Louis MO; Boeing, Seattle WA; and Westinghouse, Baltimore MD. Currently there are 19 total contractors and 54 total contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Recent significant accomplishments include: (1) developed and transitioned to the production line new fastener hole drilling procedures that will reduce cost, and improve structural durability of airframes, (2) developed and demonstrated repair procedures for large area damage in advanced composite structure, (3) prepared interim guidance for operating combat loaded aircraft on bomb damaged runways, (4) completed investigation of the extent to which the boron/epoxy skins of the F-15 stabilator are affected by moisture absorption

resulting from long-term exposure to a high humidity service environment, (5) evaluated and demonstrated the production feasibility of graphite/thermoplastic composite structure as a substitute for graphite/epoxy structural components, and (6) prepared a handbook covering the design and sealing of aircraft integral fuel tank structure.

2. FY 1980 Program: New starts in the metallic structures area include initial quality determination for advanced structural joining concepts, development of damage tolerance guidelines and handbooks, and evalution of a multi-processor based individual aircraft tracking concept. New starts in the composite structure area include development of special fasteners and analysis procedures to determine remaining life of damaged composite structures. The Structural Composites Design Guide is being revised to incorporate new technology and knowledge. Advanced structural concepts using metal matrix materials are being investigated for advanced missiles and space vehicles. Rapid battle damage repair procedures for tactical aircraft are being developed. Test facilities for evaluating structural integrity, flutter, fatigue, and vibration are being improved. Structural and dynamic design criteria are being developed for use of advanced structures and materials in future air vehicles.

3. FY 1981 Planned Program: Work will continue on the development of structural life analysis methods for advanced structural concepts using new materials and new joining and manufacturing methods. Also planned is continuation of development of more precise load calculating techniques for flexible structures, aircraft wing/body, and new missile configurations; noise level prediction and response of advanced structural designs such as those incorporating composite materials and adhesive bonding or other joining methods; damage tolerant designs; and active flutter suppression techniques and devices. New starts include the determination of aircraft sink speed data for updating military specifications, examining the use of flight simulators as a means for obtaining structural parameters of new aircraft configurations, developing techniques to qualify reentry vehicles for vibration and acoustic environments, and correlating experimental data with analytical predictions to verify aeroelastic tailoring design methods.

4. FY 1982 Planned Program: Efforts will include the exploitation of the latest developments in powdered metal and metal matrix technologies for structural application, the exploration of design concepts for large space structures, the continuation of structural life prediction techniques for advanced structural configurations and the development of innovative structural concepts utilizing new material developments, and new joining and manufacturing methods for generic applications to strategic and tactical aircraft, spacecraft, cruise missiles, and hypersonic vehicles.

5. Program to Completion: This is a continuing program

6. Milestones: Not applicable.

Project: #2401
Program Element: #62201F
DOD Mission Area: Engineering Technology (ED), #523

Title: Structures and Dynamics
Title: Aerospace Flight Dynamics
Budget Activity: Technology Base #1

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	5,906	6,000	7,300	8,500	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: ($ in thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	5,102	5,900	6,000	6,700	Continuing	Not Applicable

The projected increase in FY 1981 will permit additional effort in structures and dynamics technology, primarily in the areas of metallic and composite structures to provide lighter, lower cost structural designs for application to aerospace vehicles.

Project: #2402 Title: Vehicle Equipment
Program Element: #62201F Title: Aerospace Flight Dynamics
DOD Mission Area: Engineering Technolcgy (ED), #523 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The objectives of this project are to acquire the technology base and provide demonstrated technologies in the areas of conventional and alternate flight vehicle takeoff and landing systems, windshields and transparency enclosures, cryogenic cooling, internal environment control, flight vehicle vulnerability to ballistic threats and natural environment hazards, emergency crew escape, and combined environment reliability testing. These technology advancements will significantly impact the life cycle cost of subsystems and equipment, increase the probability of flight vehicle and crewmember survival, and improve flight vehicle operational capabilities. In addition, demonstrated options for improved subsystem and equipment design and performance, together with the associated scientific and engineering foundation,will be established. The approach will involve analytical, simulation, and trade-off studies; the development of candidate hardware items; the acquisition of empirical data bases for equipment performance; experimental and validation tests; data acquisition and correlation; and the dissemination of program results for system applications.

RELATED ACTIVITIES: This project receives inputs from Defense Research Sciences (PE 61102F) and from Materials (PE 62102F), as well as from the products of other national and international research and development activities. In turn, the output of this program is applied to Flight Vehicle Technology (PE 63205F), Advanced Fighter Technology Integration (PE 63245F), Aircraft Nonnuclear Survivability (PE 63244F), Aircraft Equipment Development (PE 64212F), and other advanced development, engineering development, and system development programs. Joint and cooperative projects are conducted with other laboratories, other Air Force organizations, the Army, the Navy, NASA, and foreign countries. Coordination and avoidance of duplication of effort is accomplished with these agencies, academic institutions, and industry through exchanges of information, coordinating and advisory groups, technical reviews and seminars, professional societies and meetings, and in the preparation of formal Department of Defense documents such as Technology Coordinating Papers.

WORK PERFORMED BY: Work under this program is performed in-house by the Air Force Flight Dynamics Laboratory and under contracts managed by that laboratory. Use is made of in-house facilities and the facilities of other Air Force organizations, other government organizations, and industry. The current ten major contractors are: Hughes Aircraft, Culver City CA; Rockwell International, Los Angeles CA; Boeing, Seattle WA; University of Dayton, Dayton OH; Rovac, Maitland FL; Booz Allen and Hamilton, Bethesda MD; Textron, Buffalo NY; Calspan, Buffalo NY; Helix Technology, Waltham MA; Scitech, Santa Ana CA. Currently there are 20 total contractors and 38 total contracts.

Project: #2402
Program Element: #62201F
DOD Mission Area: Engineering Technology (ED), #523

Title: Vehicle Equipment
Title: Aerospace Flight Dynamics
Budget Activity: Technology Base #1

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Recent significant accomplishments include: (1) established and experimentally validated design criteria for the protection of flight vehicle subsystems against high energy projectiles, (2) established a test capability to determine the effects of multi-fragment impact on flight vehicles, (3) published a critical analysis of survivable fuel system designs for application to future combat aircraft, (4) completed an analysis of aircraft transparency enclosure failure and associated operation and maintenance costs, (5) completed a conceptual design study for an emergency crew escape system for the high acceleration flight regime, and (6) installed in the Aircraft Survivability Research Facility a test and analysis capability to assess the residual strength of structural subsystems when impacted by ballistic combat threats.

2. FY 1980 Program: Current work includes continuation of the conceptual design of an aircraft radial tire, feasibility assessment of an alternate takeoff and landing system for battle damaged runway application, characterization of the lightning hazard and selected ballistic combat threats to air vehicles, development of high temperature resistant transparency enclosures (e.g., windshields), ejection seat escape concepts for the high dynamic pressure and high acceleration flight regimes. New start efforts include development of an integrated brake control concept and active landing gear shock strut for rough/soft field operations.

3. FY 1981 Planned Program: Work will continue on studies, design, and laboratory evaluation of candidate concepts for the cryogenic cooling of superconductor power sources and missile-borne infrared sensing systems. Development will progress on environmental control systems for cruise missile avionics bays; protection of major flight vehicle subsystems against ballistic combat threats, atmospheric electrical hazards, and birdstrikes; and landing gear concepts for operation on rough fields and takeoff from battle damaged runways. Assessments will be made of the vulnerability of cruise missile subsystems and composite material structures to ballistic threats. Conceptual studies will be conducted for acceleration of combined environments reliability testing techniques for application to externally carried avionics.

4. FY 1982 Planned Program: Efforts will continue on improving the quality and serviceability of aircraft landing gear, brakes, and tires to reduce logistics and maintenance costs; development of heat pipe heat exchangers for cooling avionics equipment, determining the effect on air vehicles of hypersonic fragment impact; and verification of advanced fuel system ullage concepts.

5. Program to Completion: This is a continuing project.

6. Milestones: Not applicable.

Project: #2402 Title: Vehicle Equipment
Program Element: #62201F Title: Aerospace Flight Dynamics
DOD Mission Area: Engineering Technology (ED), #523 Budget Activity: Technology Base #1

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	4,208	4,400	5,500	6,400	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:
($ in thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	4,138	4,300	4,400	4,900	Continuing	Not Applicable

The projected increase in FY 1981 will permit additional effort in vehicle equipment exploratory research with particular emphasis on cooling and environmental control, atmospheric electrical hazards, and vulnerability of composite structures to ballistic impact.

Project: #2403 Title: Flight Control
Program Element: #62201F Title: Aerospace Flight Dynamics
DOD Mission Area: Engineering Technology (ED), #523 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The purpose of this project is to develop flight control systems technology which matches the performance and dynamic characteristics of the vehicle, its armament and mission systems with the pilot to obtain maximum capability while assuring safety, survivability and economy. The elements of flight control technology include cockpit arrangements, control logic, aircraft stability and control, control sensors, and actuation subsystems. Other important aspects are refining control design techniques and specifications, and improvement and validation of simulation techniques. The approach includes development of analytical techniques, development of breadboard engineering models, evaluation and validation of advanced control concepts and devices, and aggressive transition of technology. The evaluation and validation includes the laboratory, wind tunnel, simulation and/or flight tests necessary to demonstrate the validity of advanced control concepts, devices and techniques. Transition is enhanced by involvement of the using commands wherever possible in the evaluation and validation process. The principal formal means of technology transition is through specifications, handbooks, design guides and criteria, and technical reports.

RELATED ACTIVITIES: This project receives inputs from Defense Research Sciences (PE 61102F) and from Avionics (PE 62204F), as well as from the products of other national and international research and development activities. In turn, the output of this program is applied to Flight Vehicle Technology (PE 63205F), Advanced Fighter Technology Integration (PE 63245F), Digital Avionics Information System (DAIS) (PE 63243F), other advanced development, engineering development, and system development programs. Joint and cooperative projects are conducted with other laboratories, other Air Force organizations, the Army, the Navy, NASA, FAA, and foreign countries. Coordination and avoidance of duplication of effort is accomplished with these agencies, academic institutions, and industry through exchanges of information, coordinating and advisory groups, technical reviews and seminars, professional societies and meetings, and in the preparation of formal Department of Defense documents such as Technology Coordinating Papers.

WORK PERFORMED BY: Work under this program is performed in-house by the Air Force Flight Dynamics Laboratory and under contracts managed by that laboratory. Use is made of in-house facilities and the facilities of other Air Force organizations, other Government organizations, and industry. The ten major contractors are: Honeywell, Minneapolis MN; Electronic Associates, Long Branch NJ; Lear Siegler Inc, Grand Rapids MI; Systems Technology, Inc., Hawthorne CA; McDonnell Douglas, St Louis MO; Boeing, Seattle WA; Bunker-Ramo, Westlake Village CA; General Electric, Binghamton NY; Logicon, San Diego CA; and Dynamic Controls, Dayton OH. Currently there are 23 total contractors and 47 total contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Recent significant accomplishments include: (1) developed and demonstrated an Integrated Flight Management system designed specifically for tactical theater operations which improves fighter effectiveness throughout the entire mission by assisting the pilot in meeting critical time-space positions such as for aerial refueling, coordinated attack, and interdiction missions, (2) developed and successfully flight tested in a SAC operational KC-135 a boom operator's Head-Up Display which demonstrated increased aerial refueling safety,

reduced refueling time, and its use as an aid in training boom operators, (3) verified innovative analytical redundancy concepts in flight test of digital flight control which will lead to increased reliability in advanced systems, (4) designed, fabricated, and bench tested an electromechanical flight control actuation unit (power-by-wire) and demonstrated the feasibility of controlling flight control surfaces without dependence on hydraulic power, and (5) published a major revision of Military Specification MIL-F-8785B (now C), Flying Qualities Specification for Manned Aircraft, widely used by the US military services, industry, and friendly foreign countries.

2. FY 1980 Program: Emphasis has been increased on low cost missile control technologies and integrated aircraft and subsystem control that maximize use of on-board sensors. This is being done through digital data processing and time-shared information displays. The result will be to increase pilot effectiveness and to reduce crew station complexity and proliferation of displays and devices. Control system design methods are being validated through ground and flight simulation. Ground simulation equipment is being updated to incorporate computer and display advancements and to reflect adverse weather operation. Critical missile flight control techniques are being developed and design criteria provided. Work on integration of flight control with propulsion control has been started. Innovative flight control concepts are being evaluated. New simplified cockpit arrangements and displays are being developed for better man-machine interface and pilot effectiveness in the combat environment.

3. FY 1981 Planned Program: Work will be continued on flight control technology tasks to interface with external systems for a one-man, night/all-weather weapon delivery capability with emphasis on low altitude operation. Engineering flight simulation will be upgraded to provide the capability to synthesize full tactical air-to-air and air-to-ground combat missions. Integration of flight control with propulsion control will continue. Studies will be conducted on aeroservoelastic interactions to provide the methodology to analyze and test interdependent aerodynamics, flight control, and structural systems. Flight/weapon control laws will be integrated with emphasis on guided weapons. Effort will be extended on the development and validation of new control concepts, systems, devices, and displays.

4. FY 1982 Planned Program: Planned work includes development of the technology baseline for second generation digital flight control systems, development of an air mass reference system with all sensor components confined to the aircraft skin for reduced radar cross section, and development of a "self-repairing" flight control system through self-correction and reconfiguration. Other activities relate to further integration of flight control with weapons, avionics and propulsion systems.

5. Program to Completion: This is a continuing project.

6. Milestones: Not applicable.

Project: #2403 Title: Flight Control
Program Element: #62201F Title: Aerospace Flight Dynamics
DOD Mission Area: Engineering Technology (ED), #523 Budget Activity: Technology Base #1

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	5,128	5,600	7,000	8,100	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:
($ in thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	5,826	5,600	5,600	6,200	Continuing	Not Applicable

The difference between FY 1980 and FY 1981 budget data will permit greater emphasis on flight control technologies to obtain maximum capability in conjunction with the armament and mission systems for greater effectiveness, survivability, safety and economy of future flight vehicles.

Project: #2404
Program Element: #62201F
DOD Mission Area: Engineering Technology (ED), #523

Title: Aeromechanics
Title: Aerospace Flight Dynamics
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to initiate and conduct technology programs in the areas of aerodynamics, aerothermodynamics, performance analysis, configuration research, technology assessment and integration, and wind tunnel and flight experiments. These technology programs are directed toward improved mission capability, reduced development risk, and reduced development and operation cost. The approach includes emphasis in the following areas: maneuver and cruise technologies; integration of the airframe and subsystems such as propulsion, conventional weapons, and laser; aerodynamics of strategic and tactical missiles; technology assessment of advanced systems including life cycle costing and design methodology; and flight investigation of fuel conserving technologies, hypersonic experiments, and advanced integrated technologies. Fundamental technology base efforts include test and prediction techniques, design criteria, wind tunnel simulation, and flight test correlation.

RELATED ACTIVITIES: This project receives inputs from Defense Research Sciences (PE 61102F) and from Materials (PE 62102F), as well as from the products of other national and international research and development activities. In turn, the output of this program is applied to Flight Vehicle Technology (PE 63205F), Advanced Fighter Technology Integration (PE 63245F), and other advanced development, engineering development, and system development programs. Joint and cooperative projects are conducted with other laboratories, other Air Force organizations, the Army, the Navy, NASA, and foreign countries. Coordination and avoidance of duplication of effort is accomplished with these agencies, academic institutions, and industry through exchanges of information, coordinating and advisory groups, technical reviews and seminars, professional societies and meetings, and in the preparation of formal Department of Defense documents such as Technology Coordinating Papers.

WORK PERFORMED BY: Work under this program is performed in-house by the Air Force Flight Dynamics Laboratory and under contracts managed by that laboratory. Use is made of in-house facilities and the facilities of other Air Force organizations, other government organizations, and industry. The ten major contractors are: Rockwell International, Los Angeles CA; McDonnell Douglas, St Louis MO and Long Beach CA; Grumman, Bethpage NY; General Dynamics, Fort Worth TX and San Diego CA; Science Applications INC., La Jolla CA; Boeing, Seattle WA; Lockheed, Marietta GA; Stephen Howe Consultants, Surrey UK; General Applied Science Laboratories, Westburg NY; and Aerophysics Research, Bellevue WA. Currently there are 20 total contractors and 51 total contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Recent significant accomplishments include: (1) significant reductions in the amount of wind tunnel testing required for development of advanced forms of weapons and carriage mode through application of a new panel aerodynamic (PANAIR) computer code, (2) demonstration of lower profile drag by a forward swept wing-body research model as compared to an equivalent aft swept wing, (3) use of a mini remotely piloted vehicle (XBQM-106) to test a Millimeter Wave Contract Seeker, and (4) perfecting of a copper line ratio spectral technique to define much more accurately the temperature and enthalpy of very high energy arc test flows used to develop nose tips of many Department of Defense missiles.

Project: #2404
Program Element: #62201F
DOD Mission Area: Engineering Technology(ED), #523

Title: Aeromechanics
Title: Aerospace Flight Dynamics
Budget Activity: Technology Base #1

2. FY 1980 Program: Work is continuing on the integration of aircraft airframes with propulsion systems, weapons, and lasers. Innovative aircraft concepts and designs are being developed and their performance and potential contribution to the Air Force mission is being analyzed and evaluated. Advanced engine nozzle configurations are being investigated, and aerodynamic and aerothermodynamic improvements to ballistic, cruise, and air-to-air missiles are being developed and tested. New and emerging technologies are being assessed to determine their impact on systems effectiveness and development and operating costs. The capability of ground test facilities is being enhanced to minimize the need for costly flight testing. Performance prediction methodology is being refined. Low cost remotely piloted vehicles for target acquistion and destruction are being developed. Conceptual designs of high speed research vehicles, including cruise aircraft and reentry vehicle types, are being investigated, and experiments for conduct on such vehicles are being identified.

3. FY 1981 Planned Program: Efforts will continue on performance and cost estimating and design methodology, as well as on the design, analysis, and wind tunnel testing of advanced conceptual air vehicle models. Supersonic integral weapons carriage and missile/aircraft separation at high speeds will be investigated. Work will be initiated on powered lift design criteria to improve flight maneuverability and to optimize short takeoff and landing benefits. Attempts will be made to quantify laser beam degradation resulting from gaseous ejection into the boundary layer. Air vehicle performance and survivability technology will be developed, including configuration component research to reduce detection. Design optimization and integration methods and techniques will be devised for improved mission performance at minimum cost. The high pressure, high enthalpy arc heater reentry nose tip test facility is scheduled to reach the design goal of 100 atmospheres and will include a particle nose tip erosion test capability. A water tunnel will provide a flow visualization capability, and the upgrading of in-house wind tunnel facilities will continue.

4. FY 1982 Planned Program: Investigations will continue on aerodynamic reentry vehicle and aerodynamic cruise and maneuver technology. Critical technology drivers for advanced strategic, tactical, and airlift aircraft will be identified. Studies of supersonic favorable interference designs are expected to culminate in configurations having 25% higher efficiency.

5. Program to Completion: This is a continuing project.

6. Milestones: Not applicable.

Project: #2404 Title: Aeromechanics
Program Element: #62201F Title: Aerospace Flight Dynamics
DOD Mission Area: Engineering Technology (ED), #523 Budget Activity: Technology Base #1

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	6,900	7,500	9,900	12,000	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:
($ in thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	7,251	7,100	7,200	8,000	Continuing	Not Applicable

The increase shown for FY 1981 will permit improvement of engineering simulation and ground test capability which will provide more thorough evaluation of new aerospace vehicle concepts and designs. This, in turn, will reduce the risk in application of technology and reduce the need and cost of more extensive flight testing.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62202F
DOD Mission Area: Environmental and Life Sciences (ED) #522

Title: Aerospace Biotechnology
Budget Activity: Technology Base, #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	29,167	31,000	35,800	39,800	Continuing	Not Applicable
06CH	Aerospace Medical Division Laboratory Operations	16,489	17,329	18,000	18,200		
6302	Occupational & Environmental Toxic Hazards in Air Force Operations	2,234	2,300	2,900	3,500		
6770	Biotechnology Studies in Advanced Systems	250	200	300	300		
6893	Manned Weapon Systems Effectiveness	1,580	1,400	1,500	2,100		
7184	Man-Machine Integration Technology	2,734	3,071	3,600	4,400		
7231	Safety and Aircrew Effectiveness in Mechanical Force Environments	1,736	1,700	2,600	3,000		
7755	Aerospace Medicine	753	600	700	900		
7757	Radiation Hazards in Aerospace Operations	1,729	2,700	3,900	4,700		
7930	Advanced Crew Technology	1,662	1,700	2,300	2,700		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Biotechnology is the core Air Force program for development of human operator centered technologies required for the development and operation of complex and sophisticated weapons systems. The program is a coordinated matrix of projects aimed at facilitating the role of man in hazardous operational environments and at capitalizing on inherent human capabilities to enhance weapon systems effectiveness. The program funds the operational support and management for the research and development activities performed by the Aerospace Medical Division, Brooks AFB, TX, which includes the Air Force Aerospace Medical Research Laboratory, Wright-Patterson AFB OH, and the USAF School of Aerospace Medicine, Brooks AFB TX.

Program Element: 62202F
DOD Mission Area: Medicine & Life Science, #131

Title: Aerospace Biotechnology
Budget Activity: Technology Base, #1

BASIS FOR FY 1981 RDT&E REQUEST: The FY 1981 planned program includes the following efforts: identification of toxic hazards in the AF mission and work environment to provide protection technology and define impact of AF operations on environmental quality; definition of bioeffects, exposure hazards, and safety criteria to limit personnel health risks and provide effective protection against electromagnetic radiation from lasers, radar sources, and nuclear weapons; improvement of the safety and effectiveness of AF personnel exposed to hazardous mechanical force fields (noise, motion, impact, windblast and acceleration); investigation of specific design solutions for more effective man-machine integration; establishment of selection/retention criteria to extend air-crew longevity; increase air and ground crew readiness and optimal performance in mission stress environments; development of countermeasures to the human operator in enemy weapons systems; and, evaluation of chemical defense equipment and methodology.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: 62202F
DOD Mission Area: Environmental and Life Sciences (ED) #522

Title: Aerospace Biotechnology
Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: Biotechnology is the core Air Force program for developing human operator centered technologies required for the design, development, and operation of increasingly complex and technologically sophisticated weapons systems. The three key parts of the biotechnology program are to define the safe limits of operator performance in extreme operational environments; to develop protective concepts and equipments which extend the performance envelope; and, to develop man-machine interface criteria which optimize systems performance and capabilities. The products of this program are applied primarily to corollary hardware development programs in the mission areas of strategic offense and defense; tactical air superiority; tactical interdiction; command, control, and communications; and intelligence. In addition, technology products from efforts in bioeffects of electromagnetic radiation, lasers, chemical propellants, and aircraft/missile noise are used to form national consensus standards and to assure environmental compatability of fielded and developmental weapons systems. Several key factors drive the increasing investment in this program. These include reliance on more technology rich hardware systems to counter the numerical superiority of threat systems; the requirement to accommodate the All Volunteer Force by careful application of human-centered design principles; the requirement to reduce life cycle costs of weapons systems; and the national environmental concern with lifetime effects of exposure to various forms of radiation and energetic chemicals. This program element, in addition to being the primary technical base exploratory development effort in Aerospace Biotechnology, provides technical support to other Air Force and DoD agency programs and receives partial reimbursement for the services provided. In the case of basic research accomplished by the laboratory, full reimbursement is provided by Program Element 61101F, Laboratory Directors Funds. The project funding break reflects the best estimate considering these anticipated reimbursements but may require adjustment to the degree that reimbursements are actually earned.

RELATED ACTIVITIES: The Biotechnology program is formally coordinated with the other services, National Aeronautics and Space Administration, industry, and the university community through numerous coordination mechanisms and agreements. These include topical reviews, the Electromagnetic Radiation Management Advisory Council, Training and Personnel Technology Conferences, the Triservice Aeromedical Research Panel, and several Joint Technology Coordinating Group working bodies. The program is also coordinated on an international basis through the Air Standardization Coordinating Committee, and several North Atlantic Treaty Organization groups including the Defense Research Group, Advisory Group for Aerospace R&D, and the Military Agency for Standardization. In addition, bilateral efforts have been established with friendly nations, particularly with the United Kingdom, in the area of chemical defense for aircrews. Within the DOD, joint efforts and operating locations have been established with the Army Aeromedical Laboratory and the Naval Medical Research Institute. The biotechnology programs in electromagnetic radiation, lasers, chemical propellants, and noise are periodically reviewed by nationally recognized peer groups within the National Academy of Sciences/National Research Council, and the American National Standards Institute. Efforts responsive to Air Force Systems Command are specifically coordinated with the responsible product division, systems program office, or Air Force laboratory. Liaison is maintained with AF operational commands. Support to the Air Force Surgeon General is provided on a continuing basis.

Program Element: 62202F
DOD Mission Area: Environmental and Life Sciences (ED) #522

Title: Aerospace Biotechnology
Budget Activity: Technology Base, #1

WORK PERFORMED BY: The Biotechnology Program is conducted by the Aerospace Medical Division through its two laboratories: the USAF School of Aerospace Medicine, Brooks AFB TX, and the Air Force Aerospace Medical Research Laboratory, Wright-Patterson AFB OH. The in-house portion of the program is centered on unique, complex, man-rated experimental facilities which are generally not available in the aerospace industry or academic institutions. The contract portion of the program complements the in-house efforts. The ten major contractors in FY 1980 are: University of California, Irvine, CA; Systems Research Laboratories, Inc., Dayton, OH; Booz-Allen & Hamilton, Inc., Bethesda, MD; University of Washington, Seattle, WA; Raytheon Service, Co., Burlington, MA; Cober Electronics, Inc., Sanford, CN; Payne, Inc., Annapolis, MD; Technology, Inc., San Antonio, TX; Simulation Technology, Inc., Dayton, OH; University of Dayton, Dayton, OH; McDonnell Douglas Corp., Long Beach, CA. There are an additional 71 contracts conducted by 65 contractors.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Some of the products from this program include the following: completion of a study to define the dose-response and no-effect level of the oncogenic potential of hydrazine and unsymmetrical dimethylhydrazine inhalation; completion of studies to determine the effect and limits of the Titan III exhaust products on agricultural, ornamental, and native vegetation of the Vandenberg AFB area and incorporation of the results in the Space Shuttle Environmental Impact Statement; Radio Frequency Radiation Dosimetry Handbook #2 completed and distributed to U.S. and international researchers; completed a survey of North Truro AFS which indicated no acute or chronic health hazards from radio frequency radiation (RFR) emissions originating from equipment there; developed and constructed laser protection spectacles for Tactical Air Command use; completed technology base for engineering development of windblast protection equipment for current and future aircraft emergency escape systems, completed evaluation of the A-10 side opening canopy and found it unacceptable; developed and partially validated a target/recognition model; provided human factors modifications to the Boeing crewstation design for update on the B-52G/H aircraft; completed a five-year DoD study on the physical and mental status of repatriated prisoners of war; developed a simplified sorbent tube sampler for Titan II and III missile propellants; developed a computer model to account for the properties of the human visual system, search strategies, ground threat optics, and aircraft optical signatures.

2. FY 1980 Program: The current program includes the following efforts: perform mutagenic/teratogenic/carcinogenic screening technology for assessing health hazards of propellants and fuels; determine toxicity of shale derived synthetic fuels; develop new methodology to understand the metabolic fate of toxic compounds by exposure to animals with metabolic systems similar to man; investigate long-term low-level RFR exposure; determine human body aerodynamic properties; develop windblast injury protection concepts; develop refined noisemap, noisefile, and noisecheck technology for the Air Installation Compatible Use Zone program; establish human standards and criteria for

human test and evaluation of crash/escape protection systems; develop crew workload criteria for advanced tactical aircraft cockpit design; define and prototype automated systems for analysis of medical data; develop microcomputer based prototype vector cardiographic analysis concept for Air Force use; develop an integrated inflight physiologic data acquisition and management system; perform comparative evaluation of on-board oxygen generating systems; expand G-stress studies; develop a manned threat quantification capability to investigate enemy command, control, and communications (C^3) in ground-to-air threat systems; develop a system simulation and modeling procedure for evaluation and optimization of aircrew performance in chemical threat environments.

3. FY 1981 Planned Program: The FY 1981 planned program includes: develop fire control display concepts to improve tactical missile delivery accuracy for emerging short and medium range air-to-air missiles; mid-term review of the comprehensive long-term low-level radio frequency radiation (RFR) bioeffects study; develop crew utilization rules for C^3 operations in various ground and flight environments; develop a human centered design package for advanced escape systems incorporating technology for powered body positioning and restraint, flail injury reduction, spinal injury reduction, seat-man stabilization, and reduction in ejection frequency time; develop molecular correlates of toxic chemicals; and investigate aircrew performance in acceleration environments during high performance aircraft maneuvers.

4. FY 1982 Planned Program: The FY 1982 planned program includes: netted threat assessment of mixed force manually directed weapons; manned threat assessment of chemical agent warfare against C^3 operations; human operator specifications for optimizing advanced displays; workload assessment of C^3 operations centers; epidemiology case history studies of health hazards associated with occupational exposure to hydrazine fuels; population-weighted environmental noise impact indices; human criteria for advanced escape system design integration; hypersonic escape system technology; bioeffects of long-term low-level RFR exposure; RFR accident exposure investigation technology, prospective risk assessment of RFR health in exposed Air Force populations; inflight aircrew performance evaluation system.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Program Element: 62202F
DOD Mission Area: Environmental and Life Sciences (ED) #522

Title: Aerospace Biotechnology
Budget Activity: Technology Base, #1

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	25,220	28,200	31,000	32,900	Continuing	Not Applicable
06CH	Aerospace Medical Division Laboratory Operations	15,524	15,700	16,800	16,600		
6302	Occupational & Environmental Toxic Hazards in Air Force Operations	2,158	2,290	2,300	2,600		
6770	Biotechnology Studies in Advanced Systems	142	200	0	0		
6893	Manned Weapon Systems Effectiveness	1,259	1,648	2,000	2,300		
7184	Man-Machine Integration Technology	2,268	2,665	3,200	3,600		
7231	Safety and Aircrew Effectiveness in Mechanical Force Environments	1,425	1,713	1,700	2,100		
7755	Aerospace Medicine	424	556	600	700		
7757	Radiation Hazards in Aerospace Operations	1,207	1,941	2,700	2,900		
7930	Advanced Crew Technology	813	1,487	1,700	2,100		

Changes are reflected in the FY 1981 program due to the additive costs of the 1 October 1979 civilian pay raise, revised estimates of reimbursements, and the overall goal to achieve 5 percent real growth in the Exploratory Development Program. In addition to these changes, in FY 1980 Project 6893 was redirected and Project 6770 was reestablished. In FY 1981 substantial increases were made in Project 7757 for expanded radio frequency radiation studies and in Project 6302 for toxicology projects; Projects 6893 and 6770 were changed because of redirection in FY 1980.

Project: #06CH
Program Element: 62202F
DoD Mission Area: Environmental and Life Sciences (ED) #522

Title: Aerospace Medical Division Laboratory Operations
Title: Aerospace Biotechnology
Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides the resources to conduct the research and development activities of the Aerospace Medical Division (AMD) at Brooks AFB TX, and its R&D laboratories. The project provides for the pay and related costs of civilian physicians, scientists, engineers and support personnel as well as for travel, transportation, rents, communication utilities, laboratory supplies and unique equipment and other related costs needed to conduct biotechnology research and development. The program managed by AMD is one of applied research and exploratory development in biotechnology (e.g., flight environments and biodynamic stress effects; toxic chemical and electromagnetic radiation hazards; and human engineering) and aerospace medicine (e.g., aeromedical evacuation of patients; medical selection; care and retention of flyers).

RELATED ACTIVITIES: This project accounts for about 52 percent of the funds of the exploratory development program which is predominantly an in-house program conducted by specialized technical teams using complex, unique research facilities and devices. Related activities are discussed in the Descriptive Summary for the overall program element.

WORK PERFORMED BY: The Aerospace Medical Division has overall program responsibility and delegates project management to the USAF School of Aerospace Medicine, Brooks AFB TX, and the Air Force Aerospace Medical Research laboratory, Wright-Patterson AFB OH.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. Program to Completion: This is a continuing program.

2. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	16,700	16,800	16,600	18,200	Continuing	Not Applicable

3. Comparison with FY 1980 Budget Data: Changes are reflected in the FY 1981 program due to the additive costs of the 1 October 1979 civilian pay raise.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62203F
DOD Mission Area: Engineering Technology (ED), #523

Title: Aerospace Propulsion
Budget Activity: Technology Base #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	43,417	46,500	53,500	61,100	Continuing	Not Applicable
06CL	Laboratory Operations	12,800	13,200	14,200	14,400	Continuing	N/A
3012	Ramjet Technology	5,600	4,900	5,600	6,400		
3048	Fuel, Lubrication & Fire Protection	4,300	6,700	9,100	9,600		
3066	Turbine Engine Technology	13,617	15,000	16,900	20,300		
3145	Aerospace Power Technology	6,600	6,700	7,700	10,400		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element develops the propulsion and power technology in support of current and future aerospace vehicles and weapons systems. Exploratory development and component/subsystem evaluations are conducted in the technical areas of aeroturbine engines, ramjet engines, fuels, lubricants and fire protection technology as well as power generation, distribution and usage technology. The program also provides for the operation and management of the Air Force Aero Propulsion Laboratory (AFAPL) at Wright-Patterson AFB OH.

BASIS FOR FY 1981 RDT&E REQUEST: This is a level of effort program providing technology base for advanced development in aerospace propulsion and power systems. In FY 1981 the major exploratory development emphasis will be the maintenance of the strong turbine life assessment and durability efforts and initiation of new gas path componentry, combustor level testing of synthetic fuels, self sufficient aircraft power, and ramjet technology for tactical missiles.

OTHER APRPOPRIATION FUNDS:

	FY 1979	FY 1980	FY 1981	FY 1982
Military Construction (3300)	9,130	0	0	0

Program Element: #62203F
DOD Mission Area: Engineering Technology (ED), #523

Title: Aerospace Propulsion
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: Both contractual and in-house efforts will be accomplished. The turbine engine programs are geared to development and test of engine components and subsystems for timely inclusion in core gas generators and system responsive advanced development programs. The ramjet programs are designed to continue support of Advanced Strategic Air Launched Missiles (ASALM) while making major technology thrust in low cost ramjet propulsion system components for tactical missiles. Flight vehicle power programs are geared toward advancing electrical, thermal, hydraulic, and mechanical power for USAF space systems, reentry vehicles, manned aircraft, missiles, munitions, and special high power systems. The area of fire protection concentrates on timely development of effective fire prevention, detection, containment and suppression technology with minimum penalty to the prime mission. Aircraft and missile fuels and lubrication technology explores advancement of knowledge in combustion and lubrication phenomena in modern air breathing systems with a goal of improving efficiency and durability. To minimize cost and maximize availability of jet fuels, major projects in specification variability testing and alternate fuels will continue to receive increasing emphasis. This program element, in addition to being the primary technical base exploratory development effort in aerospace propulsion, provides technical support to other Air Force and DoD agency programs and receives partial reimbursement for the services provided. In the case of basic research accomplished by the laboratory, full reimbursement is provided by PE 61102F, Defense Research Sciences. The project break reflects the best estimate considering these anticipated reimbursements, but may require adjustment to the degree that reimbursements are actually earned.

RELATED ACTIVITIES: This program receives information from and provides technology for PE 61102F, Defense Research Sciences; PE 62102F, Materials; PE 62601F, Advanced Weapons; PE 63202F, Aircraft Propulsion Subsystems Integration; PE 63211F, Aerospace Structural Materials; PE 63215F, Aviation Turbine Fuels Technology; PE 63216F, Advanced Turbine Engine Gas Generator; PE 63246F, Aircraft Subsystem Technology; PE 63302F, Advanced Missile Propulsion; PE 63313F, Advanced Missile Subsystems Demonstration; PE 63314F, Strategic Bomber Enhancement, PE 63605F. Advanced Radiation Technology; and PE 63723F, Civil and Environmental Engineering Technology. Coordination with Army, Navy, National Aeronautics and Space Administration (NASA), Department of Energy (DOE), Department of Transportation (DOT), Environmental Protection Agency (EPA), industry and academia accomplished by joint projects, information exchanges and standing committees.

WORK PERFORMED BY: Work is managed and performed by the Air Force Aero Propulsion Laboratory (AFAPL), Wright-Patterson AFB, OH. Other Air Force organizations involved are the Aeronautical Systems Division, Wright-Patterson AFB OH; the Air Force Space Division, Los Angeles, CA; and Armament Division, Eglin AFB, FL. The ten major contractors for the program in FY 1979 are: Cadre Corporation, Doraville, GA; General Motors Corp., Indianapolis, IN; Garrett Corp., Phoenix, AZ; United Technologies Corp., East Hartford, CT; General Electric Corp., Cincinnati, OH; Marquardt Corp., Van Nuys, CA; Teledyne Industries, Inc., Toledo, OH; McDonnell Douglas Corp., St. Louis, MO, and Long Beach, CA; Hughes Aircraft Corp., Los Angeles, CA; Systems Research Laboratory, Inc., Dayton, OH; and University of Dayton, Dayton, OH. There are 79 contractors with 182 contracts.

Program Element: #62203F
DOD Mission Area: Engineering Technology (ED), #523

Title: Aerospace Propulsion
Budget Activity: Technology Base #1

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Highly ruggedized turbine engine components have been demonstrated and are transitioning to advanced technology turbine engine demonstrators promising much more durable engines in the future. A variable geometry nozzle insert for advanced strategic air launched ramjet powered missiles which will significantly improve range has been demonstrated. Established safe procedure and fuel additive for cold weather refueling of foam filled tanks in fighter aircraft. Permanent Magnet Variable Speed Constant Frequency Starter/Generators for aircraft have successfully transitioned to Advanced Development promising higher reliability, reduced cost and weight.

2. FY 1980 Program: The Compressor Research Facility will be accepted by the Air Force and in-house research testing will begin. Turbine engine componentry with emphasis on improved mechanized design and analysis methods, test techniques, design criteria, and development procedures necessary to the achievement of improved structural durability and life will continue. Higher combustor temperature strategic ramjet missile propulsion will start. Combustor rig testing of alternate turbine engine fuels will be generating the data base for gas generator level testing. New work efforts on very high energy density rechargeable batteries for ground power systems in support of strategic missile systems will be started.

3. FY 1981 Planned Program: The vast majority of exploratory development efforts are multi-year tasks. As such, a large percentage of the above described programs will continue plus others such as the following. An all-up digital electronic flight weight turbine engine control system will be initiated. High tip speed turbine engine compressor development work will be initiated. A new start in high temperature, long duration combustor liners for strategic ramjets is planned. Because of the variation in properties of the sources of alternate turbine engine fuels, work is planned to develop analysis methods to test them. An effort is planned to investigate performance sensitivities to configuration changes of high performance space qualified gallium arsenide solar cells as a precursor to a low cost manufacturing technology program.

4. FY 1982 Planned Program: Many of the above efforts plus others will continue. Work on a very high pressure ratio centrifugal compressor stage will be initiated. A program to improve the technology in aircraft fire and explosion vulnerability protection methods is planned for this year. Exploratory development in advancing hardening technology for spacecraft power systems from natural and induced threats will start.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Program Element: #62203F
DCD Mission Area: Engineering Technology (ED), #523

Title: Aerospace Propulsion
Budget Activity: Technology Base #1

7. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	40,880	42,800	46,500	49,300	Continuing	N/A
06CL	Laboratory Operations	12,000	12,000	12,200	12,500		
3012	Ramjet Technology	3,800	5,600	5,225	5,200		
3048	Fuel, Lubrication & Fire Proection	4,590	5,000	5,275	5,980		
3066	Turbine Engine Technology	14,550	13,600	16,500	17,150		
3145	Aerospace Power Technology	5,940	6,600	7,300	8,470		

Changes are reflected in the FY 81 program due to the additive costs of the 1 October 1979 civilian pay raise, revised estimates of reimbursement for support provided to other programs and agencies, and the goal to achieve five percent real growth in the total Air Force Exploratory Development Program. Project changes in FY 1980 and FY 1981 reflect increased emphasis in alternate turbine engine fuels technology.

Project: #06CL — Title: Air Force Aero Propulsion Laboratory Operation
Program Element:: #62203F — Title: Aerospace Propulsion
DOD Mission Area: Engineering Technology (ED), #523 — Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the support activities required to operate the Air Force Aero Propulsion Laboratory's (AFAPL) exploratory and advanced development programs. The laboratory provides technical support to current and future systems programs and undertakes operational support projects in its mission areas. The project provides for the pay and related costs of civilian scientists, engineers, and supporting personnel, travel, transportation, rents, communications and utilities costs, procurement of supplies and equipment, and contractor support service.

RELATED ACTIVITIES: This project supports and complements all of the technical projects under this program element, as well as all other projects and programs managed by AFAPL, such as PE 63202F, Advanced Propulsion Subsystems Integration; PE 63215F, Aviation Turbine Fuels Technology; PE 63216F, Advanced Turbine Engine Gas Generator; PE 63246F, Aircraft Subsystems Technology; PE 63401F, Space Vehicle Subsystems, under which AFAPL directs Project 682J, Advanced Space Power; and PE 63723F, Civil and Environmental Engineering Technology. Direct costs incurred by these advanced development programs are reimbursed by these programs to this project.

WORK PERFORMED BY: The AFAPL, Wright-Patterson AFB, OH, is the organization responsible for management of the projects included under the program element.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: Plans and accomplishments of Air Force Aero Propulsion Laboratory are discussed in the descriptive summaries for the overall program element and individual projects included in this submission.

1. Program to Completion: This is a continuing program.

2. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	12,800	13,200	14,200	14,400	Continuing	Not Applicable

3. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Project 06CL	12,000	12,000	12,200	12,500	Continuing	Not Applicable

Changes are reflected in the FY 1979, 1980, and 1981 programs due to the additive cost of the 1 October 1979 civilian pay raise and revised estimates of reimbursement for support to other programs and agencies.

Project: #3012
Program Element: #62203F
DOD Mission Area: Engineering Technology (ED), #523

Title: Ramjet Technology
Title: Aerospace Propulsion
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project develops ramjet component and engine technology to improve performance and reduce costs of strategic and tactical air-launched missiles, drones, and remotely piloted vehicles. Ramjet propulsion concepts being evaluated include: a liquid fuel integral rocket-ramjet (IRR) for volume limited long-range high-speed missiles; various ramjet configurations for simple inexpensive tactical missiles utilizing solid fuels; and a gas generator fueled "ducted rocket." These efforts include component development of inlets, combustors, nozzles, fuel controls, and engine technology demonstrators.

RELATED ACTIVITIES: This program is closely coordinated and includes jointly funded efforts with: the Navy on solid fuel ramjets; the Air Force Rocket Propulsion Laboratory on ducted rockets and the Air Force Materials Laboratory on engine structures. Ramjet technology supports the requirements of PE 63313F, Advanced Missile Subsystems Demonstration; PE 63314F, Strategic Bomber Enhancement; and PE 63302F, Advanced Missile Propulsion. This program focuses on the propulsion requirements of the Aeronautical Systems Division, Wright-Patterson AFB, OH, and the Armament Division at Eglin AFB, FL. Program coordination is maintained through meetings, conferences and the Joint Army-Navy-NASA (National Aeronautics and Space Administration)-Air Force (JANNAF) Interagency Propulsion Committee.

WORK PERFORMED BY: This project's in-house and contractual efforts are managed and performed by the Air Force Aero Propulsion Laboratory, Wright-Patterson AFB, OH. The contractors in FY 1979 were: The Marquardt Co., Van Nuys, CA: Chemical Systems Division of United Technologies Corp., Sunnyvale, CA; McDonnell Douglas, St. Louis, MO: Williams Research Corp., Walled Lake, MI; Atlantic Research Corp., Alexandria, VA; Analytic Services, Inc., Arlington, VA: and Acurex Corp., Mountain View, PA. These contractors were involved in 22 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Significant strides in high temperature ramjet combustor components have been achieved. Free jet testing (i.e., simulated flight testing) of ducted rockets have been accomplished. A variable geometry nozzle insert for advanced strategic air launched missiles with significant range increase has been demonstrated.

2. FY 1980 Program: Variable fuel flow ducted rocket ramjet propulsion subsystems will be continued. Very high temperature combustors for strategic ramjets, advanced cruise missile inlets and nozzles componentry, low cost fuel controls, and advanced fuels development programs and preliminary work in advanced air-to-ground ramjets will be initiated. Other FY 1979 and prior year efforts will continue.

Project: #3012

Title: Ramjet Technology

Program Element: #62203F

Title: Aerospace Propulsion

DOD Mission Area: Engineering Technology (ED) ,#523

Budget Activity: Technology Base #1

3. FY 1981 Planned Program: Most programs in progress in FY 1980 will continue. Propulsion system level work for a simplified integral boost-sustainer solid fuel ramjet will be initiated. A fuel control system development that utilizes advanced fuels and operates with variable inlets and nozzles will start. Preliminary work on a variable geometry ramjet propulsion subsystem is planned.

4. FY 1982 Planned Program: Programs described above and others will continue. Ducted rocket ramjet technology previously developed in small diameters is now planned for a scale up to larger diameters for greater payload and range capability. Cruise missile and tactical missile exploratory technology programs will continue. New starts in cruise missile fuel controls and engines, scale up of variable flow ducted rocket engines and improved boost motor/sustained engine integration.

5. Program to Completion: This is a continuing program.

6. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E: Funds	5,600	4,900	5,600	6,400	Continuing	Not Applicable

7. Comparison With FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Project: 3012	3,800	5,600	5,225	5,200	Continuing	Not Applicable

Adjustments are level of effort changes within Program Element and reflect an increase in emphasis in variable flow ducted rockets and a decrease in emphasis for liquid fueled ramjets.

Project: #3048 Title: Fuels, Lubrication & Fire Protection Technology
Program Element: #62203F
DOD Mission Area: Engineering Technology (ED), #523 Title: Aerospace Propulsion
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: Efforts under this project are oriented toward providing fuels management technology, lubricants and lubrication techniques, bearing and gear technology, and fire protection methods and techniques which will satisfy the stringent requirements of present and future weapons systems. Approaches to meet the objectives of this project include the evaluation of fuels from sources other than petroleum, development of fuels and lubricants with improved high temperature characteristics, development of advanced fuel management concepts and lubrication techniques, development of advanced bearing and gear concepts; and development of hazard protection capability for the effective prevention and control of fire and explosion associated with flight vehicle combustibles.

RELATED ACTIVITIES: This project provides technology for PE 62102F, Materials; PE 63202F, Aircraft Propulsion Subsystems Integration; PE 63215F, Aviation Turbine Fuels Technology; PE 63216F, Advanced Turbine Engine Gas Generator; PE 63244F, Aircraft Non-Nuclear Survivability; and PE 63246F, Aircraft Subsystems Technology. Coordination with the Army, Navy, National Aeronautics and Space Administration(NASA), the Defense Fuels Supply Center, the Fuels and Lubricants Standardization efforts of the North Atlantic Treaty Organization (NATO), and the Department of Energy (DOE) is accomplished by a broad spectrum of interactions and exchanges.

WORK PERFORMED BY: The work is managed and performed by the Air Force Aero Propulsion Laboratory (AFAPL), Wright-Patterson Air Force Base, OH. The 10 major contractors for FY 1979 were: Teledyne Industries, Inc., Toledo, OH; Systems Research Lab, Inc., Dayton, OH; UOP, Inc., Des Plaines, IL; AiResearch Manufacturing Co., Phoenix, AZ; Falcon Research & Development Co., Denver, CO; Monsanto Research Corp., Dayton, OH; The Boeing Company, Seattle, WA; Sun Oil Company, Marcus Hook, PA; United Technologies Corp., West Palm Beach, FL; and University of Dayton, Dayton, OH.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The technology developed under this project has led to the qualification of Department of Defense fuels and lubricants such as JP-4, JP-5, JP-7, JP-8 (the NATO standard fuel), JP-9, and JP-10. An anti-static electricity additive has been developed and incorporated into JP-4 and JP-8 thereby eliminating an explosive refueling problem. Experimental work has been conducted on fuel tank fire and explosion vulnerability to high energy lasers. Representative Air Force turbine engine combustors have undergone preliminary screening tests with alternate fuels. A new ramjet fuel, RJ-6, specification for the Advanced Strategic Air Launched Missile was developed to provide better low temperature properties.

2. FY 1980 Program: Work of the nature described above from prior years plus others will continue. Several alternate fuels combustion research programs will be awarded this year. Combustor rig testing of alternate fuels will be developing the data base for gas generator level turbine engine testing. Work on non-conventional combustion processes such as reforming to reduce carbon formation thereby reducing smoke will start this year.

3. FY 1981 Planned Program: Previously described efforts and others will continue. A new model for fire/explosion vulnerability and protection techniques will be initiated. Other new starts include large engine foil bearing feasibility, additional alternate fuels efforts to accelerate the technology base in this critical area, and large scale aircraft dynamic fire protection testing in conjunction with the Federal Aviation Administration.

Project: #3048 Title: Air Force Aero Propulsion Laboratory Operation
Program Element: #62203F Title: Aerospace Propulsion
DOD Mission Area: Engineering Technology (ED), #523 Budget Activity: Technology Base #1

4. FY 1982 Planned Program: Most effort previously described and others will continue. New starts are planned in antioxidants, additives for lubricants, advanced roller bearing work, and boron slurry fuels for cruise missiles.

5. Program to Completion: This is a continuing program.

6. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	4,800	6,700	9,100	9,600	Continuing	Not Applicable

7. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Project 3048	4,590	5,000	5,275	5,980	Continuing	Not Applicable

This change represents a significant increase in emphasis on technology for alternate fuels.

Project: #3066
Program Element: #62203F
DOD Mission Area: Engineering Technology (ED), #523

Title: Turbine Engine Technology
Title: Aerospace Propulsion
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project develops technology to achieve the major turbine engine goals which include: increased operational reliability, cycle flexibility and performance; and reduced fuel consumption, weight, acquisition and operational costs. Analytical and experimental efforts to achieve these objectives address: fans and compressors, high temperature combustors, turbines and seals, controls, diagnostics, mechanical design techniques and environmental considerations. The project considers the total propulsion system (inlet, engine, nozzle) and its integration into a weapon system.

RELATED ACTIVITIES: This project is coordinated with the Navy, Army, National Aeronautics and Space Administration (NASA), Department of Energy (DOE), and the Department of Transportation in meetings, inter-service committees and headquarters staff coordination. Component advancements are integrated into PE 63201F, Advanced Propulsion Subsystems Integration; PE 63216F, Advanced Turbine Engine Gas Generator; and PE 63246F, Aircraft Subsystem Technology. Jointly funded programs with the Navy, NASA and the Air Force Materials Laboratory are developing advanced turbine engine component technology for future applications

WORK PERFORMED BY: Work is managed by the Air Force Aero Propulsion Laboratory, Wright-Patterson AFB OH. The ten major contractors in FY 1979 were: Cadre Corporation, Doraville GA; Pratt and Whitney Aircraft Division of United Technologies Corporation, East Hartford CT and West Palm Beach FL; Garrett Corporation, Los Angeles CA and Phoenix AZ; General Electric Company, Evendale OH and Lynn MA; Detroit Diesel Allison Division of General Motors, Indianapolis IN; Calspan Corporation, Buffalo NY; McDonnell Douglas Corporation, St Louis MO; Systems Control, Inc, Palo Alto CA; Mechanical Technology, Latham NY; and the University of Dayton, Dayton OH. There are 19 contractors with 71 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Significant accomplishments included: demonstrated the advanced "high throughflow" compressor concept which is 50% shorter and has 60% fewer parts than compressors in current operational/development engines; extensive testing validated the durability and maintainability of the shingle liner combustor; development of a high pressure single stage centrifugal compressor offering a potential 40% cost reduction for turbofan engines; and the adoption by industry of a validated three-dimensional stress analysis to improve turbine blade mechanical reliability. Additionally, contractor acceptance, through independent testing, of several inhouse theoretical models will help define life cycle cost and performance.

Project: #3066
Program Element: #62203F
DOD Mission Area: Engineering Technology(ED), #523

Title: Turbine Engine Technology
Title: Aerospace Propulsion
Budget Activity: Technology Base #1

2. FY 1980 Program: Many programs already underway will continue. Major efforts include shakedown and calibration of the compressor research facility and initiation of research testing turbine engine componentry with emphasis on improved mechanical design and analysis methods, test techniques, design criteria, and development procedures necessary to the achievement of improved structural durability and life. New starts include advanced multivariable turbine engine controls, high tip speed combustors, advanced shroud seals, and high temperature turbines for small engines.

3. FY 1981 Planned Program: Many of the FY 1980 programs will continue. New starts are planned in advanced fault tolerant digital controls, rotor flutter phenomena, transonic turbine flow, compressor rub dynamics, turbine engine materials life cycle analysis, and new high energy fuels testing.

4. FY 1982 Planned Program: A large portion of the previously described efforts plus others will continue. New starts include turbine engine digital control integration, high pressure ratio centrifugal compressor, advanced compact combustor, turbine vane design, turbine engine structural/material studies, turbine engine diagnostic studies, expendable turbine engines.

5. Program to Completion: This is a continuing program.

6. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	13,600	15,000	16,900	20,300	Continuing	Not Applicable

7. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to completion	Total Estimated Costs
Project 3066	14,550	13,600	16,500	17,150	Continuing	Not Applicable

Adjustments have been made in FY 1980 to augment Project 3048, Fuels, Lubrication & Fire Protection Technology in the area of alternate turbine engine fuels technology.

Project: #3145
Program Element: #62203F
DOD Mission Area: Engineering Technology (ED), #523

Title: Aerospace Power Technology
Title: Aerospace Propulsion
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project includes the development of solar power, fuel cells, batteries, hydraulics and power conversion, conditioning and transmission for both space and non-space applications. These analytical and experimental efforts form a balanced, broad base in power subsystem technology responsive to anticipated needs of aeronautical, missile, space and electronic systems including special ground power needs. General goals of these are increased power output, decreased weight and volume, decreased vulnerability, increased life and reliability, increased tolerance to environments, and provision of effective options in technology and capabilities for future systems application in the conceptual stage. The Air Force Aero Propulsion Laboratory (AFAPL) provides a single point of technical management for these programs within the Air Force. A strong technological base has been established for these efforts by extensive work in prior fiscal years. This program emphasizes chosen options for specific power subsystem technologies to provide improved capabilities for near-term applications and more advanced technology for long-term Air Force power demands.

RELATED ACTIVITIES: The Army, Navy, Department of Transportation (DOT), Department of Energy (DOE), and National Aeronautics and Space Administration (NASA) have exploratory development programs in areas related to this project to support their respective and unique requirements for systems and supporting subsystems. Coordination is maintained at all levels through symposia, meetings, professional associations and the Interagency Advanced Power Group. This program receives inputs and provides technology for PE 61102F, Defense Research Sciences; PE 62102F, Materials; PE 62204F, Aerospace Avionics; PE 62601F, Advanced Weapons; PE 63246F, Aircraft Subsystems Technology; PE 63401F, Space Vehicle Subsystems; PE 63605F, Advanced Radiation Technology; and PE 63723F, Civil and Environmental Engineering Technology.

WORK PERFORMED BY: Work is managed and performed by the AFAPL at Wright-Patterson AFB, OH. Other Air Force organizations involved are the Aeronautical Systems Division, Wright-Patterson AFB, OH, and the Space Division, El Segundo, CA; Ballistic Missile Office, San Bernadino, CA; and the Air Force Engineering and Services Center, Tyndall AFB, FL. The ten major contractors are: Eagle Picher Industries, Inc., Joplin, MO; Teledyne CAE, Toledo, OH; General Electric Company, Erie, PA; Rockwell International Corporation, Canoga Park, CA; AiResearch Manufacturing Company, Phoenix, AZ; Southeastern Center for Electrical Engineering, Auburn, AL; University of Dayton, Dayton, OH; Magnetic Corp. of America, Sunnyvale, CA; and Hughes Aircraft, Los Angeles, CA. There are 29 contractors with 52 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Representative accomplishments under this program include the development of a permanent magnet aircraft generator which is much simpler and more reliable than conventional devices, the demonstration of an advanced solar cell which is more efficient than any currently used device and the transition to industry of a revolutionary cell separator material for nickel-cadmium battery which eliminates the dangerous "thermal runaway" problem in aircraft batteries. Advances in high power technology have included demonstration of a lightweight Magnetohydrodynamic (MHD) channel, inverters and switches. System level specifications for high power equipment have been written which will now become the industry standard. Metal-gas batteries for space applications are transitioning to PE 63401F, Space Vehicle Subsystems. These batteries have the capability of doubling the storage capacity and increasing life expectancies by at least 50% over batteries in current satellites.

Project: #3145 Title: Aerospace Power Technology
Program Element: #62203F Title: Aerospace Propulsion
DOD Mission Area: Engineering Technology (ED), #523 Budget Activity: Technology Base #1

2. FY 1980 Program: In the continuing effort to meet military requirements, the next generation spacecraft solar cells will be hardened against natural and hostile radiation effects in a program initiated this year. Studies investigating military uses of fuel cells for mobile systems and energy storage strategies for remote renewable energy systems will begin. High power liquid oxygen/JP-4 gas generators will move into the demonstration phase of their development. Hydraulic systems compatible with new nonflammable hydraulic fluids will begin testing and qualification. Other tasks will start plus many programs previously started will continue.

3. FY 1981 Planned Program: Previously described programs plus others will continue. New starts are planned in thermal energy storage systems for spacecraft, component improvements in metal-gas spacecraft batteries, exploratory development in new high energy density spacecraft batteries, fuel cell applications for mobile systems,and thermal storage systems for remote sites, high power switches, rechargeable lithium batteries for missile ground support systems, high efficiency hydraulic system energy management, low cost jet fuel turbine engine starters, and studies in high power measurement techniques.

4. FY 1982 Planned Program: Programs described above plus others will continue. New starts are planned in development of multi-threat hardening systems, heat engines for military terrestrial applications, pulsed high power system component development, low temperature thermal batteries, advanced low cost auxiliary power units, and high power systems protection devices.

5 Program to Completion: This is a continuing program.

6. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	6,600	6,700	7,700	10,400	Continuing	Not Applicable

7. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Project 3145	5,940	6,600	7,300	8,470	Continuing	Not Applicable

Adjustments are level of effort changes within Program Element for FY 1980 and augmentation of the alternate fuels program in Project 3048 for FY 1981.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62204F
LOD Mission Area: Electronics & Physical Sciences, 521

Title: Aerospace Avionics
Budget Activity: Technology Base #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	54,945	55,200	56,800	58,800	Continuing	Not Applicable
06CQ	Air Force Avionics Laboratory Operations	20,402	21,600	23,200	23,500		
2000	Active Electronic Countermeasures	3,565	3,300	3,400	3,600		
2001	Electro-Optical Technology	2,662	3,000	3,000	3,000		
2002	Microwave Technology	6,391	6,000	5,800	5,900		
2003	Avionic System Design Technology	3,367	3,940	4,040	4,300		
2004	Technology for Reconnaissance and Targeting Avionics	1,952	2,100	2,200	2,300		
2623	Very High Speed Integrated Circuits	60	0	0	0	0	60
6095	Inertial Reference and Guidance Technology	1,913	2,100	2,100	2,200		
6096	Microelectronics Technology	4,849	4,500	4,100	4,100		
7622	All-Weather Recce/Strike Avionics	3,020	2,500	2,500	3,000		
7629	Fire Control Avionics	2,258	2,300	2,400	2,500		
7633	Passive Electronic Countermeasures	3,074	2,700	2,800	3,100		
7662	Avionic Data Transmission & Reception	1,432	1,160	1,260	1,300		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops avionics technology which improves the functions of aerospace vehicle command, control, navigation, penetration, defense, reconnaissance, fire control, and weapon delivery Increasing threats; rising acquisition, operations, and maintenance costs; aging equipment in the inventory; and a virtual explosion of technological opportunity all dictate the need for developing improved avionics capabilities.

Program Element: 62204F
DOD Mission Area: Electronics & Physical Sciences, 521

Title: Aerospace Avionics
Budget Activity: Technology Base #1

These improvements will result in better performance, lower life cycle cost, higher reliability, and greater mission effectiveness singly in some developments and in combination in other developments. The program also provides for the operations and management of the Air Force Avionics Laboratory at Wright-Patterson AFB OH.

BASIS FOR FY 1981 RDT&E REQUEST: This is a program to provide technology developments in support of aerospace vehicle command, control, navigation, penetration, defense, reconnaissance, fire control, and weapon delivery. Major emphasis is placed on developing techniques, components, subsystems, and avionics system architectures which reduce life cycle costs, and which improve avionics reliability, mission effectiveness, and survivability.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: 62204F
DOD Mission Area: Electronics & Physical Sciences, 521

Title: Aerospace Avionics
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This program develops the technology which is used in upgrading present avionics systems and which will be used in avionics systems of the future. Items developed range from devices such as integrated circuits, improved avionics components, gyroscopes and radar signal processors, to concepts for the architecture of total avionics systems. Efforts may be grouped into four categories: Avionics Electron Devices; Electronic Warfare Technology; Reconnaissance, Navigation, Weapon Delivery and Fire Control Technology; and Avionics Systems Technology. Efforts within the Electron Device area develop the electronic building blocks for all avionics systems. Devices developed fall into three categories. Electro-optical devices include such items as low energy lasers, electro-optical detectors, light modulators, beam deflectors, fiber optic devices and integrated optical circuits. Microwave devices include items such as microwave tubes; solid state microwave diodes and transistors for detection, amplification, and modulation of microwave signals; microwave integrated circuits; antennas; and radomes. Microelectronic devices include items such as small-, medium-, large-, and very large-scale integrated circuits and hybrid circuits for a whole host of avionics signal and data processing and storage applications. In addition to developing the electron devices themselves the associated processing, materials and packaging technologies are developed to insure usability in the avionics environment. Main thrust areas are frequency agile lasers for countermeasures applications, microwave low noise and power transistors and traveling wave tube technology for radar and electronic warfare applications, gallium arsenide and silicon integrated circuits for extremely high speed signal processing applications, and magnetic bubble memory technology for non-volatile mass memory with no moving parts. Efforts in Electronic Warfare Technology develop jammer and threat warning receiver techniques and components against threats in the radio, microwave, infrared and visible spectra. Also developed are chaff; decoys; camouflage; and equipment for electronic, optical, and radiation intelligence collection. The objective of the developments is to affordably increase the chances of Air Force aircraft and aircrews penetrating enemy airspace and returning home safely. Major thrusts are in monopulse radar countermeasures, command, control, and communications countermeasures and optical/infrared countermeasures technology. The objective of Reconnaissance, Navigation, Weapon Delivery and Fire Control Technology efforts is to enable Air Force aircraft to accomplish their intended missions at the least cost. To do this, targets must be found and classified; aircrews must know where they are with respect to the target; and bombs, missiles, and bullets must be directed to the targets. To find and classify targets, techniques, components and subassemblies are developed for radar, optical and infrared reconnaissance. To get the aircraft to the target (and home again) navigation and inertial reference concepts and components are developed. Radar and electro-optical components and techniques for air-to-air and air-to-ground weapon delivery and fire control systems are developed to get the firepower in the target. An integral part of developing the hardware to do these jobs effectively at low cost is the development of the software to control hardware and aid the aircrew in distinguishing targets from non-targets. Major thrusts are technology for automatic target classification, fire control algorithms for improved probability of kill, improved inertial sensors, synthetic aperture radar techniques, and laser radar for improved tactical weapon delivery. The objectives of the efforts in Avionics Systems Technology are to provide the concepts, techniques, and equipment to integrate the subsystems within an avionics suite so that: (1) information can be exchanged among subsystems effectively; (2) unnecessarily redundant components may be eliminated; (3) the avionics system will be able to function effectively even when devices fail or battle damage is sustained; (4) avionics can be upgraded economically; and (5) command and control links into, out of and within the aircraft are effectively

maintained. Major thrusts are development of technology for fault tolerant systems, exploitation of microprocessors embedded in avionics architecture, and jam resistant video data links for weapon delivery. This program element, in addition to being the primary technical base exploratory development effort in Aerospace Avionics, provides technical support to the Air Force and DOD agency programs and receive partial reimbursement for the services provided. In the case of basic research accomplished by the laboratory, full reimbursement is provided by Program Element 61102F. The project break reflects the best estimate considering these anticipated reimbursements, but may require adjustment to the degree that reimbursements are actually earned.

RELATED ACTIVITIES: Tri-Service and interagency coordination is continually accomplished. All electron device work is coordinated through the Advisory Group on Electron Devices which advises the Office of the Undersecretary of Defense for Research and Engineering (OUSDRE). All work on fiber optics components and systems applications is coordinated through the Tri-Service Fiber Optics Coordinating Group. Developments in thermal imaging are coordinated through the Night Vision Technology Panel under the Joint Development Laboratory Commanders (JDLC) which, in turn, is under the Joint Logistics Commanders (JLC). A Tri-Service effort to standardize electronic countermeasures power chains and traveling wave tubes is occuring under JDLC auspices. All electronic warfare efforts are coordinated through the Countermeasures Subgroup of the Aircraft Survivability Joint Technical Coordinating Group (JTCG) under the JLC. In addition, work in infrared countermeasures and missile launch detection is coordinated through an annual review by OUSDRE. A joint Air Force - Army program to improve electronics reliability and maintainability through improved design methodology is proceeding under the JTCG for Reliability, Availability and Maintainability. Ring laser gyro work is coordinated through the Joint Services Guidance and Control Committee under OUSDRE. The Naval Weapons Center and the Air Force Avionics Laboratory (AFAL) have a memorandum of agreement to develop a new concept in tail warning radar. The Services and the National Aeronautics and Space Administration (NASA) are cooperating in developing a nuclear magnetic resonance gyroscope. AFAL and the Navy are cooperating in the development of strapdown (non-gimballed) inertial sensors and their associated software. NASA and AFAL are coordinating their magnetic bubble memory developments to prevent duplication. AFAL, Navy, Army, and the Defense Advanced Research Projects Agency are cooperating in the development of mercury cadmium telluride focal planes for thermal imaging applications. Related Activites include: Defense Research Sciences, 61102F; Aerospace Flight Dynamics, 62201F; Materials, 62102F; Command, Control, and Communications, 62702F; Advanced Avionics for Aircraft, 63203F; Reconnaissance Sensors/Processing, 63208F; Electronically Agile Radar, 63241F; Digital Avionics Information System, 63243F; Strategic Bomber Enhancement, 63314F; Space Vehicle Subsystems, 63401F; Advanced Space Communications, 63431F; Conventional Weapons, 63601F; Advanced Radiation Technology, 63605F; Electronic Warfare Technology, 63718F; Advanced Communications Technology 63727F; Air-to-Air Identification of Non-Cooperative Targets, 63742F; Electro-Optical Warfare, 63743F; Counter-Countermeasures Advanced Development, 63740F; Aircraft Avionics, 62202A; Electronic and Electron Devices, 62705A; Tactical EW Technology, 62715A; RPV Supporting Technology, 62732A; Aircraft Avionics Equipment, 63207A; Night Vision Investigations, 62709A; Night Vision Advanced Development, 63710A; Electron Device Technology, 62762N; Avionics, 63202N; Advanced Electron Device Development, 63742N; Airborne Electromagnetic/Optical Systems, 63797N; and Very High Speed Integrated Circuits, 62704F.

Program Element: 62204F
DOD Mission Area: Electronics & Physical Sciences, 521

Title: Aerospace Avionics
Budget Activity: Technology Base #1

WORK PERFORMED BY: The Air Force Avionics Laboratory (AFAL), Wright-Patterson AFB OH, manages the work performed under this program. Specialized facilities operated by AFAL in support of this program include: The Electronic Warfare Anechoic Chamber, Electronic Defense Evaluator, Dynamic Electromagnetic Environment Simulator, Dynamic Analyzer, Avionics System Analysis and Integration Laboratory, Solid State Fabrication Facility, Hybrid/Printed Circuit Facility, Computer-Aided Design Facility, Mobile Evaluation Laboratory, Reference System Software and Evaluation Laboratory, 100-Inch Collimator, Laser Research Laboratory, Radar Reflectivity Measurement Facility, Targeting Systems Characterization Facility, Global Positioning System Evaluation Facility, Ring Laser Gyro Laboratory, and Radar Signal Processing Laboratory. The ten major contractors were: Hughes Aircraft Co., Malibu, Torrance, and Culver City CA; Raytheon Co., Waltham and Bedford MA; Goodyear Aerospace, Akron OH; Systems Research Laboratories, Inc., Dayton OH; Texas Instruments, Inc., Dallas TX; TRW, Inc., Redondo Beach CA; General Electric Co., Utica NY; Environmental Research Institute of Michigan, Ann Arbor MI; International Telephone and Telegraph Corp., Nutley NJ; and Northrop Corp., Rolling Meadows IL. In addition there were 104 other contractors located nationwide with 184 contracts. In all there were 331 contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In the Avionics Electron Device area the following are highlights. A self-heated lead vapor laser was demonstrated and transitioned to an optical search development. The final design review was completed on the first integrated optical circuit spectrum analyzer (to reduce size weight and cost of electronic countermeasures receivers). A charge coupled device detector was demonstrated and the final design was completed for a strapdown star sensor to reduce satellite attitude control subsystems costs. An in-house gallium arsenide integrated pilot line was established to create militarily useful functions for which processing speeds greater than those for Very High Speed Integrated Circuits are required. Several integrated circuits and silicon detectors were designed and built in-house and delivered to the users. These devices solved availability problems for Space Division; the Maverick System Program Office; and the San Antonio and Warner Robins Air Logistics Centers. Significant improvements were made in microwave field effect transistors (FETs). Five Watt FETs were combined to achieve tens of Watts output power in x-band for radar and countermeasures applications. Silicon diodes and combiners with improved bandwidth efficiency and power were demonstrated. These solid state devices are leading to replacement of low to medium power tubes. Novel millimeter wave circuit concepts were developed which promise to yield fabrication cost savings in traveling wave tubes on the order of 90%. In the Electronic Warfare Technology area the following are highlights. Positive breaklocks were demonstrated against Two techniques for countering a were evaluated to be very effective in a laboratory environment. Evaluation of the was successfully completed. This system would be used against air-to-air missiles. The High Probability of Intercept Receiver was transitioned to Program Element 63718F, Electronic Warfare Technology for use in the Advanced Power Management System.

Program Element: 62204F
DOD Mission Area: Electronic & Physical Sciences, 521

Title: Aerospace Avionics
Budget Activity: Technology Base #1

Technology for operating the in a jamming environment was transitioned to the System Program Office. Construction began on an aircraft rotation platform to be used for measuring laser backscatter of operational aircraft and evaluating backscatter reduction coatings. In the Reconnaissance, Navigation, Weapon Delivery and Fire Control area the following are highlights. The fabrication of the processor hardware was completed in the Real Time 3D Target Classifier effort. This is a downward looking system which can speed the reconnaissance process by automatic classification of tactical targets. This effort will lead into the Forward Looking Active Classification effort which will help relieve pilot workload on air-to-ground strike. Feasibility of making molded (rather than machined) inertial gyro parts to reduce costs of missile grade gyros was demonstrated, breadboard models were designed, and tests of the gyros started. The Global Positioning System Evaluator was installed. This system is to be used for evaluating Global Positioning System receivers in a jamming environment. The Laser Gyro Laboratory was partially set up and automated to gather mirror characterization to improve ring laser gyros. A technique to recover the radar signal in the presence of heavy jamming has been developed and laboratory tested. The technique, Heterodyne Look-through will be tested in an APG-63 (F-15 radar). All subsystems of an electro-optical director fire control system were delivered and laboratory tested prior to shipping them to Air Defense Weapon Center for flight test. In the Avionics Systems Technology area the following were highlights. MIL-STD-1750 was published establishing the Air Force standard architecture for airborne computers. An evaluation of the new DOD computer language Ada was performed and the results presented to the Office of the Undersecretary of Defense for Research and Engineering. These efforts are designed to lower software costs. A wideband spread spectrum modulator-demodulator was developed for use in image transmission from weapons or remotely piloted vehicles for guidance and control in a jamming environment. The modulator demodulator was transitioned to Program Element 63727F, Advanced Communication techniques.

2. FY 1980 Program: In the Avionics Electron Devices area the following are highlights. A feasibility model of a ten Watt carbon dioxide laser is being demonstrated for tactical laser radar applications. Avalanche photodiode detectors for weapon delivery applications will be demonstrated. A new effort is being started to develop high power, reliable gallium arsenide microwave power diodes at 10 and 20 gigahertz continuous operation with greater efficiency. Applications are in radar and countermeasures. The development of millimeter wave power tubes for potential countermeasures applications is being emphasized. A transistor power combining effort will demonstrate 40 watts continuous wave at x-band for radar applications. Gallium Arsenide integrated circuit technology is seeking a planar (high circuit density) process compatible with electron beam patterning. Applications for these circuits are in signal processing for radar, imagery, and countermeasures. Processing speeds will be beyond the range contemplated for Very High Speed Integrated Circuits. A magnetic bubble device technology effort will develop the base for multi-gigabit space recorders for Space Division. A previously developed radiation hardened microprocessor chip set will be programmed to carry out the MIL-STD-1750 instruction set. In the Electronic Warfare Technology are the following highlights. Monopulse countermeasures and pulse doppler radar countermeasures are receiving emphasis. An effort to counter
is starting. Efforts are starting to develop counters to
range is being developed. An effort is starting to develop in the millimeter wavelength range. In the

Reconnaissance, Navigation, Weapon Delivery, and Fire Control area are the following highlights. The multifunction tactical laser radar technology effort is starting to develop a high resolution sensor for close in tactical weapon delivery. Extension of the 3-D target classification technology to forward looking applications is beginning. The Spin Coupled Accelerometer Gyro (which lowers the inertial measurements unit parts count) will be completed. Development of two ring laser gyros with non-dithered mirrors has begun. Design of two nuclear magnetic resonance gyros (which have no moving parts and are smaller than ring laser gyros) is beginning. The Heterodyne Lookthrough electronic counter-countermeasure technique will be evaluated on the APG-63 radar. The survivable radar technology (hard to detect, hard to jam) is receiving major emphasis. Studies are being completed on air-to-ground integrated strike avionics configurations and the concept definition for an infrared search and track set for interceptor application. New initiatives deal with offensive fire control for long range air-to-air target detection and definition of air-to-air multiple targeting under the Tactical Air-to-Air Coupling System. In the Avionics Systems Technology area highlights follow. Design of the Electronic Terrain Map is being completed and development of the brassboard development will start. This is an electronically generated map to aid aircrews. Studies of avionics computers architectures which integrate complicated systems containing more than one data bus is underway. Initial testing of three members of the Avionics Computer Family from three different contractors will begin. This effort seeks to reduce software costs by using hierarchical systems with upward compatible software. A MIL-STD-1553 compatible fiber optic data bus is being installed in the in-house system avionics simulation facility and testing will begin. Technology risk reduction efforts are beginning in support of the Integrated Communication, Navigation, and Identification Avionics work in Program Element 63727F, Advanced Communications Technology.

3. FY 1981 Planned Program. In the Avionics Electron Devices area the following are highlights. Feasibility of using eximer lasers and a solid state pump laser for near infrared countermeasures applications will be demonstrated. Also demonstrated will be the detector for a tactical laser radar. Work will begin on an optimized version of the ten watt carbon dioxide laser for a tactical laser radar. The first integrated optic spectrum analyzer chip will be delivered. Integrated optics offers advantages in size, weight and cost in radio frequency warning receivers. Work in microwave solid state devices will continue to push power, efficiency, bandwidth and low noise in order to replace tubes at low to medium powers. Low noise field effect transistor work will be developed at frequencies up to 60 gigahertz for communications, radar, and countermeasures applications. An x-band crossed field amplifier tube will be demonstrated for multimode (air-to-air and air-to-ground search and track) radar to remove multiple transmitter costs. A transistor power combiner with an output 40 Watt at x-band will be demonstrated. An effort will begin to develop the computer aided design techniques for interconnecting integrated circuits whose clocking rates are beyond those of Very High Speed Integrated Circuits. A new thrust will start in high speed signal processing circuits with applications in electronic countermeasures. In the Electronic Warfare Technology area the highlights follow. Flight tests will begin on potential improvements to the progress.

Program Element: 62204F
DOD Mission Area: Electronics & Physical Sciences, 521

Title: Aerospace Avionics
Budget Activity: Technology Base #1

An effort will start to derive approaches to jamming Development will begin on an system which will have a low false alarm rate. A study will investigate using a In the Reconnaissance, Navigation, Weapon Delivery, and Fire Control areas the highlights follow. The Hybrid Focal Plane Module effort will begin for forward looking infrared (FLIR) applications. It will offer FLIR detectors which do not have the extreme cooling requirements of silicon detectors. The Strategic Application Thermal Imaging Sensor critical components will be demonstrated. Development will begin of a strapped down accelerometer for advanced cruise missile and reentry vehicle guidance. High accuracy ring laser gyros (without dithered mirrors) will be tested at the Central Inertial Guidance Test Facility. The Radar Signal Processing Laboratory will process Spotlight radar data and the radar testbed will be checked out both in support of the survivable radar (hard to detect, hard to jam) technology effort. Development of a terrain following/terrain avoidance electronic counter-countermeasures display to enable the pilot to maintain a safe low altitude control of the aircraft when the automatic terrain following system is jammed. A joint Air Force Avionics Laboratory and Air Force Flight Dynamics Laboratory development will begin in integrated fire control and flight control concentrating on issues of all-weather sensors, multiple targeting and guided weapon delivery. Preliminary design will begin for passive identification using radio frequency emissions. In the Avionics Systems Technology area highlights follow. The Head Up Display (HUD) Technology Demonstration will integrate the liquid crystal display generator and the wide angle holographic optics to give a HUD with a wider usable viewing angle and a longer lived display than is currently available. Verification testing of the three candidates for the MIL-STD-1750 computer family will continue. Adaptive signal processing techniques will be used to design a software programmable aircraft radio system for 1990's use. Image compression work will concentrate on three-dimensional signal processing for video data link application in a jamming environment. Testing of the MIL-STD-1553 compatible fiber optic data bus will be completed. Fiber optics offer immunity from radio frequency interference and low weight.

4. FY 1982 Planned Program: In the Avionics Electron Devices area the following are highlights. An all solid state near infrared laser with wavelength agility will be demonstrated for countermeasure applications. Development of critical components for fiber optic gyros will start. A 250 x 250 cell spatial modulator will be demonstrated for optical signal processing applications. Aluminum gallium arsenide detectors will be demonstrated for applications in uncooled star sensors for satellite attitude control. Evaluation of 100 solid state x-band microwave phased array modules will be completed, and work will begin on a phased array aperture containing 2500 modules. The goal is a tubeless radar with better than 1000 hour mean time between failure. A single bottle dual mode (pulsed and continuous wave) traveling wave tube will be demonstrated for countermeasures applications. A solid state power combiner for replacing medium power tubes in countermeasures applications will be demonstrated. A silicon metal semiconductor field effect transistor integrated circuit demonstration will start. The goal is to combine high speed and low power advantages in a technology not being pursued in Very High Speed Integrated Circuits effort. The magnetic bubble memory four megabit chip will be demonstrated for space data recorder application. Gallium arsenide large scale integrated circuits with clock rates of two to three gigahertz will be demonstrated for extremely high speed processing appli-

cations. In the Electronic Warfare Technology area the following are highlights. The study of countermeasures against the subsystem will be completed. Evaluation of television countermeasures using the will be completed. Efforts in for communications jamming will be transitioned into advanced development. Development will begin using Very High Speed Integrated Circuits for an electronic warfare signal processor. The will be completed. Exploitation of a will be completed. chaff concepts will be developed. In the Reconnaissance, Navigation, Weapon Delivery and Fire Control area the following are highlights. The design and fabrication of a solid state television and forward looking infrared sensor using common optical components will be completed. The object is increased sensor performance usable in day and night. Development of the electro-optical/millimeter wave sensor will continue with the goal of combining the best aspects of each spectral range. The nuclear magnetic gyro brassboard fabrication will begin on this no-moving-parts gyro. Development of radio frequency large scale integrated circuits to reduce the cost of Global Positioning System receivers will be completed. The ring laser gyro laboratory will be converted to a nuclear magnetic resonance gyro laboratory for evaluation of the gyros. The terrain following/terrain avoidance display fabrication will begin. A foliage penetration effort will start in low frequency radar. Two dimensional target recognition techniques will be applied to air-to-air identification. Initial definition studies of a stealthy fire control system will start as will design of an integrated fire control and flight control system for the A-10. In the Avionics System Technology the following are highlights. Performance testing of the Electronic Terrain Map will begin to determine its best use in the cockpit. Flight testing of the Integrated Head Up Display will start. Implementation of a trial system for management of a multi-data bus avionics system will begin. Work will begin on advanced airborne communications signal processing concepts and algorithms compatible with Very High Speed Integrated Circuits. The goal is increased flexibility for meeting new jamming threats and NATO compatibility. New efforts will investigate very wideband image compression techniques to provide jam-resistance in such reconnaissance platforms as the TR-1.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Program Element: 62204F
DOD Mission Area: Electronics & Physical Sciences, 521

Title: Aerospace Avionics
Budget Activity: Technology Base #1

7. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	50,430	56,900	63,200	62,000	Continuing	Not Applicable
06CQ	Air Force Avionics Laboratory Operations	20,900	20,960	22,400	22,900		
2000	Active Electronic Countermeasures	3,130	3,100	3,400	3,800		
2001	Electro-Optical Technology	2,600	2,700	3,000	3,200		
2002	Microwave Technology	4,900	5,000	5,400	5,800		
2003	Avionic System Design Technology	3,500	3,600	3,900	4,200		
2004	Technology for Reconnaissance and Targeting Avionics	2,300	2,400	2,500	2,700		
2623	Very High Speed Integrated Circuits		5,540	8,000	3,500	10,000	27,040
6095	Inertial Reference and Guidance Technology	2,100	2,200	2,300	2,500		
6096	Microelectronics Technology	3,900	4,000	4,000	4,300		
7623	All-Weather Recce/Strike Avionics	1,900	2,000	2,100	2,400		
7629	Fire Control Avionics	1,800	1,900	2,100	2,200		
7633	Passive Electronic Countermeasures	2,400	2,300	2,800	3,000		
7662	Avionic Data Transmission & Reception	1,000	1,000	1,300	1,500		

Changes are reflected in the FY 1980 and FY 1981 program due to the additive costs of the 1 Oct 1979 civilian pay raise and revised estimates of reimbursement for support provided to other programs and agencies. The major change in this program is the removal of all funding in FY 1980 and beyond for the Very High Speed Integrated Circuits (VHSIC) effort from this program element. The Air Force, Army, and Navy funding requested for FY 1980 now appears in Program Element 62704F, Very High Speed Integrated Circuits. This change was made to insure unified management for the VHSIC program. Due to delays in starting the VHSIC program most of the FY 1979 funds were used to fund integrated circuit work outside the VHSIC scope: microwave device development, radar technology advances, and countermeasures technology development.

Project: #06CQ
Program Element: 62204F
DOD Mission Area: Electronics & Physical Sciences, 521

Title: Air Force Avionics Laboratory Operations
Title: Aerospace Avionics
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the support activities required to operate the Air Force Avionics Laboratory (AFAL), Wright-Patterson AFB OH. AFAL is responsible for research, exploratory and advanced development programs concerned with navigation and guidance, weapon delivery and fire control, reconnaissance and aerospace surveillance, aerospaceborne communications, electronic countermeasures, avionic systems architecture and integration, and electronic and electro-optical device technology. The laboratory provides technical support to current and future systems programs and undertakes operational support projects in its mission areas. This project provides for the pay and related costs of civilian scientists, engineers, and support personnel; travel; transportation of equipment; rental equipment, communications and utilities costs; procurement of supplies and equipment; duplication and reproduction services; and contractor support services for maintenance and modification of facilities.

RELATED ACTIVITIES: This project supports and complements all of the technical projects under this program element as well as other projects and programs managed by the AFAL, including: Advanced Avionics for Aircraft, 63203F; Reconnaissance Sensors/Processing Technology, 63208F; Electronically Agile Radar, 63241F; Digital Avionics Information System, 63243F; Electronic Warfare Tecnology, 63718F; Advanced Communications Technology, 63727F; Air-to-Air Identification of Non-Cooperative Targets, 63742F; Electro-Optical Warfare, 63743F; and Counter-Countermeasures Advanced Development, 63750F; and Very High Speed Integrated Circuits, 62704F.

WORK PERFORMED BY: The Air Force Avionics Laboratory, Wright-Patterson AFB OH, is responsible for the management of the projects under this program element.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: The accomplishments and plans for this support program are covered in the Descriptive Summary for the total program element.

1. Program to Completion: This is a continuing program.

2. Milestones: Not applicable.

3. Resources ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	20,402	21,600	23,200	23,500	Continuing	Not Applicable

Project: 06CQ
Program Element: 62204F
DOD Mission Area: Electronics & Physical Sciences, 521

Title: Air Force Avionics Laboratory Operations
Title: Aerospace Avionics
Budget Activity: Technology Base #1

4. Comparison with FY 1979 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	20,900	20,960	22,400	22,900	Continuing	Not Applicable

Changes are reflected in the FY 1980 and FY 1981 program due to the additive cost of the 1 Oct 1979 civilian pay raise and revised estimates of reimbursement for support provided to other programs and agencies.

Project: 2002
Program Element: 62204F
DOD Mission Area: Electronics & Physical Sciences, 521

Title: Microwave Technology
Title: Aerospace Avionics
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides the microwave technology required to improve the performance, reduce the cost, and exploit alternative configurations for the avionics functions of data transfer, weapon delivery, navigation, countermeasures, surveillance, reconnaissance, fire control, and guidance. The scope of activity extends from critical microwave device development through selected equipment feasibility demonstration in the areas of microwave sources, microwave circuits, antennas, radomes, and microwave sensor techniques. The development of device technology and associated circuit techniques which support both high performance and/or low cost system implementations are prime concerns of this project. It also addresses near term needs and the application of current technology to the solution of problems being experienced by production equipment deployed within operational commands. Current needs are for improved solid state microwave power sources having increased power output, efficiency, bandwidth, and frequency of operation. Thermionic tube technology improvements are needed to achieve higher power output, better efficiencies, improved linearity, and lower cost for radar, communication, and countermesures applications. Antenna activities are directed to reducing power losses and improving the cost effectiveness of phased arrays. A millimeter wave technology base, including devices, circuits, and radomes is critically needed to support the anticipated use of these frequencies by future missile terminal guidance sensors. Radome developments are addressing broadband hypersonic missile applications such as the Advanced Strategic Air Launched Missile (ASALM) and broadband millimeter wave terminal guidance sensors.

RELATED ACTIVITIES: The Army, Navy, Defense Advanced Research Projects Agency, and National Aeronautics and Space Administration have exploratory development programs in related areas to support their specific requirements and which also complement those of the Air Force in selected cases. Coordination is accomplished and the risk of duplicative efforts is minimized through the interagency/industrial function of the DOD Advisory Group on Electron Devices and through symposia, meetings and other professional associations. Related activities include: Advanced Avionics for Aircraft, PE 63203F; Electronically Agile Radar, PE 63241F; and Electronic Warfare Technology, PE 63718F. Millimeter wave technology is provided to support PE 63609F, Advanced Attack Weapons; PE 63431F, Advance Space Communications Technology; and PE 63205F, Lincoln Laboratory. Radome Technology is provided to support PE 63314F, Strategic Bomber Enhancement.

WORK PERFORMED BY: The Air Force Avionics Laboratory, Wright-Patterson AFB OH, is the organization responsible for the management of this project. In-house facilities available to support this project include a near field antenna and radome measurement and analysis facility, and a microwave technology laboratory for device circuit and microwave subassembly design fabrication, test, and evaluation. The ten largest contractors were: Hughes Aircraft Co., Malibu, Torrance and Culver City CA; Raytheon Co., Walthan and Bedford MA; Texas Instruments, Dallas TX; Varian, Palo Alto CA and Hayes Middlesex UK; Northrop Corp., Rolling Meadows IL; Motorola Inc., Scottsdale AZ; Georgia Institute of Technology, Atlanta GA; University of Dayton, Dayton OH; Westinghouse Electric Corp., Baltimore MD and Pittsburgh PA; and Spectra Research Systems, Irvine CA. In addition there were sixteen other contractors located nationwide with nineteen contracts. In all there were 64 contracts.

Project: 2002
Program Element: 62204F
DOD Mission Area: Electronics & Physical Sciences, 521

Title: Microwave Technology
Title: Aerospace Avionics
Budget Activity: Technology Base #1

1. FY 1979 and Prior Accomplishments: Solid state device technology continued to improve. Low noise field effect transistors (FETs) with noise figures below 2 decibels (dB) at x-band and single stage gains of greater than 10 dB have been demonstrated. A single stage small signal amplifier was developed which provided 7 dB gain and 1 milliwatt output power from 18 to 26 gigahertz (GHz). These devices find use in radar and electronic countermeasures use in radar and electronic countermeasures front ends. Power FET technology was pushed on several fronts because of its promise for impacting microwave systems. Significant improvements have been realized in power, frequency of operation, reproducibility, gain, bandwidth, and efficiency. Single stage amplifiers have demonstrated one Watt output power over the octave from 6 to 12 GHz at 5 dB gain and 20% efficiency. Five Watt FETs are being used in power combiners to achieve tens of watts in x-band. These transistors and the power combiners will be used to replace low to medium power microwave tubes at substantial cost savings and reliability improvement. Silicon and gallium arsenide diodes and power combiners using them also improved with tube replacement in mind. Diodes and diode amplifiers for space communications applications were in development. Four diodes were combined in a waveguide circuit that delivered 2.4 Watts at 60 GHz. Voltage controlled oscillators (VCOs) were designed and fabricated which reduce size and complexity of their subassembly by a factor of four. VCOs are used in tuning countermeasures systems. Diode power combining transitioned to advanced development in Program Element 63203F, Advanced Avionics. Improved mixers, circulators, and local oscillators for millimeter wave signal reception and control were demonstrated. These components will be used in countermeasures and missile guidance applications. Development of 100 x-band solid state transmit/receive modules for phased array airborne radar application began. This is preliminary to developing a tubeless radar aperture containing 2500 modules which will have greater than 1000 hours mean time between failure. In the power tube area there was progress on several fronts. Novel millimeter wave coupled cavity traveling wave tube (TWT) circuit concepts were developed which promise to yield cost savings in fabrication of 90%. TWT stabilizing techniques were developed which will increase helix tube peak power output by a factor of 10. A low profile antenna for air-to-air and air-to-satellite operation at ultrahigh frequency was developed.

2. FY 1980 Program: Solid state power generation techniques will continue to advance both silicon and gallium arsenide (GaAs) diodes and transistors. A new program is being started to develop GaAs continuous wave diodes and establish a technology base for reliable, high power, efficient devices at 10 and 20 gigahertz. Transistor power combining will demonstrate 40 Watts continuous wave power at x-band. Development at on-chip power combining is starting for 35 gigahertz (GHz) frequency operation. Development of a 60 GHz solid state phased array for satellite communications applications will begin. A GaAs power transistor which will reproducibly yield 4 Watts at 10 GHz, 6 Watts at 10 GHz (for selected devices), 2 Watts at 15 GHz and 1 Watt at 20 GHz will be demonstrated. High power pulsed GaAs diodes to active missile seeker applications will be demonstrated. Development of millimeter wave components such as mixers, local oscillators, high speed switches, and electronic phase shifters will begin for the 100-300 GHz range. A millimeter wave voltage controlled oscillator will be demonstrated with countermeasures applications in mind. Magnetostatic surface wave devices will be demonstrated for signal processing directly at microwave frequencies. In the tube area, development will begin on extremely high frequency and K-band traveling wave tubes for

countermeasures applications. Results from a concluding development of broadbandwidth crossed field amplifier design techniques are beind fed into an effort to show the feasibility of building a crossed field amplifier tube for countermeasures application which has both pulsed and continuous wave capability from 8 to 18 GHz. The gun for a high power fast wave interaction tube called a Peniotron will be completed. The goal in developing the Peniotron is a high power millimeter wave tube which can be flown and which doesn't have the high magnetic field requirements of the gyrotron.

3. FY 1981 Planned Program: The silicon bipolar power transistor development will conclude, the resultnt devices compared to the gallium arsenide field effect transistors from the previous year, and a new power transistor effort will begin. The goals will extend to half a Watt at 30 gigahertz (GHz) for communications applications. A low noise field effect transistor with goals of 3 decibels (dB) at 30 GHz and 6 dB at 40 GHz will be demonstrated. On-chip impedance matching improvements will be included so that packaged devices will have lower noise figures. A pulsed diode development will start for missile seeker applications. A conventional solid state millimeter wave power diode development will start as will a power diode effort using new interactions in the millimeter wave regime. Goals for the efforts will be set in conjunction with Air Force Armament Laboratory. Power combining circuits and configurations at x-band with 40 Watt output will be demonstrated as will power combining at millimeter wave frequencies. Applications are tube replacement in radar, missile seekers, and countermeasures systems. Amplifiers for satellite communications application will be demonstrated. Development of a voltage controlled oscillator for millimeter wave countermeasures systems will begin. Microwave and optical interactions will be investigated for signal reception and control purposes. The 35 gigahertz (GHz) microwave printed circuit active aperture for missile guidance applications will be tested. The 100 solid state modules for phased airborne array radar will be tested and fabrication of the 2500 module phased array aperture will begin. The goal is a tubeless multimode radar aperture which has greater than 1000 hours mean time between failures. Work will begin on a 20-30 GHz phased array for airborne communications applications. In the power tube area several efforts on cathodes and electron guns for power tubes conclude with the outputs being fed into an advanced thermionic gun design. The dual mode crossed field amplifier tube will be demonstrated for countermeasures applications. Using the output of the previous year's electron gun study a detailed engineering design will be made of the Peniotron high power millimeter wave tube (countermeasures applications). If the design is successful the tube fabrication will be carried out in Program Element 63203F, Advanced Avionics, the following year.

Project: 2002
Program Element: 62204F
DOD Mission Area: Electronics & Physical Sciences, 521

Title: Microwave Technology
Title: Aerospace Avionics
Budget Activity: Technology Base #1

4. FY 1982 Planned Program: Solid state efforts will continue to seek replacement of low and medium power tubes with solid state diodes and transistors and power combiners for each. The goals will be to increase bandwidth, efficiency, reliability and lifetime while decreasing price and noise. Frequencies will be chosen by application - radar, missile guidance, countermeasures, or communication. Integrated millimeter wave circuit development will start. Development of devices in a new compound semiconductor material with better potential than gallium arsenide will start. A solid state replacement for a 2-10 gigahertz driver traveling wave tube in an electronic countermeasures system will be tested. A channelized field effect transistor receiver for countermeasures applications in the 1 to 20 gigahertz region will be demonstrated. In the tube area a field emitter array electron gun development will start. This electron gun does not require heating to emit electrons. An advanced multifunction radar tube development will start based on data from the crossed field amplifier tube effort and an advanced development effort using a traveling wave tube. An alternate fast wave interaction tube will be developed in competition with the Peniotron. The goal is flyable high power tubes for millimeter wave countermeasures applications.

5. Program to Completion: This is a continuing program.

6. Milestones. Not applicable.

7. Resources. ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	6,391	6,000	5,800	5,900	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	4,900	5,000	5,400	5,800	Continuing	Not Applicable

The additional funds were used to fully fund crossed field amplifier tube work, the millimeter wave traveling wave tube work, the power combining work, and the millimeter wave active aperture work.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62205F
Title: Training and Simulation Technology
DoD Mission Area: Environmental and Life Sciences (ED) #522
Budget Activity: Technology Base #1

RESOURCES (PROJECT LISTING: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 EStimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	11,381	10,500	13,000	14,000	Continuing	Not Applicable
06ST	Laboratory Support	4,127	4,584	4,900	5,000		
1121	Technical Training Development	1,017	966	1,000	1,150		
1123	Flying Training Development	592	798	900	1,000		
1192	Advanced Simulator for Pilot Training	3,886	2,500	3,700	3,950		
1710	Training and Personnel Factors in System Design, Maintenance, and Operations	955	938	1,700	2,000		
6114	Simulation Techniques for Air Force Training	804	714	800	900		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Maintaining and improving readiness through training and system design is the thrust of this program. It consists of efforts grouped under the following three categories: HUMAN FACTORS, EDUCATION AND TRAINING, and TRAINING DEVICES AND SIMULATION. The Air Force must continue to develop the technology for improving personnel training and productivity, and for predicting outyear training requirements and costs. The Air Force must improve flying and technical training, and there are significant opportunities for accomplishing this task in the form of emerging technology in the flight and maintenance simulator areas. Increases in combat readiness can be achieved by improving the design and training effectiveness of flight simulators. A major thrust is underway to develop innovative methods for training air combat tactics. The expense of hands-on technical training of maintenance technicians can be reduced by the design and use of less expensive simulation devices for maintenance training. Techniciains need improved training to enable them to accomplish troubleshooting tasks more efficiently. Improvements in computer-based training systems are needed to improve training efficiency and the quality of graduates. To reduce the operational and support costs of Air Force systems, data concerning personnel, maintenance, and training must be properly considered during early design stages of weapon systems. By using techniques being developed to predict maintenance requirements as a function of weapon system design, trade-off analyses can be performed during the conceptual phase of weapon system development to minimize maintenance personnel costs, while improving weapon system readiness. These two areas of work represent a significant thrust by the Air Force toward improving productivity of the logistics functions. Efforts to develop these and similar technologies are funded by this program

element. In addition, the support of the Air Force Human Resources Laboratory (AFHRL), Brooks AFB TX, is partially funded by this program element. The Research and Development (R&D) efforts are coupled directly with the major command training programs and with programs supported by the Aeronautical Systems Division.

BASIS FOR FY 1981 RDT&E REQUEST: Examples of efforts funded by this program include evaluation of current air combat tactics; development of training programs to maintain the combat skills of aircrews and provide rapid reacquisition of these skills following long non-flying assignments; assistance to operational commands in evaluating the training effectiveness of new simulators, including the development of a test and evaluation handbook for their use; development of advanced flight simulator capabilities to simulate the full range of air-to-air and air-to-ground combat scenarios; evaluation of aircraft maintenance simulators for the F-16; implementation of an integrated management system for on-the-job training; development of computerized measurements of training effectiveness; and continuation of R&D for computer-managed instructional systems and techniques.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: # 62205F
DoD Mission Area: Environmental and Life Sciences (ED) #522

Title: Training and Simulation Technology
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This program concentrates on two of the three principal thrusts recently initiated by the Air Force Human Resources Laboratory (AFHRL): (1) Air Combat Tactics Training, and (2) Weapon System Logistics and Maintenance. These thrusts involve the development of training device technology, development and evaluation of improved flight training procedures, development of advanced maintenance training methods and media, and enhancement of techniques to predict and control operations and support costs and requirements. They are included in the major categories of HUMAN FACTORS, EDUCATION AND TRAINING, and TRAINING DEVICES AND SIMULATION. Emphasis on improved training dictates a strong technology push for better instructional strategies, training media, and aircraft and maintenance simulators. Objectives are to improve quality and efficiency, to reduce the cost of Air Force training, and to develop and evaluate simulation devices for use in technical and flying training in order to increase the overall level of combat readiness. The introduction of computer-managed instructional techniques will improve the quality of technical training. Maintenance performance can be improved by the continued development of improved technical data and sophisticated maintenance aids, such as job guides and logic tree troubleshooting aids. These aids have been shown to reduce repair time and errors associated with field level maintenance operations. Further development of techniques to predict maintenance needs as a function of weapon system design is required to properly anticipate changes in requirements for training, personnel, facilities, spares, and support equipment. This program element (PE), in addition to being the primary technical base exploratory development effort in Training and Simulation Technology, provides technical support to other Air Force and DoD agency programs and receives partial reimbursements for the services provided. In the case of basic research accomplished by the laboratory, full reimbursement is provided by PE 61102F, Defense Research Sciences. The project funding break reflects the best estimate considering these anticipated reimbursements, but may require adjustment to the degree that reimbursements are actually earned.

RELATED ACTIVITIES: The majority of work is directly in support of requirements identified by major commands, Air Staff agencies, and separate operating agencies. The process of establishing a requirement and requesting AFHRL support is identified in Air Force Regulation 80-51, Management of R&D Requirements in the Personnel and Training Program. Related efforts of the military services are identified in the Training and Personnel Technology Coordinating Paper (TCP). Related program elements are: PE 61102F, Defense Research Sciences; PE 62703F, Personnel Utilization Technology; PE 63227F, Advanced Simulator Technology; PE 63751F, Innovations in Education and Training; PE 64227F, Flight Simulator Development; PE 62757N, Training and Human Engineering Technology; PE 62722A, Army Training Technology; and PE 62727A, Non-System Training Device Technology. Research agreements are established with Air Training Command, Tactical Air Command, Air Force Logistics Command, Strategic Air Command, Naval Training Equipment Center, and National Aeronautics and Space Administration that clearly describe work to be accomplished and necessary support to be provided by the user of the technology. The Navy has a liaison office with the Flying Training Division at Williams AFB AZ. The Navy and Air Force are jointly working a number of efforts through this office. The Naval Training Equipment Center (NTEC) and Air Force Human Resources Laboratory (AFHRL) are jointly funding a contract to develop an automated and objective method of evaluating pilot skills under instrument flight conditions. AFHRL and NTEC also cooperated in a study of simulator visual field-of-view requirements for teaching carrier landings, using

AFHRL's Advanced Simulator for Pilot Training. The Air Force Simulator System Program Office (SPO) provided funds to AFHRL to determine the minimum visual cue requirements for B-52 aerial refueling training, and the F-16 SPO provided funds to assist AFHRL in developing an F-16 simulation capability. The Flying Training Division is collocated with Air Training Command at Williams AFB AZ. A branch of the division is located with the Tactical Air Command at Luke AFB AZ. The Technical Training Division is collocated with the Air Training Command at Lowry AFB CO. The Advanced Systems Division is collocated with the Air Force Logistics Command, the Simulator Systems Program Office, and numerous other Air Force Laboratories at Wright-Patterson AFB OH. The Air Force Human Resources Laboratory is very much aware of the related activities and needs of the primary Air Force users. The AFHRL has recently expanded a Memorandum of Agreement with the Army Program Manager for Training Devices, which formerly covered only scanned laser visual system development, to include Computer Image Generation and projector technology development. The AFHRL has also developed a Memorandum of Agreement with the F-16 System Program Office concerning maintenance aids development and resource planning and allocation. In addition, personal contacts, meetings, and formal contacts between specific focal points provide coordination between development efforts.

WORKED PERFORMED BY: The program is managed by AFHRL, Brooks AFB TX. Three AFHRL divisions support this program element: Advanced Systems, Wright-Patterson AFB OH; Technical Training, Lowry AFB CO; and Flying Training, Williams AFB AZ. The major contract efforts in FY 1979 were conducted by the following companies: Lear Siegler, Oklahoma City OK; Systems Research Laboratory, Dayton OH; Boeing, Seattle WA; McDonnell-Douglas, St. Louise MO; Systems Engineering Lab, Ft. Lauderdale FL; General Electric, Daytona Beach FL; Singer, Binghampton NY; University of Denver, Denver CO; American Institute for Research, Washington DC: and University of Dayton OH. The total contract program ($7,454K) included a total of 46 contractors.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: This program consists of efforts grouped under the following three categories: HUMAN FACTORS; EDUCATION AND TRAINING; and TRAINING DEVICES AND SIMULATION. Accomplishments in the category of HUMAN FACTORS include the development and application of a logistics composite model and its use in describing the logistics and manpower requirements for peacetime versus wartime situations, the development of specifications for the procurement of improved maintenance aids, and the compilation and analysis of available data on simulator fidelity, cost, utilization, and instructional feature characteristics versus training effectiveness. EDUCATION AND TRAINING accomplishments include initial studies of the application of systems analysis procedures to the design, evaluation, and management of on-the-job training; and development of improved field evaluations of technical training graduates and in-course testing procedures. In the category of TRAINING DEVICES AND SIMULATION, studies were performed which demonstrated that current platform motion systems do not contribute to training effectiveness of fighter/attack simulators. As a result, Tactical Air Command deferred the procurement of platform motion systems for future simulators. Specifications were developed for more effective simulator visual systems for training aerial refueling tasks. Significant support was provided to USAF in the test and evaluation of new simulators. A life cycle cost analysis model for flight simulators was developed and the Advanced Simulator for Pilot Training (ASPT) was modified to

simulate an F-16 aircraft for transition training and air-to-ground combat training R&D. The ASPT was used in a preliminary evaluation of the effectiveness of A-10 aircraft at penetrating well-defended target areas and launching air-to-ground attacks. Accomplishments in flight simulator design include the completion of a human sensory perception model to serve as a design guide for determining future simulator visual and motion cue requirements, and advancements in the development of projectors for simulator visual systems to provide brighter, higher resolution displays. A Self-Instructional Laboratory Research and Development (R&D) Management course was developed to teach scientists and engineers how to efficiently initiate and manage R&D contracts for the Department of Defense. Improved technical data presentation techniques, such as job guide manuals and logic tree troubleshooting aids, were developed, tested and are now in operational use for such systems as the C-141, B-52, A-10, F-5E, F-15, and F-16.

2. FY 1980 Program: In the category of HUMAN FACTORS, efforts in team training for command, control, and communications (C^3) systems will continue and other efforts in the further development of logistics research will be initiated. Those efforts include: development of ownership costing techniques to determine cause and effect relationships between weapon system design and outyear logistics and maintenance requirements; development of data files relating weapon system design and use to support requirements and performance for all operational weapon systems; and analysis of the training, personnel, and work responsibilities of maintenance personnel to determine how their time is actually used. In the category of EDUCATION AND TRAINING, investigations are continuing into training methods that will lead to the development of a system architecture for computer-based instructional systems which will provide more effective training in both field and resident environments. New efforts will be initiated in On-The-Job Training (OJT) by defining the basic requirements of an Integrated Training Management System to incorporate the technologies of delivery systems, instructional materials, and management systems to effectively establish a total OJT system. Results of these efforts will improve the efficiency and effectiveness of Air Force training programs. In the category of TRAINING DEVICES AND SIMULATION, work will be completed on the identification of the skills required to perform air combat maneuvers, development of techniques to measure these skill levels in current aircrews, development of a specialized training program for Tanker/Transport/Bomber aircrews, development of improved training for tactical decision making in air-to-air combat, and assisting in the test and evaluation of new flight and mission simulators for the E-3A. New efforts will be initiated to define aircrew performance measurement requirements for Air Training Command, Strategic Air Command, and Tactical Air Command; to improve Air Force techniques for applying Instructional Systems Development Technology; to evaluate air combat tactics to be employed by A-10 and F-16 aircrews; to evaluate the impact on pilot training of the F-16 side arm control fly-by-wire system; and to determine the motion cuing requirements for training control of Remotely Piloted Vehicles. In the area of simulator research and design, efforts will continue to develop large-cabin visual displays; to develop a simulator test and certification guide; and to improve instructor/operator station design. Efforts will begin to integrate perceptual research data into a well-developed simulator design guide, to improve helmet-mounted display design, and to create revolutionary Computer Image Generation (CIG) concepts which could provide much more information and detail in visual scenes.

3. FY 1981 Planned Program: In the category of HUMAN FACTORS, work will continue on team training research, ownership costing techniques, product performance data files, and analysis of maintenance personnel duties. The objective here is to improve productivity within the maintenance system as well as to develop the best procedures for improving productivity in other functional areas within the logistics system. Work will continue on development of a logistics macro model that will aid in policy development and resource control. Work will begin on a systems analysis of Command, Control, and Communication systems (including an examination of operational requirements, hardware characteristics, and training practices), an examination of the readiness of aircraft maintenance organizations, and the development of an integrated logistics system model for use in forecasting the whole spectrum of logistic needs (e.g., training, personnel, facilities, transportation) early in the acquisition cycle of a weapon system. Support will be provided to the Military Airlift Command during the modification of the new Ground Processing Segment (GPS) of their C-5 management system. The GPS deals with existing maintenance forms and automated parts ordering to respond to in-flight data automatically collected on C-5 engine parameters. In the category of EDUCATION AND TRAINING, continued efforts will study training systems to determine the cost and capability of training at base level, and to determine which courses should be taught in a residence school and which should be taught in the field through on-the-job training. Efforts will also be initiated to develop adaptive end-of-course evaluation measurement techniques to provide an effective measure of the success and effectiveness of computer-based instruction. Work will be completed on a training system that integrates a microprocessor with microfiche technology and provides a low-cost, adaptive, self-instructional capability for use at all levels of AF training. In the category of TRAINING DEVICES AND SIMULATION, work will be completed on the application of computer-managed instruction in undergraduate pilot training, determination of simulator scene content required to train low-level terrain-following target penetration tactics, evaluation of simulated weapons delivery training using a high-resolution helmet-slaved Area-of-Interest scene inset within a wide-angle field of view visual display, determination of the minimum visual cues necessary to train aerial refueling in a simulator, and the publication of a handbook for use by operational commands in performing test and evaluation of new simulators. Work will continue on the evaluation of air combat tactics to be employed by A-10 and F-16 aircrews, and the development of an improved training program to maintain the combat skills of current aircrews and assist pilots in the rapid reacquisition of these combat skills after long non-flying assignments. New efforts will be initiated to determine the motion and visual cuing requirements for effective simulator training of F-16 aircrews, to determine the effect of pilot experience on ease of transition to the F-16, and to assist in the test and evaluation of the B-52/KC-135 weapon system trainer. In the area of simulator technology, work will be completed on a wide-angle multi-view display for large-cabin aircraft, and on a simulator test and certification guide. Work will continue on the simulator design guide, helmet-mounted display development, and the development of new Computer Image Generation (CIG) concepts. Work will begin on advanced high-resolution radar simulation and on direct-access visual display development, a new display concept offering improved CIG/display interface and increased potential for high brightness and resolution. Work will also begin on low-cost portable simulators for use by field units and large, total mission (e.g., multiple aircraft, multiple target) simulators.

Program Element: # 62205F Title: Training and Simulation Technology
DoD Mission Area: Environmental and Life Sciences (ED) #522 Budget Activity: Technology Base #1

4. FY 1982 Planned Program: In the category of HUMAN FACTORS, efforts will be completed on the development of team training techniques for Command, Control, and Communication (C^3) personnel, a product performance data file, ownership costing techniques, and analysis of the daily duties of maintenance personnel. Work will continue on the systems analysis of C^3 systems, the evaluation of maintenance organization readiness, and integrated logistic systems modeling. In the category of EDUCATION AND TRAINING, aids will be developed to assist Air Force instructors in developing courseware and management tools for computer-based/computer-managed instructional programs. Investigation of the utility of computer-assisted instructional techniques to improve on-the-job training will continue, as will the evaluation of the utility of these new delivery systems and techniques. In the category of TRAINING DEVICES AND SIMULATION, work will be completed on solving current problems in applying Instructional Systems Development technology to Air Force training programs, developing an F-16 aircrew training program outline making optimum use of flight simulation, determining the effect of pilot experience on ease of transition to the F-16, determining motion and visual cue requirements for effective simulator training of F-16 aircrews, determining aircrew performance measurement requirements for Strategic Air Command and Tactical Air Command, and developing a simulator design guide. Work will continue on the development of a continuation training program for the maintenance of combat skills in active aircrews and the reacquisition of those skills after a non-flying assignment, and on advanced radar system simulation and instructor/operator station design development. New efforts will be initiated to apply video disk technology to simulator training, determine the training effectiveness of color in simulator visual displays, and evaluate how production F-16 simulators can be improved and best utilized for both air-to-air and air-to-ground training. Other studies will be initiated to investigate simulator training effectiveness in air combat maneuvering, produce combat scenarios for air-to-surface attack training, air-to-air and surface-to-air missile evasion, and develop new combat tactics and war game strategies.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

Program Element: 62205F — Title: Training and Simulation Technology

DoD Mission Area: Environmental and Life Sciences (ED) #522 — Budget Activity: Technology Base #1

8. Comparison with FY 1980 Budget Data: ($ in Thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	6,930	9,900	11,400	12,100	Continuing	Not Applicable
06ST	Laboratory Support	3,760	4,021	4,300	4,200		
1121	Technical Training Development	952	1,000	1,200	1,300		
1123	Flying Training Development	567	610	900	1,200		
1192	Advanced Simulator for Pilot Training	(3,700)	2,531	2,500	2,600		
1710	Training and Personnel Factors in System Design, Maintenance, and Operations	966	918	1,200	1,300		
6114	Simulation Techniques for Air Force Training	685	820	1,300	1,500		

In FY 1980, the decrease of $0.9M resulted in the stretch-out of an effort to provide realistic scene texturing in simulator visual systems. The FY 1981 increase is due to the 1 October 1979 Civilian Pay Raise, the overall goal to achieve 5% real growth in Exploratory Development, and changes in the anticipated reimbursements. The increase in the technical projects will provide for improved efforts in the evaluation and training of combat tactics for A-10 and F-16 aircrews; and will support a 7-day, 24-hour schedule for the Advanced Simulator for Pilot Training. The increase will also enhance efforts to improve the efficiency of the logistics functions through technology advancements.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62302F
Title: Rocket Propulsion
DOD Mission Area: Engineering Technology (ED), #523
Budget Activity: Technology Base #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	27,572	28,600	32,800	36,500	Continuing	Not Applicable
06CJ	Laboratory Operations	9,872	9,300	9,900	10,000		
3058	Space Propulsion Technology	4,700	4,700	5,500	7,000		
3059	Ballistic Missile Propulsion	5,500	5,600	7,000	7,800		
3148	Air Launched Missile Propulsion	5,500	6,800	7,600	8,600		
5730	Multiple Application Technology	2,100	2,200	2,800	3,100		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides new concepts and techniques in rocket propulsion technology to improve Air Force ballistic missiles, satellite propulsion, space launch systems, air launched strategic and tactical missiles. Proven technologies for solid propellant motors, liquid rocket engines, electric thrusters and high payoff advanced propulsion concepts minimize the development risk of advanced Air Force missile systems. This program also provides the operational support and management of the Air Force Rocket Propulsion Laboratory, Edwards AFB, CA.

BASIS FOR FY 1981 RDT&E REQUEST: This is a continuing program providing the rocket propulsion technology base for all future Air Force missile and space systems. In addition, this technology base supports the Navy, Army, and NASA developments with approximately 55% of the nation's rocket propulsion technology being developed at the Air Force Rocket Propulsion Laboratory. Major thrust encompasses all of the Air Force application areas for rocket technology, ballistic missiles, air launched missiles and space systems.

OTHER APPROPRIATION FUNDS: Not applicable

Program Element: #62302F
DOD Mission Area: Engineering Technology (ED), #523

Title: Rocket Propulsion
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: New concepts and techniques in rocket propulsion technology are pursued to improve ballistic missiles, satellite propulsion systems, and air launched strategic and tactical missiles. This includes efforts to develop higher performance propellants; stronger and lighter weight cases and nozzles; less erosive nozzle inserts; advanced thrust vector control and increased service life for solid propellant rockets; high performance and long life electric propulsion systems; post boost propulsion with increased payload capability; longer life liquid propellant satellite attitude control systems; improved performance space launch vehicle upper stages. This program element, in addition to being the primary technology base exploratory development effort in rocket propulsion, provides technical support to other Air Force and DoD agency programs and receives partial reimbursement for the services provided. In the case of basic research accomplished by the laboratory, full reimbursement is provided by PE 61102F. The project funding break reflects the best estimate considering these anticipated reimbursements, but may require adjustment to the degree that reimbursements are actually earned.

RELATED ACTIVITIES: Technology base activities are related to NASA, Navy and Army programs. Coordination is accomplished through the Joint Army-Navy-NASA-Air Force (JANNAF) Interagency Propulsion Committee, and through working level meetings and inter-service committees. This program provides the technology base for PE 63302F, Advanced Missile Propulsion, PE 63401F, Space Vehicle Subsystems, and also supports: PE 12431F, Defense Support Program; PE 27161F, Tactical Air Interceptor Missiles; PE 63306F, Defense Suppression Weapons Advance Technology; PE 63311F, Advanced Ballistic Reentry Systems; PE 63313F, Advance Missile Subsystems Demonstration; PE 63314F, Strategic Bomber Enhancement; PE 63317F, Theater Ballistic Missile; PE 63370F, Advance Medium Range Air-to-Air Missile; PE 64312F, M-X; and PE 64406F, Space Defense System.

WORK PERFORMED BY: Air Force management of this effort and a comprehensive in-house program is provided by the Air Force Rocket Propulsion Laboratory, Edwards AFB, CA. Eleven active test areas with 35 test positions include propellant formulation and small scale mixing capability, and sea level and simulated altitude test facilities to test new subscale to full scale components. The ten major contractors in FY 1979 were Thiokol Chemical Corporation, Brigham City, UT and Huntsville, AL; United Technologies (Chemical Systems Division), Sunnyvale, CA; Hercules, Inc., Magna, UT; Aerojet Company, Sacramento, CA; Rockwell International, Canoga Park, CA; Atlantic Research Corporation, Alexandria, VA; McDonnell Douglas Corporation, Huntington Beach, CA; TRW, Inc., Redondo Beach, CA; Fairchild Industries, Farmingdale NY; and Martin Marietta Corporation, Denver, CO. There are 22 additional contractors with 21% of the total contract value.

Program Element: #62302F
DoD Mission Area: Engineering Technology (ED), #523

Title: Rocket Propulsion
Budget Activity: Technology Base #1

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Propulsion technologies which made possible the Titan, Minuteman, Inertial Upper Stage (IUS), SRAM and reduced smoke Sidewinder and Maverick weapons systems were developed under this program. Demonstrated rocket technologies include high energy propellants in full scale mixes, which provide a 100 percent increase in payload for the upper stages of MX, compared to Minuteman technology - they can also be adapted for higher performance space motors - lightweight simplified extendible exit cones for ballistic missile upper stages which provide 15 percent payload increases, a debris free solid motor thrust termination technique, advanced low cost liquid propellant feed systems for post boost propulsion, a minimum smoke propellant which eliminates the visible contrail from the rocket exhaust 90 percent of the time at altitudes below 27,000 feet, satellite thrusters with 100 percent more life than previously demonstrated, and an integral rocket booster for ramjet application. A simple folded metal, exhaust gas deployed nozzle extension provided the highest performance (301 sec ISP) yet achieved on a solid rocket space motor. Radial burning pulse motor technology was demonstrated in a seven inch motor diameter, providing decreased peak and increased terminal velocities for air launched missiles.

2. FY 1980 Program: A major emphasis in ballistic missile propulsion continues to be insuring the transfer of previously demonstrated booster propellant, booster component and payload propulsion advanced technologies to the MX with reduced risk and increased confidence. Component efforts concentrate on demonstrating proven design techniques and reproducible fabrication methods for large carbon/carbon nozzles using integral throat and entrance section. Composite motor case development will emphasize increasing the usable strengths of Kelvar composite materials by 10 percent and extension to the air launched environment. Demonstration of reliable, lightweight, high expulsion efficiency post-boost propellant feed systems will be completed. Integrated propulsion/vehicle design analyses will identify performance payoffs and critical component technologies for advanced payload propulsion Air launch missile propulsion emphasizes demonstration of minimum smoke propellants with decreased hazards (no nitroglycerin) and increased burn rates for wider applications. Effort will be initiated to evaluate pre-packaged liquid performance potential for weight and volume limited air launched missile application. In the satellite propulsion area efforts will be initiated on improved performance monopropellants and demonstration of components for integrated bipropellant satellite propulsion. A high performance propellant containing HMX oxidizer will be demonstrated in an IUS size motor. Effort will continue to demonstrate high performance propellant and lightweight component options for the air launched Space Defense booster second stage. Advanced concepts include beamed energy and solar propulsion investigations.

Program Element: #62302F | Title: Rocket Propulsion
DoD Mission Area: Engineering Technology (ED), #523 | Budget Activity: Technology Base #1

3. FY 1981 Planned Program: High performance propellant development will continue. High energy fluorinated propellants will transition to advanced technology demonstration. Efforts will be initiated to develop high energy, low hazard (Class 1.3) propellants. Advanced solid rocket space motor technologies including HTPB/HMX propellant and expandible high area ratio nozzles will transition to advanced technology demonstration. Space Defense propulsion option efforts will continue and work will begin on demonstration of improved technology for the booster first stage.Advanced ballistic missile booster and payload efforts will be initiated for application to medium range ballistic missiles. Development of integrated bipropellant propulsion for satellites will continue. Monopropellant heater technology will transition to thruster demonstration to provide a 25% reduction in propellant requirements for satellite stationkeeping. A non-carcinogenic monopropellant will move into engine development. Low thrust, long burn propulsion for large deployed satellite structures will begin development. Component development for continuous throttling prepackaged liquid propulsion for air-launched missiles will be initiated. Propulsion energy management and minimum smoke propellant development will be continued in support of air launched missile requirements. Efforts will continue to evaluate critical components for beamed energy and solar propulsion advanced concepts.

4. FY 1982 Planned Program: Development efforts of low cost nozzles and propulsion options for small theater ballistic missiles will be demonstrated including prepackaged liquid propulsion, thrust termination and advanced payload delivery propulsion. Integrated bipropellant satellite propulsion efforts will concentrate on major engine and tankage demonstration. The pulsed plasma electric satellite thruster will transition to an advanced technology demonstration program. High energy ducted rocket propellant development will be initiated. Continuous throttling prepackaged liquid propulsion will be demonstrated for air launched missiles. Service life motor design capability will continue into full scale motor verification. Beamed energy propulsion feasibility will be demonstrated. An advanced electric magnetoplasma dynamic propulsion concept will be demonstrated for application to attitude control for large space structures.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

Program Element: #62302F
DoD Mission Area: Engineering Technology (ED), #523

Title: Pocket Propulsion
Budget Activity: Technology Base #1

7. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	25,600	26,700	28,600	30,200	Continuing	Not Applicable
06CJ	Laboratory Operations	9,400	9,000	9,300	9,400		
3058	Space Propulsion Technology	3,400	4,300	4,700	5,000		
3059	Ballistic Missile Propulsion	6,500	5,000	5,600	5,600		
3148	Air Laurched Missile Propulsion	4,300	6,400	6,830	7,600		
5730	Multiple Application Technology	2,000	2,000	2,200	2,600		

Changes reflected in the FY 1981 program include: increased funds in Project 3058 for acceleration of low thrust long duration propulsion system development for large deployed satellite structures; project 3059 provides an increased level of effort in advanced payload propulsion options and accelerated carbon/carbon nozzle and thrust vector control design technology; project 5730 provides an increased level of effort in non-intrusive diagnostics to support motor and propellant development; project 06CJ is increased due to the 1 October 1979 civilian pay raise.

Project: #06CJ
Program Element: #62302F
DOD Mission Area: Engineering Technology (ED) #523

Title: Laboratory Operations
Title: Rocket Propulsion
Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides funds for the support activities required to conduct exploratory and advanced development programs and to operate the Air Force Rocket Propulsion Laboratory, Edwards Air Force Base CA. This is one of five projects which make up the exploratory development program for Rocket Propulsion. The project provides technical support to the Space and Aeronautical Systems Divisions of the Air Force Systems Command. The project provides an in-house program covering the following areas; propulsion phenomenology investigations, new concepts feasibility, applications evaluations, and systems support. It provides for the pay and related costs of civilian scientists, engineers and supporting personnel, travel, transportation, rent, communications and utilities costs, procurement of supplies and equipment, and contractor support services.

RELATED ACTIVITIES: This project supports all of the technical projects under this program element as well as all other projects and programs managed by Air Force Rocket Propulsion Laboratory. Projects under 61102F, Defense Research Science, 63302F, Advanced Missile Propulsion, other advanced development program elements, and major system support reimburse this project for all direct cost.

WORK PERFORMED BY: The Air Force Rocket Propulsion Laboratory, Edwards AFB CA, is responsible for management of this project.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: Plans and accomplishments are discussed in the descriptive summary for the overall program element and individual projects.

1. Program to Completion: This is a continuing program.

2. Resources: ($ in thousands)

FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
9,872	9,300	9,900	10,000	Continuing	Not Applicable

3. Comparison with FY 1980 budget data:

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
9,400	9,000	9,300	9,400	Continuing	Not Applicable

The FY 1981 program has been increased to reflect the 1 Oct 1979 civilian pay raise.

Project: #3058
Program Element: #62302F
DoD Mission Area: Engineering Technology (ED), #523

Title: Space Systems Propulsion Technology
Title: Rocket Propulsion
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project develops rocket propulsion technology for application to future military satellites and space launch and orbital transfer vehicles. Existing propulsion systems are being improved by extending life and increasing performance. New propulsion system concepts are evaluated. Related rocket plume data for the development of sensors to detect and track enemy missiles and satellites is being developed. Plume contamination models are developed to control spacecraft contamination.

RELATED ACTIVITIES: Technology base activities are related to NASA and Navy programs. Coordination is accomplished through the Joint Army-Navy-NASA-Air Force (JANNAF) Interagency Propulsion Committee, and through working level meetings and inter-service committees. This program provides the technology base for PE 63302F, Advanced Missile Propulsion, and also supports: PE 12431F, Defense Support Program; PE 63401F, Space Vehicle Subsystems; PE 63411F, Space Shuttle; and PE 64406F, Space Defense System.

WORK PERFORMED BY: Air Force management of this effort and a comprehensive in-house program is provided by the Air Force Rocket Propulsion Laboratory, Edwards AFB, CA. The major contractors in FY 1979 were: Thiokol Chemical Corp., Brigham City, UT and Elkton, MD; United Technologies (Chemical Systems Division), Sunnyvale, CA; Aerojet Company, Sacramento, CA; Rockwell International, Canoga Park, CA; Bell Aerospace Company, Buffalo, NY; Martin Marietta, Orlando, FL; Accurex Corp., Mountain View, CA; TRW, Inc., Redondo Beach, CA; Fairchild Industries, Farmingdale, NY; Grumman Aerospace Corp., Bethpage, NY; and Calspan Corp., Buffalo, NY. There is a total of 21 contracts all performed by these contractors.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Work has continued toward providing long life high performance on orbit propulsion for satellites. A one year in-house test program has been successfully completed on 5 lb monopropellant thrusters. Two of the thrusters met the life goal of a million pulses which represents a 100% improvement over previous demonstrations. A 300 lb hydrazine catalytic thruster demonstrated long life durability during a 180 firing test series while accumulating over 6000 secs of firing duration. This represents a 75% life extension over previously demonstrated capability. In the area of electric propulsion a significant breakthrough has been achieved to resolve the problem of electrode erosion. A new electrode design has been evaluated and the results indicate that not only does the new design offer the required durability, it also offers a 30% increase in specific impulse. In the area of Launch and Orbital Transfer, a very successful test was conducted of a solid rocket kick motor. The motor (Star 37Y) which included a gas deployed skirt out to an area ratio of 117:1 demonstrated a high specific impulse of 301 secs while spinning at 100 RPM. A test program has been completed and the data used to verify the liquid thruster plume contamination model so it can be used by spacecraft designers to design around potential

contamination problems. A series of tests have been conducted to determine the exhaust plume characteristics representative of multi-nozzle missiles. The characterization of such flow fields is important to the development of plume signature models for enemy strategic systems.

2. FY 1980 Program: In the satellite propulsion area work will continue on extending the life of hydrazine monopropellant thrusters at both the 5 lb and 0.2 lb thrust levels. Work will begin on improved performance propellants including superheated hydrazine and advanced propellants. Work will begin on demonstrating the components for a higher efficiency integrated bipropellant propulsion system capable of 10 years reliable space operation. In the space launch and orbital transfer area work will continue on the transfer to space motor application of high performance solid propellant technology developed for ballistic missiles. Work will continue on development of high area ratio extendible exit cones for solid rocket space motors. Work will continue to demonstrate a motor containing high performance propellants and lightweight components for the upper stage of an air launched space defense system. Work will begin to evaluate concepts for propulsion energy management such as throttling and thrust termination for solid space motors. Development will begin of low thrust-long duration liquid engine and tankage components for deployment of acceleration sensitive structures from low earth shuttle parking orbit to high earth operational orbits.

3. FY 1981 Planned Program: A non-carcinogenic monopropellant replacement for hydrazine will move into engine development. Previously developed monopropellant heater technology will transition to thruster demonstration to provide a 25% reduction in propellant requirements for satellite stationkeeping. Integrated bipropellant component development will continue. Development will be initiated on a 5 millipound pulsed plasma electric thruster for missions requiring thrust levels greater than one millipound. Transition of high performance ballistic missile propellant and nozzle technology to space motors will continue. To support the Space Defense Miniature Vehicle concept, work will continue to demonstrate improved performance motors sized for the first and second stages. Efforts will be initiated to investigate and develop engine components that would provide the necessary additional performance and operation to the existing Space Shuttle Main Engine to make it compatible with an advanced military vehicle. Efforts will also continue to verify rocket exhaust plume contamination models for solid rocket space motors such as the IUS.

4. FY 1982 Planned Program: Efforts in integrated bipropellant satellite propulsion will transition to major engine and tankage demonstrations. The millipound pulsed plasma electric propulsion effort will transition to an advanced technology demonstration program. The transition of ballistic missile technology to space launch motors will proceed to higher performing propellants (Class 1.1). An effort will be initiated to demonstrate energy management techniques for solid propellant space motors.

Project: #3058
Program Element: #62302F
DOD Mission Area: Engineering Technology (ED), #523

Title: Space Systems Propulsion Technology
Title: Rocket Propulsion
Budget Activity: Technology Base #1

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: ($ in thousands)

FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
4,700	4,700	5,500	7,000	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
3,400	4,300	4,700	5,000	Continuing	Not Applicable

This project is increased in FY 1981 to accelerate development of low thrust, long duration propulsion for large deployed satellite structures.

Project: #3059
Program Element: #62302F
DoD Mission Area: Engineering Technology (ED), #523

Title: Ballistic Missile Propulsion
Title: Rocket Propulsion
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides proven propulsion technology for advanced ballistic missiles. Principal efforts include the development and demonstration of propellant options, lightweight nozzle and case options to provide up to 10% range or payload increase; post boost propulsion systems to increase the accuracy and flexibility of weapons delivery system; and technology to enhance reentry vehicle accuracy and survivability. Each of the preceding are being coupled with performance optimization in regard to reliability, service life, life cycle cost, basing modes and development risks.

RELATED ACTIVITIES: Technology base activities in this area are closely coordinated with the Navy and the Air Force Ballistic Missile Organization. Present and planned programs are closely coordinated through the Joint Army-Navy-Air Force (JANNAF) Interagency Propulsion Committee. This project will provide a technology base for PE 63302F, Advanced Missile Propulsion, and also supports: PE 63317F, Theater Ballistic Missile; PE 63311F, Advanced Ballistic Reentry Systems; and PE 64312F, M-X.

WORK PERFORMED BY: Air Force management of this project is provided by the Air Force Rocket Propulsion Laboratory, Edwards AFB, CA. The contractors in FY 1979 were: United Technologies/Chemical Systems Division, Sunnyvale, CA; Aerojet Company, Sacremento, CA; Rockwell International, Canoga Park, CA; Thiokol Chemical Corporation, Brigham City, UT; Ehrenpreis, Fort Lee, NJ; Bell Aerospace Company, Buffalo, NY; United Technologies Research Center, East Hartford, CT; Aerotherm Corporation, Mountain View, CA; Atlantic Research Corporation, Alexandria, VA; Fluorochem, Inc., Azusa, CA; Southern Research Institute, Birmingham, AL; Hercules, Inc., Magna, UT. There is a total of 35 contracts, all performed by these contractors.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Solid propellant activities emphasized the development of safe high performance propellants and the development of process techniques to ensure the availability of low cost propellant ingredients. Efforts were continued to perform final tailoring and scale up of energetic fluorinated propellants. Successful demonstration of the process to chemically grind the solid propellant oxidizers RDX and HMX was accomplished. The smaller sizes of these oxidizers enhances safety and the mechanical properties of the resultant solid propellant. The chemical grinding process offers a substantial cost savings over presently used mechanical grinding techniques. Successful testing of carbon/carbon nested cone expandable exit cones has further increased the confidence in the carbon/carbon technology that was selected for the MX missile. The feasibility of manufacturing liquid rocket engine parts, for application to advanced payload propulsion systems, by the injection molding process was demonstrated. A columbium thrust chamber and injector were fabricated by mixing metal powders with a binder/plasticizer and molding them under very high pressure. The close tolerances and excellent material finishes associated with this process results in reduced machining time and provides a significant manufacturing cost savings.

Project: #3059 Title: Ballistic Missile Propulsion
Program Element: #62302F Title: Rocket Propulsion
DoD Mission Area: Engineering Technology (ED), #523 Budget Activity: Technology Base #1

2. FY 1980 Program: Emphasis will continue on development of higher performance propellants containing energetic plasticizers and polymers. Efforts will be initiated to develop a high energy, low hazard (Class 1.3) propellant with performance characteristics typical of high energy (Class 1.1) propellants. Carbon/carbon composite nozzle efforts will concentrate on materials properties characterization and material structural performance determination for the development of nozzle design approaches. The development of a lightweight expandable exit cone (EEC) utilizing radiation cooled carbon/carbon cloth will be initiated. Prepackaged (hermetically sealed propellant and zero maintenance) liquid propulsion system development will emphasize the demonstration of critical individual component technologies for application to future standoff ballistic missile systems. Design analyses of advanced payload delivery and reentry vehicle propulsion systems will be completed. Efforts to insure ballistic missile propulsion system reliability and a long predictable service life will continue. Efforts will concentrate on the development of a predictable surveillance plan applicable to the MX.

3. FY 1981 Planned Program: High energy fluorinated propellants will transition to advanced technology demonstration. The development of low cost high energy nitramine oxidizers (HMX and RDX) will transition to pilot plant operations. The development of low hazard high performance (Class 1.3) propellants will continue. Full scale nozzle material characterization will continue. Lower cost, more reliable component investigations will include filament wound motor insulation of one-third the cost of elastomeric insulators, new resin/fiber combinations for improved Kevlar composite cases and a simplified nozzle thrust vector control system with 8 degree omniaxial deflection for advanced upper stages. The development of high performance, low burn rate solid propellants will be initiated for application to medium range ballistic missiles. Effort will be initiated to evaluate prepackaged liquid performance potential for weight and volume limited air launched missile application. Advanced payload delivery efforts will transition from design analyses to hardware development of compact high performance propulsion for individually powered reentry vehicles. Efforts to insure ballistic missile propulsion system reliability and a long predictable service life will continue. Efforts will be initiated to provide structural models for propellant and motor response to vibration and shock environments to eliminate the need to conduct full-scale motor tests to obtain service life estimates.

4. FY 1982 Planned Program: The high energy Glycidyl Azide Polymer (GAP) will transition from air launch applications to ballistic missile size motors. Development efforts of low cost nozzles and lightweight expandable exit cones will transition to the evaluation of full-scale fabricated nozzles. Prepackaged liquid propulsion system development will transition from critical component demonstration to integrated engine demonstration. Demonstration of thrust termination hardware will be initiated to provide the large degree of range flexibility required for small theater ballistic missiles (less than 30 in. diameter). Development will be initiated for high packaging efficiency, low cost integrated tankage and structure for advanced payload dispensers. Vulnerability of propulsion systems to nuclear and other types of radiation will be investigated.

Project: #3059
Program Element : #62302F
DOD Mission Area: Engineering Technology (ED), #523

Title: Ballistic Missile Propulsion
Title: Rocket Propulsion
Budget Activity: Technology Base #1

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in thousands)

FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
5,500	5,600	7,000	7,800	Continuing	N/A

8. Comparison with FY 1980 Budget Data:

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
6,500	5,000	5,600	5,600	Continuing	N/A

This project is increased in FY 1981 to provide an increased level of effort in advanced payload propulsion options and to accelerate carbon/carbon nozzle and thrust vector control design technology.

Project: #3148
Program Element: #62302F
DoD Mission Area: Engineering Technology (ED), #523

Title: Air-Launched Missile Propulsion
Title: Rocket Propulsion
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides improvements in rocket propulsion technology for future air-launched weapons. Tactical rockets with improved standoff range, better accuracy, improved service life and lower cost are being developed. Strategic air-launched missile performance improvements are being pursued through high energy propellants, energy management and improved thrust vector control. Improved aircraft survivability missile effectiveness will be provided by eliminating missile observables caused by the propulsion system.

RELATED ACTIVITIES: Army and Navy programs on improved solid propellants and improved components are well coordinated through the Joint Army-Navy-NASA-Air Force (JANNAF) Interagency Propulsion Committee. The Air Force Armament Division has related efforts in the armament propulsion area. This project will provide a technology base for PE 63302F, Advanced Missile Propulsion, and also supports: PE 63314F, Strategic Bomber Enhancement; PE 63316F, Advanced Medium Range Air-to-Air Missile ; PE 63601, Conventional Weapons Technology.

WORK PERFORMED BY: Air Force management of this project is provided by the Air Force Rocket Propulsion Laboratory, Edwards AFB, CA. The contractors in FY 1979 were: Thiokol Chemical Co., Huntsville, AL and Brigham City, UT; Hercules, Inc., Cumberland, MD; Atlantic Research Co., Alexandria, VA; Rockwell International, Canoga Park, CA; McDonnell Douglas, St. Louis, MO; Lockheed, Palo Alto, CA; Martin Marietta, Orlando, FL; Chandler Evans, West Hartford, CT; United Technologies/Chemical Systems Division, Sunnyvale, CA; Stanford Research Institute, Palo Alto, CA; and Aerojet Company, Sacramento, CA. There is a total of 34 contracts, all performed by these contractors.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A solid propellant data base has been developed to determine tradeoffs between performance, smoke, and operational limitations for tactical applications. A step closer to totally smokeless propellant was made with the successful demonstration of stable, high performance, minimum smoke propellant in a motor for air launched missile applications. Energetic oxidizers, polymer, and plasticizers have been synthesized for use in minimum smoke propellants. A range facility has been used to screen/rank low-visibility propellants and determine mechanisms of smoke formation for new propellants. A radial burning pulse motor was successfully demonstrated in the 7 inch size. The radial pulse concept has potential application in all categories of air launched missiles. Two motor concepts were demonstrated for potential application in the WASP mini-missile for anti-armor application. The first is a hybrid motor utilizing a solid booster/hybrid sustainer featuring long burn time. The second is a small solid rocket motor with pulse capability and reduced or minimum smoke. Improved performance via the use of composite cases was demonstrated during development of a high performance motor for standoff applications. Work began to improve propellant performance by formulating various high energy

(Class 1.1) propellants over burn rate ranges suitable for the air launched environment. A throttleable ducted rocket propellant effort was initiated to develop a minimum smoke propellant with increased throttling range.

2. FY 1980 Program: Continue the development of energetic propellant ingredients, verified models of missile exhaust plume signatures, evaluation and testing of motor behavior scenarios for risk evaluation, verification of composite material capability in the air launched environment, and evaluation of missile motor service life. Programs will be initiated to develop an experimental facility to screen low visibility propellants, develop minimum smoke propellant with increased burn rate, develop techniques for elimination of ignition smoke, investigate strip laminate techniques for lightweight/low cost motor cases, evaluate a prepackaged liquid propulsion system with on-demand throttling, develop and demonstrate a nozzleless booster for ducted rocket applicati d study low cost motor assembly and inspection techniques.

3. FY 1981 Planned Program: Efforts will be continued to define the visibility limits and probability of detection for air launched missiles to include acquiring a reliable Infrared (IR) and Ultraviolet (UV) exhaust signature data base. Emphasis on propellants will include service life prediction capability for minimum smoke propellants and continued development of energetic oxidizers and plasticizers. Efforts will be initiated to develop techniques for reducing cost of ignitors, develop a staged air launched motor for increased range, develop a short range pulse motor using reduced/minimum smoke propellant, demonstrate an advanced prepackaged liquid thrust chamber assembly, design a high performance thrust vector control system and develop a high energy ducted rocket propellant.

4. FY 1982 Planned Program: Continue development of a short range pulse motor, demonstration of a continuous throttling prepackaged propulsion system, demonstration of a high performance thrust vector control system, and development of high energy propellant for ducted rockets. Programs will be initiated to demonstrate adequacy of the standard IR Target signature model for tactical missiles, develop minimum smoke propellants with increased burn rate flexibility and determine feasibility of a nozzle that operates in both boost and ramjet mode of an IRR.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: ($ in thousands)

FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
5,500	6,800	7,600	8,600	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: Not Applicable. No change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62601F
Title: Advanced Weapons
DOD Mission Area: Electronic & Physical Sciences, #521
Budget Activity: Technology Base, #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	30,489	31,900	36,900	41,000	Continuing	Not Applicable
06CB	Laboratory Operations	11,192	11,300	12,200	12,400		
1900	Environmental Quality Technology	1,160	1,300	1,500	1,700		
2007	Nuclear Safety	652	800	900	1,000		
2218	Laser S/V Technology	245	500	600	600		
2444	Integrated Computational Center	860	800	700	400		
2673	Civil Engineering Technology	0	0	200	300		
3326	Laser Applications	10,824	10,900	12,500	13,900		
5797	Advanced Weapons Concepts	836	1,200	2,790	4,500		
8809	Nuclear S/V Technology	4,720	5,100	5,510	6,200		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops the technology base for advanced weapons and their adaptation to Air Force systems. Studies and experiments are conducted in laser applications, survivability/vulnerability (S/V), advanced weapon concepts, nuclear weapons environment, civil engineering technology, and environmental quality. Operation and maintenance of the Air Force Weapons Laboratory at Kirtland AFB NM are also included.

BASIS FOR FY 1981 RDT&E REQUEST: The development of advanced weapons systems requires a strong technology base in the areas of high energy lasers and the effects of high energy laser weapons on aircraft, missiles and satellites; the effects of nuclear weapons (blast, dust, radiation, and electromagnetic pulse) on strategic, tactical and command, control and communication systems; advanced weapons concepts; techniques for hardening and shielding against advanced weapons; environmental quality analysis and protection; and nuclear safety engineering for radio-isotope application in space.

OTHER APPROPRIATION FUNDS:

	FY 1979	FY 1980	FY 1981	FY 1982
Military Construction ($ in thousands)	0	0	0	6,590

Program Element: #62601F Title: Advanced Weapons
DOD Mission Area: Electronic & Physical Sciences, #521 Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This program element (PE) provides the Air Force (AF) with a sound technology base for the development of advanced weapons and the adaptation of these weapons to AF systems. A variety of studies and experiments are conducted in laser weapon technology, survivability/vulnerability (S/V) analysis of AF systems to high energy laser and nuclear weapon threats, nonconventional weapon concepts, nuclear weapon environment definition, and environmental quality technology. This program element also includes operation and maintenance of the Air Force Weapons Laboratory (AFWL). The technology base developed here is required to provide the AF with the most advanced weaponry and to prevent technological surprise by other nations. This program element, in addition to being the primary technology base exploratory development effort in advanced weapons, provides technical support to other AF and Department of Defense agency programs and receives partial reimbursement for the services provided. In the case of basic research accomplished by the laboratory, full reimbursement is provided by PE61102F, Defense Research Sciences. The project break reflects the best estimate considering these anticipated reimbursements, but may require adjustment to the degree that reimbursements are actually earned.

RELATED ACTIVITIES: The efforts performed under this program element are related to projects sponsored by the Defense Nuclear Agency (DNA), the Defense Advanced Research Projects Agency (DARPA), and other military developmental and operational organizations. The AFWL performs efforts funded by DNA under the Nuclear Weapons Effects program element, PE62704H. This program element provides the technology base for AFWL efforts funded by systems program offices, such as Minuteman Squadrons, PE11213F (X-ray, electromagnetic pulse (EMP) and blast S/V analysis), and Advanced Ballistic Re-entry Systems, PE63311F (development of hardened re-entry vehicle materials), and augments exploratory development of laser technology funded by the DARPA strategic technology program, PE62301E. The Engineering & Services Laboratory (ESL), Air Force Engineering and Services Center (formerly Civil and Environmental Engineering Development Office) environmental quality program under this program element has joint activities in catalytic combustor technology with the National Aeronautics and Space Administration (NASA) and in air quality measurement technology with the Environmental Protection Agency. This program provides exploratory development for the AFWL Advanced Radiation Technology Program (PE63605F), the Navy high energy laser and ballistic missile programs, the AFWL Systems Survivability (Nuclear Effects) Program (PE64711F), and the ESL Civil & Environmental Engineering Technology Program (PE63723F). In addition, the program provides exploratory development for radiation hardened electronics for use by AF and NASA system programs.

WORK PERFORMED BY: The AFWL at Kirtland AFB NM manages most of the work performed under this program element. The ESL at Tyndall AFB FL manages Project 1900, Environmental Quality Technology, and Project 2673, Civil Engineering Technology. AFWL facilities involved in the work include the Impact Facility, Sandia Optical Range, the Laser Laboratory, the SHIVA Electromagnetic Implosion X-Ray Source, the Dipole and TRESTLE EMP simulators and the Civil Engineering Research Facility. ESL facilities include the Environmental Chemistry Research Laboratory. The ten major contractors in FY 1979 were: Airesearch, Torrence CA; Scientific Applications, La Jolla CA; Bell-Aerospace, Buffalo NY; Rockwell Rocketdyne, Canoga Park CA; KTech, Albuquerque NM; Boeing, Seattle WA; United Technologies Research, East Hartford CT; McDonnell Douglas, St. Louis MO; Rockwell International, Thousand Oaks CA; and Boeing, Houston TX. A total of 31 contracts and 28

contractors were involved in this program element in 1979.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Air Force Weapons Laboratory (AFWL) has conducted an extensive series of programs to assess the effects of nuclear weapons on key U.S. strategic, tactical, and command, control and communication systems. The characterization of the survivability and vulnerability (S/V) of such systems as the Advanced Intercontinental Ballistic Missile (MX), E-4B, Air Launched Cruise Missile (ALCM), E-3A, F-16, Defense Support Program (DSP), and B-52 to selected nuclear weapons effects are examples. Emphasis has been placed on better definition of nuclear weapon attack environments in which selected strategic and tactical Air Force (AF) systems must operate. Simulation concepts and techniques were developed, leading to advanced analytical modeling of the nuclear detonation phenomenology and simulator facility design and construction for system and subsystem S/V validation. High energy laser (HEL) concepts developed under this program and transitioned into advanced development and support include: carbon dioxide gas dynamic lasers, pulsed and continuous wave carbon monoxide and carbon dioxide electrical discharge lasers, and hydrogen/deuterium fluoride chemical lasers. Recent advanced laser concepts research has been successful in demonstrating over 150 watts of power from a laboratory-scale chemically-pumped iodine laser at 1.315 micrometers wavelength. Laser effects research has verified theoretical predictions

An active program to explore high energy physics for new weapons applications included studies in collective ion acceleration, endo-atmospheric propagation, and neutral particle beams. Safety analyses of U.S. nuclear weapons with U.S. and North Atlantic Treaty Organization (NATO) aircraft have been conducted. Studies were completed on the F-4, F-111, ALCM design evaluations, F-16, B-52 Offensive Avionics System, Minuteman II and III, and the MX Air Mobile Basing Concept. The environmental quality efforts have led to complex analytical models supported by tests which can be used to both characterize and minimize impact by AF operations. Recent efforts have included emission measurements on F-100, F-57, J-79, and F-101 engines.

2. FY 1980 Program: There is a continuing requirement to provide for the orderly transition of nuclear weapons effects research into aerospace system development, acquisition, and operational phases. To satisfy this requirement, several efforts in this program element are continuing level of effort programs. This work in directed in four major areas: systems support, which includes assessing nuclear survivability and associated hardening costs for new systems, such as Global Positioning System, ALCM, DSP, and MX; materials and nuclear environment, to support the Nuclear Criteria Group Secretariat in improving the definition of the environment in which new systems must be able to survive; radiation hardened electronics, where the emphasis will continue on hardness screening techniques to insure reliability as well as hardness; and simulator development, particularly on the electromagnetic implosion concept (SHIVA). Another continuing project provides nuclear safety analyses necessary for AF and NATO systems. Emphasis will continue on Nuclear S/V technology in support of the MX program, and on new and continuing efforts designed to meet AF environmental quality Research and Development requirements in the area of air pollution control for turbine engine emissions, for hydrazine-type fuels, and for other alternate fuels. Fuel storage tank emission studies will be completed and recommendations for AF wide implementation will be developed. The HEL efforts will continue to emphasize

The study of repetitively-pulsed laser effects begun earlier will receive continued emphasis Application studies will continue, concentrating on the analysis of critical system technology issues and potential system effectiveness for developing advanced laser system technology. Concepts of initiated in FY 1979, will continue. Alternate laser fuels and optimized optical concepts for middle infrared wavelength lasers will receive continuing attention. Efforts on high energy physics technology, including radial pulse line accelerator studies, beam pointing and tracking studies, and lethality studies, will continue. The RADLAC I radial line accelerator will be completed and testing will be initiated. Analyses to identify critical parameters will identify other technology areas for possible accelerated development.

3. FY 1981 Planned Program: The efforts in nuclear weapons effects will continue to emphasize the conversion of available effects data into design criteria which will increase the survivability of U.S. systems. Efforts to understand the life cycle implications and develop criteria, techniques, and procedures which will maintain the hardness throughout the life cycle of systems will also be pursued. Refinement of the nuclear environment and exploration of the phenomenology of special effects weapons to understand impact on U.S. systems will also be continued. Studies to define the survivability of advanced deep basing concepts to ground motion will continue. Advanced simulator source concepts will also be pursued. The high energy laser (HEL) area will continue to emphasize the

High energy physics technology will be emphasized in the areas of component development, target vulnerability, pointing and tracking, and lethality. This program will receive increased emphasis starting in FY 1981 in support of the national particle beam technology program coordinated by the Office of the Under-Secretary of Defense, Research and Engineering (OUSDRE). Nuclear safety will continue with approximately 10 analysis efforts in support of the B-52/Air Launched Cruise Missile, F-111 Pave Tack, B-52 Short Range Attack Missile modification, and the F-16. Environmental quality efforts will emphasize air and water pollution control technology, and environmental consequences of new alternate fuels. Nuclear safety analysis of the Space Transportation System/Galileo will be conducted to meet the January 1982 launch date. Civil engineering efforts will be undertaken to develop new materials and techniques for rapid runway repair.

4. FY 1982 Planned Program: The nuclear weapons effects studies will emphasize the definition of space, ground, and near-surface environments. Techniques to produce the more severe high energy X-ray environments will be explored. HEL efforts will be directed to

High energy physics technology development will continue with expanded efforts in radial pulse line accelerator studies, pointing and tracking, power supply and conditioning, and weaponization aspects, supporting the OUSDRE coordinated national program in particle beam technology. Survivability/vulnerability support to current systems and criteria development for current and future systems will continue. Nuclear safety analysis of U.S. and North Atlantic Treaty Organization weapon systems will continue. Risk assessment/safety evaluation will be accomplished for an estimated 18-20 minor source launches with 8 missions requiring

on-site recovery support. Environmental quality efforts will include interfacing on the Water Quality and Air Quality Assessment models, and new concepts for smoke reduction using fuel additives. New or continuing civil engineering efforts on materials and techniques for enhanced rapid runway repair, on structural survivability, and on soil reinforcement for contingency operations will receive emphasis. Development of an integrated computational support system to permit multilevel security data processing has been slipped from FY 1981 due to a slippage in a related military construction program and will be pursued in FY 1982.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	28,100	29,500	31,900	33,800	Continuing	Not Applicable
06CB	Laboratory Operations	11,077	10,400	11,300	11,300		
1900	Environmental Quality Technology	900	1,300	1,300	1,500		
2007	Nuclear Safety	552	700	800	900		
2218	Laser S/V Technology	249	300	500	600		
2444	Integrated Computational Center	498	800	800	700		
3326	Laser Applications	10,021	10,400	10,900	11,900		
5797	Advanced Weapons Concepts	370	800	1,200	1,700		
8809	Nuclear S/V Technology	4,433	4,800	5,100	5,200		

Changes are reflected in the FY 1981 program due to the additive costs of the 1 Oct 1979 civilian pay raise, revised estimates of reimbursement for support provided to other programs and agencies, the goal to achieve five percent real growth in the total Air Force Exploratory Development Program, and the creation of a new civil engineering technology Project (2673). The increase in the laser applications work (Project 3326) is due to the advanced laser device concepts being strongly supported to expedite their availability for application. Other increases are to continue support of component development and technology base enhancement for new directed energy weapon concepts (Project 5797); and to provide for upgrade of the SHIVA X-ray Implosion Source (Project 8809).

Project: #06CB
Program Element: #62601F
DOD Mission Area: Electronic & Physical Sciences, #521

Title: Air Force Weapons Laboratory Operations
Title: Advanced Weapons
Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the support activities required to operate the Air Force Weapons Laboratory (AFWL), Kirtland AFB NM. AFWL is responsible for exploratory, advanced, and engineering development programs associated with nuclear and other nonconventional advanced weapons including studies of effective delivery techniques and hazards of these weapons. The laboratory provides technical support to current and future systems programs and undertakes operational support projects in its mission areas. This project provides for the pay and related costs of civilian scientists, engineers, and supporting personnel; travel and other transportation; rent, communications, and utilities costs; procurement of supplies and equipment; and contractor support services.

RELATED ACTIVITIES: This project supports and complements all of the technical projects under this program element (PE) as well as other projects and programs managed by AFWL, such as: Advanced Radiation Technology (PE 63605F); Systems Survivability (Nuclear Effects) (PE 64711F); Nuclear Effects Simulation Test Facilities (PE 64747F/1209); Air Force projects under the Defense Nuclear Agency's Nuclear Weapons Effects program (PE 62704H); Defense Advanced Research Projects Agency strategic technology program (PE 62301E); and related nuclear hardness testing and survivability developments.

WORK PERFORMED BY: The AFWL, Kirtland AFB NM, is the organization responsible for management of this project.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. Accomplishments and Future Programs: Accomplishments and future programs for this support project are covered in the Descriptive Summary for the overall program element.

2. Program to Completion: This is a continuing program.

3. Milestones: Not Applicable.

4. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	11,192	11,300	12,200	12,400	Continuing	Not Applicable

Project: #06CB
Program Element: #62601F
DOD Mission Area: Electronic & Physical Sciences, #521

Title: Air Force Weapons Laboratory Operations
Title: Advanced Weapons
Budget Activity: Technology Base, #1

5. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	11,077	10,400	11,300	11,300	Continuing	Not Applicable

Change in FY 1981 reflects the additive cost of the 1 October 1979 civilian pay raise and revised estimates of reimbursement for support provided to other programs and agencies.

Project: #3326 Title: Laser Applications
Program Element: #62601F Title: Advanced Weapons
DOD Mission Area: Electronic & Physical Sciences, #521 Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides exploratory development to establish the technical feasibility and operational practicability of lasers as weapons to fulfill specific Air Force (AF) mission requirements. Included in the scope of this project are the study of advanced laser device concepts for short wavelengths, including chemical and electric discharge lasers; the investigation and analysis of advanced adaptive optics concepts; diagnostic evaluation, modeling, and kinetics study for the hydrogen fluoride/deuterium fluoride (HF/DF) chemical laser; the development of repetitively-pulsed DF chemical laser technology; material, component, and fabrication technology development for high energy laser (HEL) optical components; the investigation of repetitively-pulsed HEL effects; and studies and analysis of potential applications of HEL systems.

RELATED ACTIVITIES: This project is part of a Department of Defense program which is coordinated by the Under Secretary of Defense for Research and Engineering, Research and Advanced Technology, and which includes work in Defense Advanced Research Projects Agency Program Elements (PEs) 62301E, Strategic Technology, and 62711E, Experimental Evaluation of Major Innovative Technology; PE 62307A, High Energy Laser Technology; PE 62735N, High Energy Laser Technology; and PE 63605F, Advanced Radiation Technology. Coordination with Department of Energy (DOE) programs is effected by attendance at DOE technical program reviews, exchange of technical publications, and cooperative efforts at the working level.

WORK PERFORMED BY: This project is managed by the Advanced Radiation Technology Office of the Air Force Weapons Laboratory, Kirtland AFB NM. A considerable portion of the work is accomplished with participation by the Air Force Aero Propulsion Laboratory, AF Aeronautical Systems Division, AF Electronic Systems Division, Air Force Materials Laboratory, Air Force Office of Scientific Research, AF Space Division, AF Aerospace Medical Division, U.S. Army Atmospheric Sciences Laboratory, National Bureau of Standards, and the Naval Research Laboratory. Major contracts supported by these funds in FY 1979 were issued to: Airesearch, Torrence CA; Scientific Applications, La Jolla CA; Bell-Aerospace, Buffalo NY; Rockwell Rocketdyne, Canoga Park CA; Boeing, Seattle WA; and United Technologies Research, East Hartford CT.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Chemical laser technology has continued to progress with the demonstration of 100 kilowatts of power from a HF laser device exhibiting good beam quality. Work with advanced fuels and nozzle bank concepts has identified improved nozzle bank technology and has characterized substitute fuels, particularly nitrogen trifluoride. In addition significant progress has been made in establishing the data base for kinetic rates and laser performance and in developing computer models for HF/DF chemical lasers. Technology investigations in new laser concepts have uncovered a number of potential concepts such as iodine, nitrogen fluoride, and several excimer laser systems. Particularly notable has been the successful demonstration of lasing from a chemically-pumped atomic iodine laser at 1.315 micrometers wavelength; laboratory-scale testing demonstrated 150 watts,

Project: #3326 Title: Laser Applications
Program Element: #62601F Title: Advanced Weapons
DOD Mission Area: Electronic & Physical Sciences, #521 Budget Activity: Technology Base, #1

In the development of optical components, optical coatings for high reflectance at carbon dioxide laser wavelengths have been develop d and tested at high power; micro-machining techniques for mirror fabrication with the potential for significantly reducing time and cost for fabrication and polishing have been developed; and work has begun on the development of coatings and window materials Progress has been made in the development of computer codes for laser resonator analysis, particularly for cylindrical geometry. Studies have been carried out on the potential applications of adaptive optics concepts. Work has begun on the development of advanced deformable mirror concepts and experiments have been initiated for the study of nonlinear adaptive optics techniques. A number of applications studies for high energy lasers have been completed,

2. FY 1980 Program: The investigation of promising new laser concepts will be pursued. Particular emphasis will be placed on the development of the In addition, the assembly of a laboratory device for the nitrogen fluoride (NF) laser concept will be completed, along with an attempt to demonstrate lasing in the NF chemical laser system. Work will continue in the development of the technology base for hydrogen fluoride/deuterium fluoride (HF/DF) chemical lasers, including the start of the laboratory evaluation of an optical resonance transfer laser concept, modeling development for advanced nozzle concepts and diffuser performance, and kinetic rate measurements. experimental results along with computer modeling and analysis will be used to evaluate the potential of repetitively-pulsed DF chemical laser concepts for efficient, high power operation. In the development of optical components, efforts in developing coatings and window materials will continue. The development of an improved diamond turning machine, for fabricating micro-machined optical components, will be completed, and work will begin on the development of advanced grating fabrication techniques. Repetitively-pulsed laser effects testing will continue, complementary theoretical work will investigate repetitively-pulsed laser damage mechanisms. Optical systems analysis techniques will continue to be improved; a full cylindrical resonator system optical quality computer code will be developed and demonstrated. In addition, advanced beam control system concepts will be investigated, including alignment concepts, optimal control theory, and implementation of adaptive optics. Applications analysis will continue, considering advanced laser systems technology

3. FY 1981 Planned Program: The evaluation of advanced laser device concepts will receive increasing emphasis The beam control system requirements for longer range applications will be considered in greater detail in terms of optical components techniques/subsystems for increasingly accurate pointing and tracking, and advanced adaptive optics techniques. Applications analysis will be

used to evaluate technology advances

4. FY 1982 Planned Program: The emphasis on breadboard demonstrations as subsystem technology becomes available.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	10,824	10,900	12,500	13,900	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Estimate	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	10,021	10,400	10,900	11,900	Continuing	Not Applicable

The FY 1980 program remains basically as planned. The goals of the FY 1981 program are unchanged; however, the level-of-effort has been increased to support earlier availability of the technology associated with the advanced concepts.

Project: #8809 Title: Nuclear Survivability/Vulnerability Technology
Program Element: #62601F Title: Advanced Weapons
DOD Mission Area: Electronic & Physical Sciences, #521 Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: The goal of this project is to provide an effective transfer of technology gained from nuclear weapons effects research into concrete steps to increase the survivability of Air Force (AF) systems to nuclear encounters. To effect this transfer, the hardness of AF systems as built or conceived will be assessed and support will be provided to assure that hardness levels are included in the system from concept selection through operational use. This life-cycle survivability program will include studies on the phenomenology of special effects, the determination of appropriate hardening levels for the system being acquired, the implementation of hardening techniques through the program office acquiring the system, the assurance that hardening levels established have been reached by verification, and the maintenance of these hardened levels throughout the operational lifetime of the system. This process will be accomplished through five major areas of effort: system support, materials evaluation and environment definition, development of radiation hardened electronics (RADTRONICS) for advanced AF weapons system, development of the technology required to simulate nuclear weapon X-ray environments, and special studies into technology impacts and applications.

RELATED ACTIVITIES: This project provides essential parts of the technology base in weapon system survivability/vulnerability and for efforts funded by program offices such as Advanced Ballistic Reentry Systems (PE 63311F); Advance Intercontinental Ballistic Missile Technology (PE 63305F); MX Engineering Development (PE 64312F); Air-Launched Cruise Missile (PE 64361F); Defense Support Program (PE 12431F); Global Positioning System (PE 63421F); Nuclear Effects Simulation Test Facilities (PE 64747F/1209); and Systems Survivability (Nuclear Effects) (PE 64711F). The project is also related to Research and Development sponsored by the Defense Nuclear Agency, the Air Force Office of Scientific Research, and other military development/operational agencies.

WORK PERFORMED BY: The Air Force Weapons Laboratory, Kirtland AFB NM, manages this project and performs some of the work in-house. Major contracts supported by these funds in FY 1979 were issued to: Computer Sciences, Cambridge MA; Dames and Morrie, Los Angeles CA; Systems Science and Software, La Jolla CA; SKM, Boston MA; McDonnell Douglas, Long Beach CA; and Effects Technology, Santa Barbara CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: To support Advanced Inter-continental Ballistic Missile (MX) missile concept development, experiments and analyses to define nuclear environments and the response of candidate structures continued through FY 1979. The Nuclear Criteria Group Secretariat continued development of criteria for MX and also completed the criteria study for the Cruise Missile Carrier Aircraft. Criteria were established for Ground Launched Cruise Missile, Defense Support Program (DSP) and Advanced Ballistic Re-entry Vehicle. Nuclear survivability and technical support was provided for the following systems: MX, E-4B, Air Launched Cruise Missile, DSP, B-52, E-3A, Space Transportation System, F-16, Defense Satellite Communications System III, and B-1. Airblast response code improvements and documentation were completed. Advanced re-entry vehicle and missile materials have been characterized as to their X-ray hardness and response. Work on trapped electron space environments continued and a study of the feasibility of using gamma scanning to determine the shielding of satellite subsystems was initiated. Structure media interaction code improve-

ments were started and development of a digital data acquisition system for ground shock measurements is continuing. Special technology studies were conducted to investigate cruise ballistic missile concepts, electromagnetic pulse environments and hardening, land and air mobile concepts, and re-entry vehicle (RV) survivability. The X-ray hardness assessment of the Advanced Ballistic Re-entry Vehicle (ABRV) was initiated under the Advanced Design Hardness Assessment Program. Testing on RV subsystems was accomplished at the Air Force Weapons Laboratory Impact Facility. In the radiation hardened electronics (RADTRONICS) area, evaluation of a power supply filter capacitor was performed in support of Advanced Ballistic Re-entry System, memory hardening efforts continued and evaluation of new solar cells was started. Transient Radiation Effects on Electronics Survivability and Vulnerability (S/V) support was also provided to several program offices.

2. FY 1980 Program: System program offices will be provided the technology support required to establish and conduct S/V programs. Assistance will be given to the various S/V reviews of designated Air Force (AF) systems. Criteria and/or hardening/survivability recommendations will be developed for several current and proposed AF systems, including Air Launched Cruise Missile, Advanced Inter-continental Ballistic Missile (MX), E-4, B-52, and F-16. Improvements in computer codes to model the responses of aircraft to blast will be completed. To improve the capability to perform vulnerability and hardening assessments of RV and missile systems, development of a computer system will be started, which will include the Nuclear Hardness Evaluation Procedures methodology, materal properties and weapons tests. Materials and environmental development efforts will include characterization of new RV materials. Materials and hardened electronics support will be provided for such systems as ABRV, MX and Advanced Maneuvering Reentry Vehicles through the Advanced Reentry Vehicle Survivability Technology Support Program. Radiation hydrodynamics work will include theoretical studies to define more complex nuclear-induced environments to support RV targeting studies, strategic structure design, and deep basing studies. Work will continue to improve computer codes for shielding calculations and rate dependent space environment effects studies will be undertaken. Under the RADTRONICS program, hardening and assessment techniques for advanced electronic technologies will continue. Optimization of the SHIVA electromagnetic implosion x-ray facility will be continued, and techniques for obtaining shorter pulses and higher energy X-ray output will be investigated. Development of techniques for applying new technologies to AF missions through the Advanced ICBM System Technology Requirements Program will be completed.

3. FY 1981 Planned Program: Technology support to the systems program offices will continue. Criteria and hardening recommendations for current and proposed systems will continue from FY 1980 or, in some cases, be initiated in FY 1981. FY 1981 systems will include the Advanced Strategic Air-Launched Missile, E-4, B-52, Ground Launched Cruise Missile, and Global Positioning System. The design hardness assessment of the ABRV begun in FY 1979 will be completed. The methodology for predicting the structural response of RV materials will be improved as will the techniques for simulating X-ray effects on these materials. Materials and hardened electronics support will continue through the Advanced Reentry Vehicle Survivability Technology Support Program. Computer code improvements to the Structures/Medium Interactions code will be completed. Under the RADTRONICS program the photodetector and linear circuit hardening assurance efforts will be completed and semiconductor laser diode hardening work will begin. Work to develop improved X-ray sources will continue in the areas of advanced power technology, load technology, and enhanced radiation technology.

Project: #8809 Title: Nuclear Survivability/Vulnerability Technology
Program Element: #62601F Title: Advanced Weapons
DOD Mission Area: Electronic & Physical Sciences, #521 Budget Activity: Technology Base, #1

4. FY 1982 Planned Program: Technology support to the system program offices will continue. Criteria development by the Nuclear Criteria Group (NCG) Secretariat for those systems designed by the NCG will also continue. The Medium Range Ballistic Missile, Defense Strategic Satellite System, and Advanced Maneuverable Reentry Vehicle are possibilities. Application of the Nuclear Hardness Evaluation Procedures methodology to additional systems is anticipated. Advanced Inter-continental Ballistic Missile component testing will be completed under the Advanced Reentry Vehicle Survivability Technology Support Program. Research on the theoretical and experimental methods for predicting the X-ray response of advanced re-entry vehicle materials will continue. If the gamma scanning technique feasibility study is successful, completion of the modification and development of the necessary scanner hardware will be completed in FY 1982. In the radiation hardened electronics area, an electro-optical component hardening handbook will be published and hardness assurance efforts for large scale integrated circuits and electro-optical components will continue. Work on the X-ray source program will continue and installation of high density capacitors in SHIVA should be completed. Development of a 3 megajoule machine which can be upgraded to 6 megajoules should be completed and in operational status by FY 1982, when experiments are scheduled to begin.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	4,720	5,100	5,510	6,200	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	4,433	4,800	5,100	5,200	Continuing	Not Applicable

The FY 1980 program remains basically as planned. The FY 1981 program has been enhanced to provide an increased level of effort for testing, analysis, and systems support.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62602F
DoD Mission Area: Engineering Technology, #523

Title: Conventional Munitions
Budget Activity: Technology Base, #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	28,700	29,600	29,500	32,700		
06CD	Air Force Armament Laboratory Operations	10,300	9,400	9,900	10,300		
2068	Guided Weapons Technology & Simulation	8,900	8,800	8,500	9,700		
2502	Bomb, Submunition, and Dispenser Technology	4,100	4,900	4,800	4,900		
2543	Weapon Evaluation/Effects Methodology	2,200	2,300	2,200	2,600		
2560	Direct Fire Weapons Technology	2,400	2,800	2,700	3,100		
2567	Weapons Carriage and Release Technology	800	1,400	1,400	2,100		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program includes efforts which provide advanced technologies in aerially delivered non-nuclear munitions and ancillary support equipment required to satisfy long range objectives of the Air Force, and to explore concepts and techniques to identify future weapon applications. This program also provides for the operational support and management of the Air Force Armament Laboratory at Eglin AFB FL.

BASIS FOR FY 1981 RDT&E REQUEST: The program to be pursued in FY 1981 includes the following technical efforts: passive and active emitter homing technology for air-to-air and air-to-surface weapons; radio frequency modeling and analysis; and radome/boresight error technology for air-to-air missile applications; advanced armor defeat concepts such as self-forging fragments and projected shape charges; millimeter wave and infrared target signature and target background measurements for anti-armor applications; analytical methodologies for conducting air-to-surface weapons effectiveness analyses; kill mechanisms and vulnerability criteria for aircraft engines;

plastic sabot concepts for flechette ammunition; advanced gun barrel rifling for conventional and telescoped ammunition; castable, insensitive explosives for general purpose weapons; plasticized nitramine propellants for use in hypervelocity aircraft cannon ammunition; new concepts to facilitate communications between the aircraft and weapons carriage and release subsystems at supersonic speeds. Emphasis will be placed on those efforts that will provide a technology base for defeat of radiating and shutdown communications and radar equipment, and for defeat of advanced armor. Technology efforts oriented to within visual range air-to-air missiles will be continued, however, emphasis on beyond visual range will be expanded to include concepts for defeat of standoff jammers and maneuvering and high altitude targets.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: 62602F
DoD Mission Area: Engineering Technology, #523

Title: Conventional Munitions
Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This program is directed toward those technology efforts required to provide the Air Force with superior air delivered non-nuclear weapons to meet long range objectives. The efforts vary from fundamental technology development to sophisticated breadboard hardware. Concepts and techniques are explored, and advanced studies are conducted to identify future weapons application and requirements. Efforts are conducted in the technical areas of: gun mechanisms, ammunition, explosives, warheads, fuzes, submunitions, dispensers, weapons carriage and release, weapons evaluation, target vulnerability assessments, air-to-air and air-to-surface seekers, sensors, autopilots and processing algorithms. Successful outputs from these programs are transitioned to appropriate advanced development programs. This program element, in addition to being the only Air Force exploratory development effort in conventional munitions, provides technical support to other Air Force and Department of Defense agency programs and receives partial reimbursement for the services provided. In the case of basic research accomplished by the laboratory, full reimbursement is provided by Program Element 61102F, Defense Research Sciences. The projects reflect the best estimate considering these anticipated reimbursements, but may require adjustment to the degree that reimbursements are actually earned. This program also includes the funds required for the operation and management of the Air Force Armament Laboratory, Eglin AFB FL.

RELATED ACTIVITIES: This program supports, through advanced technology efforts and simulation, the following PEs: 63601F, Conventional Weapons; 63609F, Advanced Attack Weapons, 64602F, Armament/Ordnance Development; and 64416F, Advanced Medium Range Air-to-Air Missiles. Related Army and Navy advanced technology efforts are coordinated through existing and specially established channels. Technology base efforts are reviewed by the Joint Directors of Laboratories Committee to coordinate related technologies and approaches. The Joint Logistics Commanders and its Joint Technical Coordinating Group for Munitions Development and Munitions Effectiveness provides an additional program coordination channel. There are special coordinating groups such as the Fuze Management Organization, the Under Secretary of Defense for Research and Engineering sponsored Joint Service Guidance and Control Committee, and the Terminally Guided Submunition group for selected development efforts. These groups are structured to review related activities to prevent duplication of identical approaches in related technology programs.

WORK PERFORMED BY: This program is managed by the Air Force Armament Laboratory, Eglin AFB FL. The work is performed by contract with industry and DoD in-house. The Air Force Armament Laboratory has the following in-house facilities: Armament Engineering and Evaluation Facility, Gun and Ballistic Technology Facility, High Explosives Research and Development Facility, Target Vulnerability and Terminal Effects Facility, Environmental Research Laboratory, Missile Integration Facility, Technical Library, and Structural Dynamics Laboratory. The ten highest dollar value contracts in FY 1979 were: Boeing Aerospace Corp., Seattle WA; Systems Control Corp., Palo Alto CA; Research Institute of Michigan, Ann Arbor MI; Orlando Technology Inc., Orlando FL; Grumman Aerospace Corp., Bethpage NY; General Dynamics Corp., Pomona CA; Aerojet Corp., Downey CA; Rockwell International Corp., Columbus OH; Chamberlain Manufacturing Corp., Waterloo IA; and Avco Corp., Wilmington MA. There were fifty-two other contractors One hundred and one contracts were distributed among the 62 contractors.

Program Element: 62602F
DoD Mission Area: Engineering Technology, #523

Title: Conventional Munitions
Budget Activity: Technology Base, #1

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Completed gun barrel erosion comparative evaluation of copper and plastic banded ammunition; results showed no appreciable barrel erosion occurred after firing ten thousand projectiles with plastic bands and complete erosion in the breech area when the same number of copper bands were tested. Completed a theoretical model to predict the onset of aerial cannon muzzle flash. Demonstrated telescoped ammunition at five thousand feet per second using molded propellant. Developed a new method of retaining plastic rotating bands on thin-walled high velocity projectiles; two hundred projectiles were successfully fired at forty-five hundred feet per second after temperature and humidity conditioning. Completed concept studies and transitioned the low altitude dispenser to advanced development. Accomplished a technology application study identifying weapon concepts to destroy hardened command and control targets. Completed sled track tests which demonstrated the feasibility of controlling the depth of burial of a submunition when impacting runway type targets. In-house expansion of the target activated munition sensor signature data base was accomplished and the feasibility of a signal microprocessor was demonstrated. Warhead efforts demonstrated the defeat of spaced armor targets at thirty calibers standoff and defeat of tank top armor. Demonstrated fuel tank defeat potential of self-forging fragments for air targets; and completed a material failure model for high strain rates for use in warhead design codes. Developed methodology for analyzing failure of large reinforced concrete structures from blast in adjacent soil. Completed an airfield sortie generation model for three classes of Warsaw Pact tactical airfields. Developed a model for evaluating time delay fuzed weapons and for mixed target types. Results from self-forging fragment tests were incorporated in the vulnerability data base. Completed the design of a steerable tactical weapon global positioning system antenna and constructed an antenna for laboratory testing. The strapdown tactical inertial guidance subsystem and tactical terrain contour matching hardware were flight tested. Conducted an evaluation of the Jovial high order language efficiency as compared with assembly level language for typical midcourse software modules. Completed design of the radio frequency target simulator and initiated hardware construction. Fall, winter and spring infrared target/background signature measurements were collected and placed in the data base. Initiated an infrared modeling and analysis program to generate a model to use for evaluating future infrared seeker concepts. Mathematically modeled the effects of aerodynamic forces and moments acting on a weapon translating through an aircraft flow field. Conducted wind tunnel tests to determine aerodynamic heating of typical guided weapons to establish a data base for comparison with full scale ground and flight tests. A laboratory model of a supersonic programmable ejector rack has been designed and partially fabricated. Initiated a program to determine the feasibility of using high pressure hydraulics as the ejector force in bomb racks. Awarded a contract to evaluate the potential of carriage and separation of weapons from the top surface of aircraft.

Program Element: 62602F
DoD Mission Area: Engineering Technology, #523

Title: Conventional Munitions
Budget Activity: Technology Base, #1

2. FY 1980 Program: Upgrade the aerial gun model to incorporate results of the telescoped ammunition and moveable gun technology efforts. Determine the feasibility and utility of an advanced tactical rocket. Continue investigations of new gun propellants with emphasis on advanced inhibited and triple base formulations. Determine the stresses and strains induced into projectiles by the spin-up process. Develop a method of relating optimum gun barrel twist rate to other rifling parameters such as number of grooves, land and groove shape and depth. Continue telescoped ammunition and plastic rotating band efforts at various velocities and at an expanded temperature range. Evaluate the stability and expected performance of the tubular projectile against armored targets. Continue interior and exterior ballistics for projectiles. Develop a mathematical model to describe the physical and performance characteristics of telescoped ammunition and decoupled gun hardware. Evaluate insensitive high explosive formulations such as melt cast nitroguanidine and trinitrotoluene mixtures, and commercially available eutectics of ammonium nitrate/ethylenediamine dinitrate for possible use in general purpose weapons. Continue development of the baseband reflectometry sensor for use in electronic countermeasure resistant fuzes. Investigate enhanced blast concepts which use dispersed particulate materials. Demonstrate feasibility of a safe and arm slapper detonator that will safely function in future highly maneuverable missiles. Conduct parametric studies for selectable linear or area submunition patterns from new dispenser concepts. Continue anti-armor warhead defeat mechanisms such as the projected shape charge and self-forging fragments. Evaluate new fuel defeat concepts which use polymerization/gellation/emulsification processes. Evaluate new concepts for submunition orientation and stabilization. Investigate techniques of missile fuzing using on a share basis information from the guidance unit. Develop a "universal" sensor for target activated munitions capable of determining target class, range and azimuth for multiple targets. Continue upgrading weapon ballistic, delivery and safe escape models. Continue target vulnerability efforts on jet engines, aircraft fuel systems, and aircraft structure. Evaluate advanced weapon concepts against threat vulnerability data. Develop a methodology for evaluating current and proposed gun systems against the projected threat. Develop methodology for evaluating the effectiveness of air-delivered weapons against vehicles such as tanks, armored personnel carriers, trucks and other combat vehicles. Modify a six degree-of-freedom store trajectory prediction program to accept aerodynamic grid data as a function of store position and attitude variables. Develop and check out aircraft/store electrical interface integration and validation equipment. Continue evaluation of advanced concepts for weapon carriage and release. Investigate new inertial sensor concepts that will meet cost, size and performance requirements for tactical weapons. Investigate emitter homing concepts for weapons that can destroy command and control radars and other electrical equipment such as electronic countermeasure devices. Complete the design phase of the digital subsystem simulator and begin delivery of equipment for integration into the existing hybrid simulator. Develop lensing techniques for minimizing radome boresight error for broadband radio frequency missile radomes. Continue effort on the air-to-air missile focal plane infrared seeker evaluation. Develop guidance and control algorithms for use with strapdown seekers on air-to-air missiles. Investigate Mellin transforms in the terminal air-to-air guidance computer code. Investigate and develop a low cost velocity update technique for tactical

weapons. Complete design of frequency scan conformal antenna for use with multi-mode air-to-air seekers.

3. FY 1981 Planned Program: Fabricate gun barrels for laboratory testing using the new rifling designs from the previous concept study. Refine the projectile rotating band design and fabricate rounds for testing. Fabricate and test a projectile sabot diverter to establish performance and interface parameters. Determine the feasibility of controlling projectiles of forty millimeters or smaller to increase the probability of hit. Continue investigation of linear nitramine plasticizers for gun propellants to evaluate stability and compatibility. Determine feasibility of using nitrocellulose/glycil azido polymer for aerial gun propellants. Continue interior and exterior ballistic efforts for projectiles and submunitions. Determine the primary characteristics of castable aluminized plastic bonded explosives by varying detonation velocity, detonation pressure, pulse length and detonation energy. Continue investigation of insensitive melt cast mixture of trinitiotoluene and nitroguanidine as an explosive for use in high volume weapons. Continue feasibility demonstration of the subnanosecond baseband reflectometry sensor for electronic countermeasure resistant fuzing. Continue evaluation of components for use in advanced dispensers. Evaluate new anti-armor defeat concepts which are capable of defeating advanced armor. Investigate the chemistry in polymerization/gellation/emulisification processes to defeat hydrocarbon fuel targets. Evaluate warhead penetration concepts and fabricate test hardware to measure structural integrity of new materials being considered. Fabricate and air gun test advanced submunition orientation, positioning and stabilization devices. Initiate a cooperative antenna technology effort to determine the feasibility of combining the functions of fuzing and guidance antennas. Investigate new fragmentation concepts for unitary warheads. Evaluate target activated sensors and develop target signature and signal propagation models. Continue investigation to determine vulnerability of secondary vehicles to self-forging fragments. Modify and document the warhead lethality analysis model for use in evaluating directional kill warheads. Continue vulnerability tests on jet engines and publish test results. Obtain a technical description of the Soviet ground support fighter and develop a vulnerability model. Complete efforts to upgrade weapon ballistic, weapon delivery and safe escape methodologies. Initiate preparation of a handbook of information applicable to the vulnerability assessments of hardened targets. Continue to upgrade and expand airfield attack methodologies. Evaluate current computer codes for predicting free stream aerodynamics and update and refine if required. Continue effort to develop an aircraft/store interface integration and validation capability. Continue optical rotational sensors effort which includes the micro-optic gyro and the solid state active laser gyro. Continue emitter homing technology efforts for both air-to-air and air-to-surface applications. Continue to develop the digital subsystem simulation capability. Conduct transmissivity and boresight error slope testing of new weapon radome concepts. Determine feasibility of a passive infrared seeker using a focal plane array. Investigate new concepts that have the potential of providing increased processing capabilities for advanced air-to-air infrared missile guidance. Evaluate strapdown seeker guidance and control algorithms through hardware-in-the-loop simulation. Continue infrared and millimeter wave measurements program. Develop a generic radio frequency mathematical and simulation model for use in evaluation and validation of seeker concepts.

Program Element: 62602F
DoD Mission Area: Engineering Technology, #523

Title: Conventional Munitions
Budget Activity: Technology Base, #1

4. FY 1982 Planned Program: Complete testing of gun barrels with new gun barrel rifling designs and determine what improvements in performance can be expected from plastic rotating bands. Using inputs from other efforts conduct a program to correct deficiencies in the plastic rotating band design. Continue the forty millimeter and under guided projectile effort. Continue gun propellant efforts on nitramine plasticizers and cyclic nitramines. Interior and exterior ballistic support efforts will continue. Develop a computer program which can be used to parametrically evaluate new gun designs. Continue efforts to develop high energy, insensitive and thermally stable explosives. Initiate a program to weaponize the previous fuel defeat investigations. Continue cooperative antenna technology effort and select concepts for preliminary functional testing. Continue program to develop target signature and propagation models and to investigate improved signal processing techniques for target activated munitions. Investigate spallation effects and spall suppression techniques on the self-forging fragment kill mechanism. Determine the response of the Flogger engine to typical warhead damage. Continue vulnerability assessments of new threat vehicles. Upgrade weapon ballistic and delivery models. Continue to computerize target descriptions for military and industrial plants. Develop new and upgrade current aircraft/store structural and aerodynamic prediction models. Design and fabricate hardware for the aircraft/store electrical interface integration and validation program. Fabricate a hydraulic powered ejector unit for preliminary feasibility testing. Seeker modeling and analysis will continue to further predict the performance of advanced seeker concepts. Continue efforts on the radome boresight error program.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

Program Element: 62602F
DoD Mission Area: Engineering Technology, #523

Title: Conventional Munitions
Budget Activity: Technology Base, #1

8. Comparison with FY 1980 Budget: ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	20,175	28,400	29,600	27,000		
06CD	Air Force Armament Laboratory Operations	9,983	9,800	9,900	10,200		
2068	Guided Weapons Technology & Simulation	3,409	8,200	7,200	6,000		
2502	Bomb, Submunition, and Dispenser Technology	3,139	4,600	4,900	4,300		
2543	Weapon Evaluation/Effects Methodology	1,432	2,200	2,700	2,600		
2560	Direct Fire Weapons Technology	1,722	2,500	3,500	2,800		
2567	Weapons Carriage and Release Technology	490	1,100	1,400	1,100		

Additional funds added to this program are to increase emphasis in emitter homing seeker concepts, strapdown seeker and midcourse weapon technologies, and development of a simulation capability for evaluating digital subsystems in weapons. Emphasis will also be increased on technologies that relate to defeat of advanced armor, this includes warheads, and dispenser concepts.
Changes are reflected in the FY 81 program due to the 1 Oct 79 civilian pay raise, revised estimates of reimbursements for support provided to other programs and agencies, and the goal to achieve 5% real growth in the total AF Exploratory Development Program.

Project: # 06CD
Project Element: 62602F
DoD Mission Area: Engineering Technology, #523

Title: Air Force Armament Laboratory Operations
Title: Conventional Munitions
Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the support activities required to operate the Air Force Armament Laboratory (AFATL), Eglin AFB FL. AFATL is the Air Force laboratory responsible for the exploratory and advanced development of non-nuclear conventional munitions. This project provides funds for the pay of civilian scientists, engineers and support personnel, travel, transportation, rents, communications and utilities costs, procurement of supplies and equipment, contractor support services, and environmental impact studies of munition testing at the Armament Division.

RELATED ACTIVITIES: This project provides in-house support to technical projects under this Program Element (PE) and as other projects and programs managed by the laboratory. AFATL is also responsible for: PE 63601F, Conventional Weapons; PE 63313F, Missile Subsystems Technology Integration; and provides technical support to PE 63609F. Advanced Attack Weapons. In addition, it provides technical assistance in armament matters to Systems Program Offices, other laboratories, and the Army and Navy as required.

WORK PERFORMED BY: The Air Force Armament Laboratory, Eglin AFB FL, is the organization responsible for management of the projects included in the Air Force Armament Laboratory program.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. Accomplishments and Future Programs: Programs and accomplishments of AFATL are discussed in the Descriptive Summary for the Program Element, and those projects exceeding five million dollars.

2. Program to Completion: This is a continuing program.

3. Milestones: Not applicable.

4. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	10,300	9,400	9,900	10,300	Continuing	Not Applicable

Project: # 06CD
Program Element: 62602F
Dod Mission Area: Engineering Technology, #523

Title: Air Force Armament Laboratory Operations
Title: Conventional Munitions
Budget Activity: Technology Base, #1

5. Comparison with FY 1980 Budget Data: ($ in thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	9,983	9,800	9,900	10,200	Continuing	Not Applicable

FY 81 increase due to 1 Oct 79 civilian pay raise.

Project: #2068
Program Element: 62602F
DoD Mission Area: Engineering Technology, #523

Title: Guided Weapons Technology & Simulation
Title: Conventional Munitions
Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: In the past this project consisted only of guided weapon simulation and analysis support to evaluate various guided subsystems design concepts in a laboratory environment. All 6.2 tactical guided weapons technology development was managed by the Air Force Avionics Laboratory under Projects 7622 and 7629. In FY 1977 this work was transferred to the Air Force Armament Laboratory. Project 2068 was expanded to accommodate this new work. The objective of Project 2068 is to provide the Air Force with advanced guidance and control technology; simulation, closed-loop subsystems testing, aerodynamic investigations and analyses; and signature measurements (millimeter wave, infrared, electro-optical, etc.) efforts leading to the design and feasibility testing of air-to-air and air-to-surface guided weapons. The various efforts are directed toward the development of low cost, highly reliable, effective tactical guided weapons which provide maximum tactical flexibility and adverse weather strike capability.

RELATED ACTIVITIES: This project supports Conventional Weapons, PE 63601F; Missile Subsystem Technology Integration, PE 63313F; Advanced Medium Range Air-to-Air Missile, PE 63316F; Advanced Aerial Targets Technology, PE 63232F; and Advanced Attack Weapons, PE 63609F. Guided Weapons Technology efforts in the services are coordinated through the Joint Service Guidance and Control Committee, and the Joint Technical Coordinating Group under auspices of the Joint Logistic Commanders and other formal and informal coordinating groups. The objective of coordination between services is to maximize technology output through complementary programs.

WORK PERFORMED BY: The Air Force Armament Laboratory, Eglin AFB FL, manages this project. The work is done on contract with industry, colleges and universities, and in-house. The ten major contractors in FY 1979 were: Boeing Aerospace Corp., Seattle WA; Systems Control Corp., Palo Alto CA; Research Institute of Michigan, Ann Arbor MI; Grumman Aerospace Corp., Bethpage NY; General Dynamics Corp., Pomona CA; Georgia Institute of Technology, Atlanta GA; Rockwell International Corp., Columbus OH; Motorola Corp., Scottsdale AZ; Computer Science Corp., Birmingham AL; and Ball Aerospace Corp., Boulder CO. There were 10 other contractors. Twenty-six contracts were distributed among the 20 contractors.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Completed a feasibility determination for a millimeter wave target simulator. Conducted a hardware-in-the-loop simulation of the bank-to-turn control concept for advanced guided weapons. Completed the design for the tactical global positioning system weapon antenna for tactical conventional missiles. Successfully validated the round robin multiplex bus interface unit functional design. Completed design of the radio frequency simulator and initiated construction. Infrared target and background measurements

were accomplished in the Continental United States on four different occasions to fully characterize seasonal variations. Established a computerized infrared data base. Established computer models of generic millimeter wave terminal guidance seekers. The dual mode radio frequency/infrared (RF/IR) seeker investigation, nearly completed, has resulted in three design concepts, two of which employ conformal antennas, and the third employs a dual aperture system. Completed design of a high performance gimbal system for highly maneuverable air-to-air missiles.

2. FY 1980 Planned Program: Initiate a study contract to determine the feasibility of implementing advanced digital electronic concepts in digital midcourse guidance systems. Using results from previous strapdown seeker efforts a preliminary design of a gimbaless autopilot will be accomplished. Initiate an aerial target scoring feasibility study to evaluate concepts for measuring near misses of a high energy laser beam. Develop the technology for molded plastic sensors and cantilever beam accelerometer sensor for use in strapdown seeker concepts. Establish a preliminary design, integration, and pattern measurement of a tactical weapon antenna for use with the tactical Global Positioning System Guidance System. Do a preliminary design of the Distance Measurement Equipment updated interial guidance for use in all-weather midcourse guidance system. Initiate a program to provide the technology to develop an advanced anti-radiation missile. Continue the millimeter wave and infrared target signature and background clutter measurements program. Conduct a detailed design trade-off study of a dual mode air-to-air missile seeker. Initiate a study to investigate and determine methods for measuring target range for passive air-to-air missile RF systems.

3. FY 1981 Planned Program: Investigate molded plastic inertial sensors for use in tactical weapons. Continue the solid state laser gyro effort. Complete the feasibility determination of the cantilever accelerometer which is based on a unique linear spring concept. Continue emitter homing technology initiative. Investigate different multi-mode seeker concepts for air-to-air missile applications. Complete design of the digital subsystem simulator and begin hardware fabrication. Continue to develop lensing techniques for minimizing boresight error slope for broadband radio frequency air-to-air missile radomes. Continue evaluation of a focal plane infrared seeker for air-to-air missile applications. Investigate infrared and millimeter wave signal processing techniques. Continue millimeter wave and infrared target and background signature measurements. Conduct hardware-in-the-loop simulations to demonstrate the accuracy and performance capabilities of strapdown seekers in actual weapons. Investigate low cost velocity update techniques for tactical weapons. Evaluate new aero-control concepts which will provide a capability to maintain control effectiveness at high angles-of-attack. Laboratory test spinel and sapphire infrared air-to-air missile radomes for thermal shock and rain errosion resistance.

Project: #2068 Title: Guided Weapons Technology & Simulation
Program Element: 62602F Title: Conventional Weapons
DoD Mission Area: Engineering Technology, #523 Budget Activity: Technology Base, #1

4. FY 1982 Planned Program: Continue evaluation of molded inertial sensors for tactical weapons. Complete evaluation of the solid state laser gyro and transition effort to advanced development. Evaluate new emitter homing concepts. Begin checkout and use of the digital sybsystem simulator. Continue simulation of advanced missiles. Infrared energy processing devices will be fabricated and mechanically and electrically interfaced with an imaging seeker. Evaluate high-speed low cost circuits for analog-to-digital and digital-to-analog conversions for guided weapon flight control sensing and actuation. Evaluate digital signal processors that can be used with high speed array processing for use with infrared and radio frequency sensor data. Investigate infrared air-to-air missile radome to include radome heating tests. Continue advanced control theory investigations and advanced seeker algorithm generation. Continue efforts to solve the adverse weather seeker problem for tactical air-to-air and air-to-surface weapons.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	8,862	8,800	8,500	9,700	Continuing	Not Applicable

8. Comparison with FY 1979 Budget Data: ($ in thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	3,409	8,200	7,200	6,000	Continuing	Not Applicable

Additional funds added to this project are to increase emphasis in emitter homing seeker concepts, strapdown seeker and midcourse weapon technologies, and developing a simulation capability for evaluating digital subsystems in weapons.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 62702F — Title: Command, Control & Communications
DOD Mission Area: Electronic and Physical Sciences (ED), #521 — Budget Activity: Technology Base #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	52,103	54,416	63,200	69,700	Continuing	Not Applicable
06DM	Laboratory Operations	23,926	25,132	26,800	27,200		
2338	Assurance Techniques for Electronics	4,875	4,600	5,200	6,000		
4506	Surveillance Technology	5,573	5,600	6,600	7,800		
4519	Communications & Control Technology	4,690	4,500	5,800	6,900		
4594	Intelligence Technology	4,459	4,784	5,800	6,900		
4600	Electromagnetic Radiation, Devices & Components	4,072	4,600	5,800	6,900		
5581	Information Sciences Technology	4,508	5,200	7,200	8,000		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides a broad technology base for advancing Air Force mission capabilities in Command, Control and Communications (C^3), a mission requirement which is rapidly increasing its significance. Six basic technology areas are pursued: Surveillance; Intelligence; Communications and Control; Information Sciences; Electronic Reliability and Electromagnetic Compatibility; and Electromagnetic Radiation, Devices and Components. The program element also provides for the operation of the Rome Air Development Center (RADC), Griffiss AFB, Rome NY, and the RADC Deputy for Electronic Technology, Hanscom AFB, Bedford MA.

BASIS FOR FY 1981 RDT&E REQUEST: This is a level-of-effort program using FY 1981 funds to advance the C^3 technology base. A few of the many major efforts which will be pursued are: Reliability characterizations of third generation microprocessors; surveillance electronic counter-countermeasures and target detection/location technology; fiber optic cabling and transceiver development for tactical communications; intelligence data handling technology improvements; computer software technology needed to best meet the forecasted Air Force needs through the year 2000.

OTHER APPROPRIATION FUNDS: Not applicable

Program E ment: # 62702F
DOD Mission Area: Electronic and Physical Sciences (ED), #521

Title: Command, Control & Communications
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This program element funds the primary Air Force exploratory development program in Command, Control and Communications (C^3). Historically, C^3 has played a critical role in warfare. However, recent technology advancements and predicted future achievements impact C^3 heavily and are escalating its role in determining future world military balances. Advances such as the emergence of microprocessors on a chip being the functional equivalent of the first computer ever built are having a more profound effect in C^3 than in any other Air Force mission area. This program element exploits such technology changes to build upon the existing base, to increase chances of earlier technical breakthroughs, and to provide the critical technology needed for ultimately fielding the most cost-effective, state-of-the-art systems. Activities in this element usually span several years as ideas progress through studies and analysis to breadboard and prototype phases. Evaluations are made at critical points for viability and new technology impacts before transitioning technologies to advanced development. Six technology areas are pursued: (1) Assurance Techniques for Electronics-To increase availability and minimize life-cycle costs of future C^3 systems, and to eliminate adverse effects on Air Force weapon system performance caused by adjacent radiators of electromagnetic energy; increase understanding of modern, complex, large-scale integrated circuit failures and to develop techniques for the test, measurement, and prediction of reliability and maintainability for new electronic devices and systems; to ensure that Air Force operational systems are immune to spurious radio interference; to prepare and maintain DOD specifications, standards and design handbooks to ensure the transfer of reliability and maintainability technology to users. (2) Surveillance Technology - To develop and apply ground and space based surveillance technology to Air Force requirements for future surveillance equipment; to develop electronic counter-countermeasures (ECCM) to reduce vulnerability of radar systems to all types of electronic countermeasures (ECM); to apply multi-dimensional high resolution concepts for enhanced target identification in a hostile environment; to develop and apply radar technology for spaceborne radar; develop advanced signal processing techniques, high power wide bandwidth thermionic radio frequency sources and transmitters, and techniques for detecting and tracking cruise missiles. (3) Communications and Control Technology - To design, develop and test techniques and concepts for providing command and control for manned and unmanned vehicles in a hostile environment. Specific efforts include developing real-time, all weather target acquisition techniques and accurate automated vehicle and weapon guidance and jam-resistant communications; to provide technology for designing nodal and terminal communication facilities, emphasizing speed and accuracy, and maximum transmission efficiency; to develop analysis and simulation techniques to aid in equipment evaluation and to improve interoperability among systems. (4) Intelligence Technology - To automate intelligence exploitation in four areas for enabling limited manpower resources to process the mountains of intelligence data being collected today: (2) signal processing within intelligence sensors to handle extremely high data rates imposed by digitized imagery and real time signal-intelligence data collection; (b) imagery exploitation to correlate and classify targets acquired from multiple sensors and sources; (c) intelligence data processing to facilitate the transfer of textual and imagery data among intelligence data bases and intelligence analysis centers; (d) and advanced targeting and charting to develop cartographic and photogrammetric techniques and equipment for tactical and strategic targeting. (5) Electromagnetic Radiation, Devices and Components-To

provide for technology in electromagnetic radiation transmission and solid state devices, components, and materials. Thrusts include exploiting the electromagnetic spectrum for use by C^3 systems and increasing the availability of these systems. Technologies pursued include antennas and radio frequency components, electromagnetic propagation studies, materials and system components for command, control and communications (C^3) applications, advanced solid state devices and circuits, optical and electro-optical components and radiation hardening technology. (6) Information Sciences Technology - To develop techniques to design, acquire, and maintain higher quality software at lower costs. Objectives are to provide the system designer with the means to specify software requirements in a complete, consistent manner and to be able to trace and test how well these requirements are met; to develop tools and procedures to make the computer programming process more productive; and to evaluate emerging computer related device technologies, such as microprocessors, to be applied to numerous Air Force systems. This program also provides for the operation and maintenance of the Rome Air Development Center (RADC), Griffiss AFB NY, and the RADC Deputy for Electronic Technology, Hanscom AFB MA. This program element, in addition to being the primary technical base exploratory development effort in Command, Control and Communications, provides technical support to other Air Force and DOD agency programs and receives partial reimbursement for the services provided. In the case of basic research accomplished by the laboratory, full reimbursement is provided by PE 61102F, Defense Research Sciences. The project funding break reflects the best estimate considering these anticipated reimbursements, but may require adjustment to the degree that reimbursements are actually earned.

RELATED ACTIVITIES: This program is actively coordinated at tri-service and interagency levels to preclude duplication and to meet overall Department of Defense (DOD) needs. Examples of this coordination are the DOD Advisory Group on Electron Devices, Interservice Antenna Group, the Technology Coordinating Paper on Electronics, the DOD Higher Order Language Working group, DOD Software Technology Panel, inter-laboratory programs, exchanges of technical reports, personnel visits, participation in seminars, and publication and review of scientific literature. Periodic reviews such as apportionment reviews and internal Air Force program reviews at all command levels further preclude duplication and sharpen the focus of program objectives. Participation in various North Atlantic Treaty Organization (NATO) panels and working groups and liaison with the European Office of Advanced Research and Development further coordinates program efforts. Work performed is related to electronics efforts at the Air Force Avionics Laboratory, Air Force Weapons Laboratory, Lincoln Laboratory, the Army Electronics Command, Office of Naval Research, National Aeronautics and Space Administration (NASA), the Defense Advanced Research Projects Agency (DARPA), and other government agencies. Image exploitation programs are coordinated through a national committee while the Defense Mapping Agency (DMA) coordinates all service programs in targeting and charting. The National Security Agency (NSA) coordinates all service programs in signals intelligence and the Defense Intelligence Agency (DIA) coordinates all work in intelligence data handling. Basic research in Program Element 61102F, Defense Research Science, directly feeds into this program. Major advanced development programs assigned to RADC to which direct technology transfers are made are: PE 63728F, Advanced Computer Technology; PE 63750F, Counter-Countermeasure Advanced Development; PE 63789F, Command, Control and Communications Advanced Development; PE 63747F, Pave Mover. Successful efforts in this program are also transitioned into other program elements such

as PE 63208F, Reconnaissance Sensors/Processing Techniques; PE 63431F, Advanced Space Communications; PE 31011G(F), Cryptological Activities; PE 31022F, Scientific and Technical Intelligence; PE 31025F, Intelligence Data Handling Systems; PE 63701B, Mapping and Charting; and PE 64750F, Intelligence Equipment. Related non-Air Force programs are PE 62725A, Computer and Information Sciences; PE 62705A, Electronics and Electronic Devices; PE 62712N, Surface/Aerospace Target Surveillance; PE 62721N, Command and Control Technology; and PE 62762N, Electronic Device Technology. Technical support is provided to the Electronics System Division, Space Division and to many other Air Force organizations too numerous to list. Support is provided to many DOD agencies including Defense Mapping Agency (DMA), Defense Intelligence Agency (DIA), Defense Communications Agency (DCA), Defense Nuclear Agency (DNA), as well as the Army and Navy.

WORK PERFORMED BY: The in-house activity is performed at the Rome Air Development Center (RADC), Griffiss AFB NY, at the RADC Deputy for Electronic Technology, Hanscom AFB MA, and at ten off-base sites located throughout New York and Massachusetts. Ten major contractors in FY 1979 were: Pattern Analysis Recognition Inc., Rome NY; Harris Corporation, Melbourne FL; Hazeltine Corporation, Greenlawn NY: Westinghouse Electronics, Baltimore MD; Syracuse University, Syracuse NY; Hughes Aircraft, Culver City CA; Texas Instruments, Dallas TX; Technology Services Inc., Santa Monica CA; TRW Inc., Menlo Park CA; Operating Systems Inc., Woodland Hills CA. There were 160 contractors with 257 contracts in FY 1979.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: This program element has provided the technology achievements responsible for the advanced capabilities of many present Air Force Command, Control and Communications Systems and will continue to impact future systems. Detailed achievements are contained in the individual project summaries. A few of the major achievements in the six basic technologies are: (1) Assurance techniques for Electronics - Reliability analyses were performed on second generation microprocessors, microcomputers and support large scale integrated (LSI) chips. Specifications were prepared for these devices. Testability factors affecting systems reliability and maintainability were identified. A study was completed to determine the structure needed for late 1980 Air Force systems electromagnetic compatibility analysis. (2) Surveillance Technology - The signal processor for the tactical surveillance Digitally Coded Radar was completed and successfully tested. High power tube technology demonstrated a 1 KW octave bandwidth radar tube which can significantly impact electromagnetic counter-countermeasures (ECCM). The advanced onboard signal processor design for the spaceborne radar was completed. (3) Communications and Control Technology - A rapid coherent communications emitter location capability was made possible by newly developed location algorithms. Experimental evaluation of a spread spectrum synchronization technique was completed for enhanced ECCM. In-house testing of a ultra high frequency (UHF) adaptive antenna processor was completed. A sidelobe

canceller for troposcatter systems and development of anti-jam coding techniques were completed. (4) Intelligence technology - An experimental model of a 1.0 Gigabit per second holographic recorder for extremely fast intelligence recording requirements was demonstrated. An advanced query capability for assessing dissimilar data bases of non-numeric data was demonstrated. Event prediction algorithms to permit intelligence analysts to test hypotheses on occurrence of events were developed and evaluated. An analysis system was installed to address exploitation of digital imagery and direct positioning techniques to support tactical and strategic targeting scenarios. (5) Electromagnetic Radiation, Devices and Components - A special four array antenna which provides hemispherical coverage from aircraft was experimentally produced. High frequency (HF) ducted communications efforts, a promising technology for survivable communications in nuclear environments, was advanced by successful extraction of a signal from an ionospheric duct. Precision clock technology for space applications produced a surface acoustic wave 1.4 GHZ clock. Device technology produced an analog binary correlator for spread spectrum and anti-jam communications. A rapid means of producing low cost indium phosphide (one hour compared to 32 days previously) was produced. A new process for hardening bi-polar integrated circuits was developed. (6) Information Sciences Technology - Mathematical models needed to predict reliability of computer software were developed. A plan was completed for producing a complete set of software acquisition tools. A handbook was completed which allows software acquisition managers to specify and then measure quality of software that contractors are developing. Efforts were continued in support of programming environments for Ada, the DOD standard higher order computer language.

2. FY 1980 PROGRAM: Efforts planned and accomplishments anticipated in the six technical areas are: (1) Assurance Techniques for Electronics - Reliability product evaluation, electrical characterization, and assurance methodology will continue for large scale integrated (LSI) circuits. A handbook on built in test (testability) for systems will be prepared. Electromagnetic effects on microcircuits will be studied. Electromagnetic susceptibility of fiber optics transducers will be investigated. (2) Surveillance Technology - Survivability and performance analyses will be completed for an advanced tactical radar. New main beam anti-jam concepts for future radars will be tested. Advanced on-board signal processing modules and power distribution techniques will be pursued. Cruise missile detection efforts will continue. (3) Communications and Control Technology - Emitter location technology will be extended to allow location independent of modulation type. A 26 pair fiber optic cable development for use in tactical environments will begin. Low data rate high frequency modem development will continue and the system design development environment program will be initiated. (4) Intelligence Technology - High speed data recording and processing development will continue. Hardware and software will be developed for imagery exploitation, using pattern recognition techniques. (5) Radiation, Devices and Components - New feed techniques for antennas will be developed to produce low sidelobes and increase anti-jam capabilities. High frequency ducted ionospheric communications will continue with further studies on the effects of disturbances on communications reliability. Programmable signal processing devices, such as signal integrators, will be developed using charge coupled devices and surface acoustic wave devices. Fiber optic radiation hardening will continue. (6) Information Sciences Technology - A computer system will be selected for use in automatically testing specifications for embedded computer systems. Software reliability modelling will be developed for determining software quality in distributed systems. Efforts in automatic programming will continue and a programming environment for Ada will be produced.

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DOD Mission Area: Electronic and Physical Sciences (ED), #521

Title: Command, Control & Communications
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3. FY 1981 PLANNED PROGRAM: Planned efforts in the six basic areas are: (1) Assurance Techniques for Electronics - Third generation microprocessors will undergo reliability evaluations. A handbook for reliability of electrical/electromechanical assemblies will be developed. Large Scale Integrated (LSI) circuit reliability techniques which are relevant will be used in the DOD Very High Speed Integrated Circuit (VHSIC) program. (2) Surveillance Technology - Development of main beam anti-jam technology for target locators and tactical radars will continue. A low altitude system design for spaceborne radar will be completed. Field testing of air launched cruise missile detection concepts will be initiated. (3) Communications and Control Technology - Emitter location techniques will be applied to countering enemy command and control capabilities. Development will begin for a standard fiber optics transceiver. Development of the 26 pair optical cable for tactical applications will continue. Studies will begin on distributed networks and system control for automated communications. Development will continue on the system design and development environment (SDDE) to be used in designing and configuring Command, Control and Communications systems. (4) Intelligence Technology - Development of a computer interface for direct processing from the high speed intelligence data recorders will continue. Hypothesis methods that will assist analysts in predicting events will be completed. Imagery data exploitation will be advanced by completion of the hardware/software evaluations. (5) Radiation, Devices and Components - Null steering techniques for spaceborne radar anti-jam capabilities will be pursued. Work will continue on high frequency ionospheric ducting communications and initial measurements will be completed. Propagation parameters for low frequency (LF) survivable communications will be determined. Device efforts will produce high frequency (HF) filters and spread spectrum processors at greatly reduced costs and weight. Radiation hardening will include large scale integrated circuits (LSI) and very large scale integrated circuits (VLSI). (6) Information Sciences Technology - The system for automatic testing of embedded computer specifications will be tested on actual on-going acquisition programs. Methods for controlling errors in distributed systems will be developed. Microprogramming verification tools will be completed. A new thrust will be undertaken to provide the exploratory development base needed to meet the Air Force computer technology requirements identified through the year 2000.

4. FY 1982 PLANNED PROGRAM: Device reliability efforts will continue to evaluate devices emerging such as very large scale integrated (VLSI) circuits. Emphasis will continue on determining testability optimization in terms of improved systems reliability and maintainability. Electromagnetic compatibility characterization of microelectronics will result in design guidelines. A breadboard model of an advanced surveillance radar will be developed. Spaceborne radar antenna and signal processing work will continue. A demonstration will be done on ground based fusion of sensors for aircraft identification purposes. Cruise missile work will transition into advanced development. Development will continue for countering enemy command and control. Work on distributed networks and adaptive communications will continue. The computer interface to work with the high speed recorders will be completed. Imagery exploitation will focus on developing more efficient algorithms for transmitting and storing digital image data. Low frequency propagation efforts for survivable communications will be completed. Digital beam steering techniques to replace large costly components and the high frequency replacement filters will be completed. Fiber optics communications will continue and portions will transition to advanced development. Radiation hardening and

electromagnetic materials will continue to meet the needs of emerging electronic components. The system for automatic testing of software specifications will be completed. A generalized software reliability model will be demonstrated. Methods for eliminating distributed systems errors and microprocessor systems design handbooks will be completed. Support to technology begun in FY 1981 to meet specific Air Force computer technology needs through the year 2000 will continue.

5. PROGRAM TO COMPLETION: This is a continuing program.

6. MILESTONES: Not Applicable.

7. RESOURCES: Not Applicable.

8. COMPARISON WITH FY 1980 BUDGET DATA:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	49,805	49,900	54,416	57,600	Continuing	Not Applicable
06DM	**Laboratory Operations**	27,965	24,600	25,600	25,700		
2338	Assurance Techniques for Electronics	3,066	4,200	4,500	5,100		
4506	Surveillance Technology	4,414	4,500	5,516	6,000		
4519	Communications & Control Technology	3,105	4,100	4,400	5,000		
4594	Intelligence Technology	3,902	4,000	4,700	5,300		
4600	Electromagnetic Radiation, Devices and Components	2,757	4,000	4,600	5,100		
5581	Information Sciences Technology	4,596	4,500	5,100	5,400		

Changes are reflected in the FY 1980 and FY 1981 program due to the additive costs of the 1 Oct 1979 civilian pay raise, revised estimates of reimbursement for support provided to other programs and agencies, and the goal to achieve five percent real growth in the total Air Force Exploratory Development Program. Project changes in the FY 1980 and FY 1981 programs include increases in technology for cruise missile detection and tracking, for emphasis on reliability and radiation hardening of large scale integrated circuits, for improving automation of intelligence data handling systems, and initiating efforts in support of computer technology needs through the year 2000.

Project: # 06DM
Program Element: # 62702F
DOD Mission Area: Electronic and Physical Sciences (ED), #511

Title: Laboratory Operations
Title: Command, Control & Communications
Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides the support activities required to operate the Rome Air Development Center (RADC), Griffiss AFB NY, and the RADC Deputy for Electronic Technology, Hanscom AFB MA. Support provided includes the pay and related costs of civilian scientists, engineers and supporting personnel, travel, transportation, rents, communications, utility costs, procurement of supplies and equipment, and contractor support services. RADC is responsible for exploratory development and assigned advanced development programs in surveillance, communications and control, intelligence, information sciences, electronic reliability and electromagnetic compatibility and electromagnetic radiation, devices and components. It is also assigned technology intensive engineering development programs, primarily in the intelligence area. RADC also provides technical support to current and future systems programs.

RELATED ACTIVITIES: The project supports and complements all the technical projects under this program element and numerous other programs being performed at the Rome Air Development Center.

WORK PERFORMED BY: The Rome Air Development Center, Griffiss AFB NY, is responsible for the management of the projects under this element. Work is performed by that organization and the RADC Deputy for Electronic Technology, Hanscom AFB MA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. Accomplishments and Future Programs: Plans and accomplishments are discussed in the Descriptive Summary for the overall Program Element included in this submission. This project will also provide for upgrade of the administrative processing support systems needed to support and reduce the workload of the laboratory contract managers. This is an experiment in office automation and management information systems.

2. Program to Completion: This is a continuing program.

3. Milestones: Not Applicable.

4. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	23,926	25,132	26,800	27,200	Continuing	Not Applicable

Project: #06DM
Program Element: #62702F
DOD Mission Area: Electronic and Physical Sciences (ED), #521

Title: Laboratory Operations
Title: Command, Control & Communications
Budget Activity: Technology Base, #1

5. COMPARISON WITH FY 1980 BUDGET DATA: Proj #06DM Laboratory Operations

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
27,965	24,600	25,600	25,700	Continuing	Not Applicable

See Program Element Summary.

Project: #2338 Title: Assurance Techniques for Electronics
Program Element: #62702F Title: Command, Control and Communications
DOD Mission Area: Electronic and Physical Sciences (ED), #521 Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: The objectives of this project are to (1) to provide the reliability and maintainability (R&M) technology required to increase the operational availability and minimize the total life cycle cost of future command, control and communications electronic equipment/systems, and to (2) reduce or eliminate the influence of undesired electromagnetic energy on Air Force weapon systems and associated subsystems. The approach for the reliability/maintainability technology program involves the development of improved understanding, measurement, analysis, quantification and prediction of characteristics that permit control and correction of part, equipment and system failures under the diverse stresses and environmental conditions encountered in Air Force operations. The electromagnetic compatibility (EMC) portion of this project addresses EMC problems whenever they surface in the life cycle process by focusing on technology for (1) analysis and prediction techniques, (2) measurement techniques, and (3) suppression/control techniques. The outputs of this project are transitioned directly to users by incorporation into various military R&M and EMC specifications, standards, handbooks and design guides.

RELATED ACTIVITIES: R&M and EMC efforts related to electronic devices are coordinated through the DOD Advisory Group on Electron Devices and Technology Coordination Paper on Electronics. In addition, tri-service panels, and working groups meet on regularly scheduled bases to discuss and coordinate activities. All of these insure that technology development programs meet military service needs and avoid unnecessary duplications. The work undertaken in this project is related to on-going activities at the Air Force Avionics Laboratory, Lincoln Laboratory, Army Electronics Command, Office of Naval Research. R&M basic research in PE 61102F, Defense Research Science, transitions into this project. The project output transitions directly into various DOD R&M specifications for which RADC is the preparing activity and both R&M and EMC technology is taken directly to system developers through vigorous system technical support activities. The EMC technology also supports the Intrasystem Analysis Program, a sophisticated computerized prediction tool used to design new weapon systems to be free of electromagnetic interference effects.

WORK PERFORMED BY: The in-house activity is performed at the Rome Air Development Center, Griffiss AFB NY. Ten major contractors in FY 1979 were: Hughes Aircraft Co., Culver City CA; Syracuse University, Syracuse NY; Martin-Marietta, Orlando FL; Atlantic Research Corp., Alexandria VA; Georgia Tech Research, Atlanta GA; Singer Kearfort, Little Falls NJ; McDonnel Douglas, St. Louis MO; Texas Instruments, Dallas TX; IITRE, Chicago IL; Microwave Associates, Burlington MA. There were seventeen (17) contractors with twenty-two (22) contracts in FY 1979.

Project: #2338 Title: Assurance Techniques for Electronics
Program Element: #62702F Title: Command, Control and Communications
DOD Mission Area: Electronic and Physical Sciences (ED), #521 Budget Activity: Technology Base, #1

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: Complete reliability analyses were performed on second generation microprocessors, microcomputers and support large scale integrated (LSI) chips. Specifically, dated specifications were generated for the 2901 and 9900 microprocessors with their listing on the qualified list expected in late CY 1979. Also, the equipment/system testability discipline was defined and factors affecting the overall testability of a system were identified. Design guidelines for built-in-test were prepared for use by military system designers. In the electromagnetic compatibility (EMC) analysis area, an Intrasystem Analysis Program (IAP) support center was established and implemented to serve as a technology transfer mechanism and as an aid in the feedback mechanism for technology development. An initial study to determine the framework for a system level EMC analysis and prediction capability for Air Force systems in the late 1980 timeframe was completed. A methodology for invoking EMC analysis procedures in Air Force weapon systems in modification status was developed. In the EMC control area, EMC design techniques to reduce spurious and broadband noise within $\pm$ 15 MHz of the carrier frequency, and ultra high frequency (UHF) solid state transmitters were developed. Additionally, technology to increase the high level interfering signal handling capability of solid state receivers was developed.

2. FY 1980 PROGRAM: The reliability and maintainability (R&M) technology efforts will concentrate on product evaluation, reliability assurance methodology and electrical characterization of microprocessors, memories and other large scale and very large scale integrated circuits (LSI and VLSI). R&M prediction studies will be performed on LSI devices with emphasis on combined hardware/software models. The concept of testability of systems will be further defined and a comprehensive handbook prepared. In the EMC analysis area, a major initiative will commence in the area of microelectronics with a study of potential EMC problems associated with increasing usage of microcircuits. Studies will also cover the EM susceptibility of fiber optic transducers, EM coupling into electrically loaded cavities, and the non-linear behavior of electronic systems. For EMC control, transmitter and receiver design technologies will be optimized and then combined with new device technology to fabricate a test vehicle transceiver for testing in C^3 environments.

3. FY 1981 PLANNED PROGRAM: Reliability evaluations will be done of third generation microprocessors including development of LSI test generation and fault isolation procedures. The R&M prediction, design and demonstration techniques and testability programs will continue to evolve methods for improving equipment/system availability and reducing life cycle costs including the development of a handbook on electrical/electromechanical assemblies. Those aspects of device reliability in LSI that have been developed under this program will be used in reliability determinations under the DOD Very High Speed Integrated Circuit (VHSIC) program, as continued from FY 1980 work. Continued EMC microelectronic characterizations, EMC modelling and shielding efforts are planned.

Project: #2338
Program Element: #62702F
DOD Mission Area: Electronic and Physical Sciences (ED), #521

Title: Assurance Techniques for Electronics
Title: Command, Control and Communications
Budget Activity: Technology Base, #1

4. FY 1982 PLANNED PROGRAM: Device reliability studies will cover Very Large Scale Integrated circuits (VLSI) technologies with initiatives in reliability assurance and computer performance modelling of advanced devices. The system testability program will cover evaluation and optimization of the analytical foundations of testability. A baseline characterization of microelectronics compatibility performance will result in design guidelines and analysis models. A technology to cancel interference across broad bandwidths will be completed.

5. PROGRAM TO COMPLETION: This is a continuing program.

6. MILESTONES: Not Applicable.

7. RESOURCES: ($ in thousands)

	FY 1979 Estimated	FY 1980 Estimated	FY 1981 Estimated	FY 1982 Estimated	Additional to Completion	Total Estimated Costs
RDT&E Funds	4,875	4,600	5,200	6,000	Continuing	Not Applicable

8. COMPARISON WITH FY 1980 BUDGET DATA: Not Applicable, no change.

Project: #4506 Title: Surveillance Technology
Program Element: #62702F Title: Command, Control and Communication
DOD Mission Area: Electronic and Physical Sciences (ED), #521 Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to develop advanced ground and space based systems, sensors and technology base for application to future Air Force surveillance needs. The major thrusts include new tactical radars, ECCM and survivability technologies; to improve performance and reduce vulnerability of military radar systems to electronic countermeasures (ECM); the application of multi-demensional high resolution concepts for enhanced target identification in a dynamic hostile environment; the development and application of spaceborne radar technology for multi-mission applications; to improve the overall survivability and performance of electronic high powered thermionic tubes/transmitters; the development of advanced signal processing techniques/equipment; and the development of a means of detecting, tracking and identifying cruise missile threats.

RELATED ACTIVITIES: Electron (thermionic) tube and device developments are coordinated through the DOD Advisory Group on Electron Devices and Technology Coordination Paper on Electronics. In addition, tri-service panels, and working groups such as the ECM working group and target identification working group, meet on regularly scheduled bases to discuss and coordinate activities. All of these insure that technology development programs meet military service needs and avoid unnecessary duplications. The work undertaken in this project is related to on-going activities at the Air Force Avionics Laboratory, Lincoln Laboratory, Army Electronics Command, Office of Naval Research and Defense Advanced Research Projects Agency. Internal Air Force coordination to avoid duplication is accomplished through program reviews at all levels of command, technology seminars and working group meetings. The technology output of the Surveillance Technology project is transitioned into PE 63789F, C^3 Advanced Development, and PE 63750F, Counter-Countermeasures Advanced Development.

WORK PERFORMED BY: The in-house activity is performed at the Rome Air Development Center, Griffiss AFB NY, at the Deputy for Electronic Technology, Hanscom AFB MA and at small off-base sites in New York state. The ten major contractors in FY 1979 were: General Electric, Syracuse NY; Varian Associates, Palo Alta CA; Harris Corporation, Ann Arbor MI; Tech Services Incorporated, Santa Monica CA; Syracuse Research Corporation, Syracuse NY; Westinghouse Electronics, Baltimore MD; IT&T Corporation, Van Nuys CA; Sperry Rand Corporation, Clearwater FL; RCA Corporation, Moorestown NJ. There were 23 contractors and 31 contracts in FY 1979.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: The tactical surveillance Digitally Coded Radar (DCR) signal processor has been completed and subjected to intensive laboratory ECCM tests at RADC. This processor has been integrated with a transmitter and a modified ASR-5 antenna to provide an experimental radar for evaluation against ECCM. In addition, supporting high power tube technology has demonstrated a 1 KW octave bandwidth radar tube which should have a significant impact on ECCM. Analytical tools were developed and trade-off analyses were conducted for spaceborne radar for various concepts of orbit selection, frequency, number of satellites, waveform design and antenna design. Trade-off issues included target detection, clutter suppression, coverage, launch vehicle constraints and ECM. In addition,

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Program Element: #62702F
DOD Mission Area: Electronic and Physical Sciences (ED), #521

Title: Surveillance Technology
Title: Command, Control and Communications
Budget Activity: Technology Base, #1

an advanced on-board signal processor design was completed. Processing requirements were generated for a postulated family of spaceborne sensors. Tactical electronic support measurement (ESM) equipment and an active radar have been used collectively to determine their combined utility in enhancing the identification of aircraft. This work clearly demonstrated the synergistic effect of employing several sensors in combination to identify unknown aircraft.

2. FY 1980 PROGRAM: Surveillance - Survivability and performance analyses for an advanced tactical radar (ATR) will be completed. Analysis and testing of new main beam anti-jam concepts for application to the E-3A and ATR radars will be performed. A low altitude strategic surveillance system design for CONUS air defense will be initiated. Advanced on-board signal processing, transmit/receive modules, phased array simulation/analysis and power distribution techniques will be pursued for spaceborne surveillance. A definition for regional fusion of identification data will be conducted utilizing multi-sensor data correlation to enhance the ability to identify aircraft. The technical feasibility of several promising concepts for air launched cruise missile detection will be evaluated. These include alarm sensors, UHF warning fences and VHF bistatics. Development of improved traveling wave tubes will begin.

3. FY 1981 PLANNED PROGRAM: Further development and testing of main-beam anti-jam technology, both for target detection and jammer location, will be pursued for tactical surveillance. Studies will be initiated to define the systems characteristics of an Advanced Airborne Surveillance Radar (AASR) for the E-3A. A strategic surveillance (spaceborne radar) low altitude system design will be completed and radio frequency interference analysis/studies will continue. Advanced on-board signal processing, transmit receive modules and phased array analysis/validation efforts will continue. A ground-to-air identification data collection effort for radar and other sensors will be started to provide a real world data base for subsequent validation efforts. Field testing of air launched cruise missile (ALCM) detection concepts will be initiated as well as studies for cueing of dedicated sensors by detection of the ALCM carrier. Development of traveling wave tubes will continue.

4. FY 1982 PLANNED PROGRAM: Preliminary system parameters of the AASR will be bounded and strawman system designs developed. From these, applicable subsystem technologies will be selected for breadboard model development. Detailed system designs and areas of technology such as transmit/receive modules and phased array analyses, for space based radar will continue. Phased array concepts and membrane hardware will be validated using existing simulations. A demonstration/validation of C^3I multi-sensor data correlation for aircraft identification will culminate in an identification testbed. ALCM detection concepts will be initiated in advanced development to include an assessment of down looking concepts for wide area surveillance. Multi-sensor system concepts demonstrating complementary sensor performance will be developed. Traveling wave tube efforts will be completed.

5. PROGRAM TO COMPLETION: This is a continuing program.

6. MILESTONES: Not applicable.

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Project: #4506
Program Element: #62702F
DOD Mission Area: Electronic and Physical Sciences (ED), #521

Title: Surveillance Technology
Title: Command, Control and Communication
Budget Activity: Technology Base, #1

7. RESOURCES: ($ in thousands)

FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
5,573	5,600	6,600	7,800	Continuing	Not Applicable

8. COMPARISON WITH FY 1980 BUDGET DATA:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Proj #4506, Surveillance Technology	4,414	4,500	5,516	6,000	Continuing	Not Applicable

Increased emphasis will be placed on enhancing radar survivability in hostile electromagnetic environments.

Project: #4519 — Title: Communications and Control Technology
Program Element: #62702F — Title: Command, Control and Communication
DOD Mission Area: Electronic and Physical Science (ED), #521 — Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: The objectives of this project are to: (1) design, develop and test advanced techniques and concepts for command and control of a mixed force of manned and unmanned vehicles in a hostile environment, (2) improve and enhance utilization of communications transmission media ranging from VLF to optical frequencies to satisfy command and control communications needs for electromagnetic survivability (ECCM), for greater flexibility in communications channel utilization and for higher data rates, (3) develop capabilities to provide efficient, reliable and survivable information handling, routing and distribution at communications terminal and Model facilities. Major thrusts include the development of a cost-effective integrated emitter location and identification capability for stand-off all-weather precision location and strike of enemy weapon systems; exploitation of spread spectrum and adaptive antenna technology to enhance ECM survivability; development and enhancement of modulation techniques to increase bandwidth efficiency; the development of facilities for generating, combining and routing of analog and digital information; to perform analysis simulation, test/evaluation and demonstrate interoperability between communications systems.

RELATED ACTIVITIES: The work undertaken in this project is related to on-going activities at the Air Force Avionics Laboratory, Lincoln Laboratory, Office of Naval Research, NASA, Defense Advanced Research Projects Agency, the US Army Satellite Communications Agency and the Defense Communications Agency. Tri-service working groups and panels, such as the Fiber Optics Coordinating Group, meet to discuss and coordinate activities. Internal Air Force coordination is accomplished at all levels of management to eliminate duplication. The technology output of the Communications and Control Project is transitioned into PE 63789F, C^3 Advanced Development and PE 33126F, Long Haul Communications.

WORK PERFORMED BY: The in-house activity is performed at the Rome Air Development Center, Griffiss AFB NY, at the Deputy for Electronic Technology, Hanscom AFB MA and at small off-base sites in New York state. The ten major contractors in 1979 were: BDM Corporation, McClean VA; Harris Corporation, Melbourne FL; Pattern Analysis Recognition, Rome NY; Hazeltine Corporation, Greenlawn NY; Ohio State University Research Foundation, Columbus OH; CNR Corporation, Upper Falls MA; IBM Corporation, Owego NY; GTE Sylvania, Needhan Heights MA; Ball Brothers Research Corporation, Boulder CO; Signatron Corporation, Lexington MA. There were 25 contractors with 44 contracts in 1979.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: The feasibility of rapid coherent communications emitter location using newly developed location algorithms having accuracies commensurate with Precision Location Strike System (PLSS) requirements was demonstrated. An extensive collection of overseas communications emitter signals was completed. The data collected were used to evaluate hardware/software techniques to identify these emitter signals. A radar signal identification program was successfully completed which can be integrated into PLSS. Electromagnetic counter-

countermeasure (ECCM) accomplishments included: Completion of experimental evaluation of spread spectrum synchronization, fabrication and test of a fast frequency hop synthesizer for distance measurement equipment (DME) data link applications, evaluation of a combined adaptive array/psuedo noise modem with desired signal identification and completion of a computer simulation program for a tactical warfare scenario. Remote keying of a VLF transmitting antenna has been demonstrated. In-house testing of a UHF adaptive antenna processor was completed and the results were transitioned to the SEEK TALK program. Various modulation schemes and associated adaptive array processors have been evaluated and work to characterize the vulnerabilities of adaptive antennas to various jamming threats has been completed. A sidelobe canceller for troposcatter radio applications was extensively tested and the development of coding techniques for anti-jamming was completed. A four bits/sec/Hz modulation technique design for line-of-sight microwave communications and a special study of fiber optics applications were completed.

2. FY 1980 PROGRAM: Communications and Control - Coherent emitter location technology will be extended to include the capability to locate and identify emitters independent of modulation. Ultra high frequency and super high frequency microstrip antenna development will continue. Guidelines will be developed for fiber optic components and development of a 26-pair fiber optic cable will be initiated. A model for line-of-sight/tropo communications systems electronic counter-countermeasures will be developed. Low data rate high frequency (HF) modem development will continue and a tunable HF transmitter effort will be initiated. Architectural design for adaptive communications will continue and a program to develop a system design development environment (SDDE) will be initiated.

3. FY 1981 PLANNED PROGRAM: Communication and Control - Coherent emitter location and identification techniques will be applied to counter enemy command and control. Development will be initiated for a standard fiber optics transceiver and millimeter wave radio development. Twenty-six pair cable fiber optics, line-of-sight/tropo system design for ECCM and HF transmitter developments will continue. Distributed network studies and system control development for automated communications systems will be initiated. SDDE development will continue.

4. FY 1982 PLANNED PROGRAM: Communications and Control - Development will continue for command and control countermeasures, standard fiber optics transceiver, millimeter wave radio, high frequency transmitter adaptive antenna, adaptive communications, and distributed networks and SDDE.

5. PROGRAM TO COMPLETION: This is a continuing program.

6. MILESTONES: Not Applicable.

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Project: #4519
Program Element: #62702F
DOD Mission Area: Electronic and Physical Science (ED), #521

Title: Communications and Control Technology
Title: Command, Control and Communication
Budget Activity: Technology Base, #1

7. RESOURCES: ($ in thousands)

	FY 1979 Estimated	FY 1980 Estimated	FY 1981 Estimated	FY 1982 Estimated	Additional to Completion	Total Estimated Costs
RDT&E Funds	4,690	4,500	5,800	6,900	Continuing	Not Applicable

8. COMPARISON WITH FY 1980 BUDGET DATA:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional Continuing	Total Estimated Costs
Proj #4519 Communications and Control Technology	3,105	4,100	4,400	5,000	Continuing	Not Applicable

Increased emphasis will be placed on fiber optics communications and on providing a development environment for Command, Control and Communications (C^3) systems.

Project: #4594 — Title: Intelligence Technology
Program Element: #62702F — Title: Command, Control and Communications
DOD Mission Area: Electronic and Physical Sciences (ED), #521 — Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to improve and/or automate techniques to extract intelligence from a variety of source data. Major thrusts include the exploitation of recording and data handling technologies for proper and timely collection, processing, storage and dissemination of extremely high data rate intelligence information; the application of speech signal processing and pattern recognition technology to C^3I systems; the development and application of automated techniques to the storage, processing, distribution and presentation of large amounts of non-numerical data for decision making; the development of improved methods and equipments for utilizing and exploiting strategic and tactical reconnaissance mapping imagery in the timely production of deployable digital and photo data bases aeronautical chart graphics and target materials; the development of techniques and hardware to improve the timeliness and quality of military target intelligence derived from reconnaissance systems; the evaluation of reconnaissance systems to determine sensor capabilities for providing timely detection and intelligence; and the automation of exploitation functions used by image interpreters and the integration of this data with other forms of intelligence.

RELATED ACTIVITIES: Image exploitation programs are coordinated through a national committee while the Defense Mapping Agency (DMA) coordinates all service programs in mapping and charting. The National Security Agency (NSA) coordinates all service programs in signal intelligence and the Defense Intelligence Agency (DIA) coordinates all work in intelligence data handling. All of the preceding insures that intelligence technology development within the services is not unnecessarily duplicated. Internal Air Force coordination is accomplished through program reveiws at all levels of command. The technology output of the Intelligence Technology project is transitioned into PE 63789F, C^3 Advanced Development; PE 63747F, Low Visibility Moving Target Acquisition/Strike; PE 63208F, Reconnaissance Sensors/Processing Techniques; PE 31011G(F), Cryptological Activities; PE 31022F, Scientific and Technical Intelligence; PE 31025F, Intelligence Data Handling Systems; PE 63701B, Mapping and Charting; and PE 64750F, Intelligence Equipment.

WORK PERFORMED BY: The in-house work is performed at the Rome Air Development Center, Griffiss AFB NY and at the Deputy for Electronic Technology, Hanscom AFB MA. The ten major contractors for FY 1979 were: DAR Incorporated, Rome NY; Synetics, Fairfax VA; Operating Systems Incorporated, Woodland Hills CA; DBAS Systems Incorporated, Melbourne FL; Control Data Corporation, Minneapolis MN; Rome Research Corporation, Rome NY; Technology Service Incorporated, Santa Monica CA; Harris Corporation, Melbourne FL; TRW, Redondo Beach CA; University of Texas, Austin TX. There were 36 contractors with 77 contracts in FY 1979.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: An experimental model of a 1.0 Gigabit per second holographic recorder/reproducer was demonstrated. Bit error rates of 1×10^{-7} and a packing density of 1.6×10^8 bits per square centimeter were achieved. Speech technology achievements included the elimination of background noise from recorded airborne communications and the development and integration of algorithms for signal gating, signal enhancement and

interference reduction into the Speech Processing Analysis Station (SPANS). An advanced query capability for non-numeric data processing which permits access to differently formatted data bases was demonstrated. This capability, designed with minimum dependence on any particular hardware or operating system, can be transferred to an operational system with the development of minor interface modules. Event prediction algorithms have been developed and evaluated which will permit an analyst to test hypotheses concerning the occurrence of events. Image exploitation advancements included image enhancement techniques to provide a real time exploitation concept for FLIR imagery and the demonstration of an advanced target location and strike (ATLAS) capability. The ATLAS demonstration used three sensor models coupled with a simulated scenario of eastern Europe to demonstrate a near real-time correlation/display of ground target information. This capability has been transitioned into PE 63789F. A Digital Analysis System (COMTAL/PDP-11/45) has been installed to address the exploitation of digital imagery materials and direct positioning techniques to support tactical and strategic targeting scenarios.

2. FY 1980 PROGRAM: Signal processing activity will include the completion of the digital optical disk development to extend its capability to 320 megabits per second with a bit error rate of 1 bit in 10^8 and 500 millisecond access time. Key technology areas include multiple channel recording and laser diode sources. A 600 megabit per second magnetic computer compatible system will continue through FY 82. Goals for the system include start/stop/seconds capability of 2.25 milliseconds and rewind speeds of up to 800 inches per second. Speech processing signal enhancement, spectral estimation and speech reduction techniques will be investigated. Non-numeric data processing activity will focus on the development of intelligence analysts in estimating future events. Hardware and software will be developed and evaluated for imagery exploitation to classify and identify targets from image data. Automatic pattern recognition, digital cueing and simulation techniques will be utilized for performing the evaluation.

3. FY 1981 PLANNED PROGRAM: Continue 600 megabit per second magnetic computer compatible system development; complete non-numeric data handling techniques to assist analysts in estimating next likely events; complete the evaluation of hardware and software for detecting, classifying and identifying targets from image data; continue speech processing activity.

4. FY 1982 PLANNED PROGRAM: Complete the 600 megabit per second magnetic computer compatible system; develop techniques to assist intelligence analysts in message centers extraction, cover and deception methods, source data scenario generation and excercise generation. Inherent in these efforts will be the development of an active data base system wherein presorted algorithms act upon the incoming data and alert the intelligence analyst when an event or combination of events are occurring. Imagery exploitation effort will focus on the development of more efficient compression algorithms for transmitting and storing digital image data.

5. PROGRAM TO COMPLETION: This is a continuing program.

6. MILESTONES: Not applicalbe.

Project: #4594
Program Element: #62702F
DOD Mission Area: Electronic and Physical Sciences, (ED), #521

Title: Intelligence Technology
Title: Command, Control and Communications
Budget Activity: Technology Base, #1

7. RESOURCES: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	4,459	4,784	5,800	6,900	Continuing	Not Applicable

8. COMPARISON WITH 1980 BUDGET DATA:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Proj #4594, Intelligence Technology	3,902	4,000	4,700	5,300	Continuing	Not Applicable

Increases will be used for technology to improve imagery exploitation.

Project: #4600 Title: Electromagnetic Radiation, Devices & Components
Program Element: #62702F Title: Command, Control and Communications
DOD Mission Area: Electronic and Physical Sciences (ED), #521 Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This project provides the Air Force with a strong technology base and the devices and techniques for exploitation of electromagnetic radiation in command, control and communications (C^3); surveillance, and other related systems. The work conducted falls into two broad categories, electromagnetic radiation and transmission technology and solid state device technology. Principal areas of activity are: antennas and radio frequency components, electromagnetic systems concepts propagation, electromagnetic materials for C^3 applications, advanced solid state devices and circuits, optical and electro-optical devices, and technology for radiation hardening. The antenna, components and propagation technologies attack methods of increasing anti-jam capabilities and survivability aspects of strategic and tactical C^3 systems. The fiber otpics efforts address the very promising techniques for replacing existing cabling systems with low cost, radiation immune, secure, wideband fiber optics links. The electromagnetic materials and devices technologies produce faster, cheaper, much smaller components for such critical missions as tactical radar signal processing. Radiation hardening ensures C^3 mission availabilities inspite of nuclear and space environments.

RELATED ACTIVITIES: Efforts related to electronic devices are coordinated through the DOD Advisory Group on Electron Devices and Technology Coordination Paper on Electronics. Antenna efforts are coordinated through the Interservice Antenna Group. Efforts are also coordinated with North Atlantic Treaty Organization (NATO) nations through participation in international panels. In addition, tri-service panels, and working groups meet on regularly scheduled bases to discuss and coordinate activities. All of these insure that technology development programs meet military service needs and avoid unnecessary duplications. The work undertaken in this project is related to on-going activities at the Air Force Avionics Laboratory, Air Force Weapons Laboratory, Air Force Materials Laboratory, Lincoln Laboratory, Army Electronics Command, Office of Naval Research. Basic research in PE 61102F, Defense Research Science, transitions into this project. Project efforts transition into advanced development programs such as PE 63789F, Command, Control and Communications Advanced Development, PE 63750F, Counter-Countermeasures Advanced Development, and PE 63431F Advanced Space Communications.

WORK PERFORMED BY: The in-house activity is performed at the RADC Deputy for Electronic Technology, Hanscom AFB MA, and at off base sites in Massachusetts. Ten major contractors in FY 1979 were: Texas Instruments, Dallas TX; Hughes Aircraft Co., Fullerton CA; Hazeltine, Greenlawn NY; Westinghouse Electronic, Baltimore MD; MEGAPULSE, Bedford MD; Sperry Rand, Great Neck NY; NORDEN Systems Inc., Norwalk CN; United Technologies, East Hartford CN; Frequency Electronics, New Hyde Park NY; SIGMA PAU Standards, Tusculoosa AL. There were 51 contractors with 64 contracts in FY 1979.

Project: #4600 Title: Electromagnetic Radiation, Devices & Components
Program Element: #62702F Title: Command, Control and Communications
DOD Mission Area: Electronic and Physical Sciences (ED), #521 Budget Activity: Technology Base, #1

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: Antenna technology produced experimental results for a special four array antenna which yields hemispherical coverage from aircraft. Conformal antennas of this type are desirable since they reduce weight and drag. New models for penetrating foliage cover with low microwave frequencies were developed for reconnaissance uses. High Frequency (HF) ionospheric ducting, a promising technology for communicating in nuclear effects environments, was further advanced through experimental verification that HF waves can be artificially ejected from the duct. Precision clocks technology need for space applications produced a successful demonstration of a 1.4 GHZ surface acoustic wave (SAW) oscillator. In radition hardening a new process for fabricating hardened bi-polar integrated circuits was developed. In the device technology area a 512 stage analog binary correlator for spread spectrum and anti-jam communications was developed. A unique charge coupled device (CCD) was demonstrated for use in Doppler Sorting in radar processors. The electromagnetic device materials produced a new method of producing low cost indium phosphide in one hour compared to 32 days by other methods. An apparatus was designed for removing quartz crystal impurities and the design is transitioning to industrial usage.

2. FY 1980 PROGRAM: Antenna technology efforts will produce new feed techniques for planar and cylindrical arrays which will yield low sidelobe patterns, thus increasing systems anti-jam capability. Conformal antenna work will include development of multi-frequency microstrip elements and a new technology approach to produce low profile antennas at extremely high frequencies (EHF), useful for more survivable communications in combat conditions. Investigations will continue in the HF ducting ionosphric communictions work with experimentation on charges in injected, propagated and extracted signals caused by ionospheric disturbances. The device efforts using SAW and CCD technology will include development of programmable devices for signal processing, such as signal integrators. Development will continue in refining electromagnetic materials needed for producing radiation resistant devices, accurate timing devices for satellite systems, and low cost replacement components using CCDs and SAW devices. Efforts to radiation harden fiber optic components and LSI devices will continue. Intrusion resistant fiber optic cabling and transmit receive modules development will be pursued as promising technology to replace some existing expensive secure communications links at much lower costs.

3. FY 1981 PLANNED PROGRAM: Antenna efforts will include feasibility determinations of wideband null steering techniques for spaceborne radars, an especially difficult problem for these large structures. The evaluation of extremely high frequency (EHF) antennas for Satellite Communications (SATCOM) will be completed. Propagation work will produce an experiment in high frequency (HF) ionospheric ducting to be completed in FY 1982 and to be tested on space experimental flights. Propagation parameters for low frequency (LF) will be determined to try to make substantial advances in this portion of the electromagnetic spectrum as a survivable communications capability under nuclear and ionospheric blackout conditions. Surface acoustic wave (SAW) and charge coupled device (CCD) work will emphasize development of high frequency (HF) filters for communications and radars to replace large costly components currently used. Also, signal correlators for wideband radars will be pursued for spread spectrum processors

to replace large, heavy, many component systems presently hindering mobility of tactical C^3 elements. Lightweight low cost digital beam steering using processors instead of large microwave control devices will be investigated for ground based phased array radars. Charge coupled device efforts will be ready for manufacturing technology. The development of low loss fiber optic cable and improved fiber optic signalling device technology will begin transition to advanced development for eventual tactical use. Radiation hardening will include characterization work for LSI and VLSI devices, metal nitrided oxide semiconductors (MNOS) memories and magnetic bubble memories. The electromagnetic materials efforts will continue with emaphsis to support acoustic and optical materials needed for the above efforts.

4. FY 1982 PLANNED PROGRAM: The program will develop the technology base to improve the efficiency utility and appropriateness of antennas, surface acoustic wave devices, electromagnetic and electro-optical materials, solid state devices, radiation hardened techniques, electromagnetic systems concepts, communication and surveillance techniques. The spaceborne radar nulling effort and low frequency propagation effort will be completed. The signal processing correlators, high frequency filter effort and digital beam steering devices will also be completed. Radiation hardening will continue for VLSI devices and fiber optic communications development technology will continue to transition and support advanced development.

5. PROGRAM TO COMPLETION: This is a continuing program.

6. MILESTONES: Not applicable.

7. RESOURCES: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	4,072	4,600	5,800	6,900	Continuing	Not Applicable

8. COMPARISON WITH FY 1980 BUDGET DATA:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Proj #4600, Electromagnetic Radiation, Devices and Components	2,757	4,000	4,600	5.100	Continuing	Not Applicable

Increased funds will be used to improve programmable signal processing device technology using charge coupled devices and surface acoustic wave devices.

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Project: #5581 — Title: Information Sciences Technology
Program Element: #62702F — Title: Command, Control & Communications
DOD Mission Area: Electronic and Physical Sciences (ED), #521 — Budget Activity: Technology Base, #1

DETAILED BACKGROUND AND DESCRIPTION: This project is the only Air Force exploratory development effort which provides technologies to solve generic problems experienced in the acquisition and maintenance of computers which are embedded in Air Force weapon systems and their associated software. The primary objective is to aid in reducing the costs associated with all phases of computer resource acquisition and supporting operational requirements. The Air Force and Department of Defense (DOD) have experienced high costs in computer resource acquisition and maintenance. The DOD's annual cost for computer systems embedded in weapons alone is $1.4 Billion due to high design, programming, test and validation, and training costs which are for the most part labor intensive. The drop in prices of computer hardware have made computers, from the smallest to the largest, a building block of every major system developed for the Air Force. Developing the software has become the most costly item of computer systems and has been rising per line of instruction delivered because of the increased complexity of the software written and rising labor costs. Software development has largely remained a heuristic technique rather than an engineering discipline. The thrust of this project, therefore, is to develop those technologies which are needed to evolve software development, acquisition, and maintenance into a controllable, disciplined process. This includes developing automated aids for both managers and designers, mathematically rigorous validation techniques for large programs, and computer techniques which allow reuse of proven software, and simplified use of high order languages. All these thrusts are beyond the existing state-of-the-art in computer technology. This project also supports the operation and maintenance of the Rome Air Development Center's (RADC) computer systems; about 41% of the project funds are required to support these.

RELATED ACTIVITIES: The work performed under this project is reviewed at the DOD level along with other 6.2, 6.3 and 6.4 programs in information processing technology. It supports the DOD Defense Systems Software Research and Development Technology Plan. Related non-Air Force programs are PE 62701A, Communications Electronics, PE 62725A, Computer Sciences, PE 62721N, Command and Control Technology, and PE 62706E Distributed Information Systems. Within the Air Force, promising technologies are passed on to PE 63728F, Advanced Computer Technology and PE 64740F, Computer Resource Management Technology, for demonstration and application,

WORK PERFORMED BY: Major contractors in FY 1979 were: Operating Systems Inc., Woodland Hills CA; University of Southern California, Los Angeles CA; TRW Inc., Menlo Park CA; Bolt Beranek and Newman, Inc., Cambridge MA; Honeywell Information Systems Inc., McClean VA; Computer Corporation of America, Cambridge MA; Utica College of Syracuse University, Utica NY; General Research Corporation, Santa Barbara CA. There were eight (8) contractors with 19 contracts in FY 1979.

Project #5581
Program Element: #62702F
DOD Mission Area: Electronic and Physical Sciences (ED), #521

Title: Information Sciences Technology
Title: Command, Control & Communications
Budget Activity: Technology Base, #1

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: In the past, the project has provided the framework for software acquisition specifications which exist today. The tools necessary to control higher order computer language, which were being proliferated and non-standardized, were developed under this project. Mathematical models needed for predicting reliability of computer sofware were developed. In FY 1979, a plan was completed which will produce a complete set of tools to be used in weapon system software acquisition to allow concise statement of the operational users requirements in the terms necessary to ensure computer program developers actualiy implement those requirements when writing the software program code. A handbook was completed that enables software acquisition managers to specify and then measure the actual quality of software that contractors are developing. The first software reliability prediction model for Avionics was developed, tested and made operational on the RADC Research and Development (R&D) computer facility for remote use by system software acquisition agencies. The R&D computer facility was upgraded to allow greater user access capability. Efforts in support of the development of Ada were continued.

2. FY 1980 PROGRAM: Evaluation of several computer systems and the selection of an optimum one for use in automatically testing specifications for embedded computer systems will be completed. Reliability modelling of software will continue with enhancements to the initial models. Efforts for providing a methodology in maintaining software will be pursued and will continue through FY 1982. Studies on the interoperability and means of determining quality of distributed systems will continue. Distributed systems are needed to increase survivability, especially in tactical systems, and studies on the intracacies of interconnecting microprocessors in systems will contribute to advancing the distributed systems technology base. Efforts in automatic programming techniques will continue and a programming environment for Ada will be produced. Funding of the research and development computer facility will continue.

3. FY 1981 PLANNED PROGRAM: The system for automatic test of embedded computer specifications will be developed and tested on on-going weapon system acquisition programs. Software reliability efforts will continue and techniques for estimating software reliability will be completed. Methods for controlling errors in distributed systems will be developed. Development of design guides, tools and standards for procuring systems containing microprocessors will continue and development of microprogramming verification tools will be completed. Development of higher order language control, automatic programming and support to Ada will continue. A very high order language programming system will be demonstrated. A new thrust will be undertaken to provide the exploratory development work need to meet the Air Force computer technology needs for the next twenty years. These needs are identified in the Air Force Systems (AFSC) Computer Technology Forecast and Weapon System Impact Study (COMTEC-2000) which is being published in the first quarter of FY 1980. This study was done in response to an AFSC initiative which specifies development planning objectives should guide future needs and laboratory programs and Independent Research and Development (IR&D) in industry should be considered in planning to meet future needs. The study contains inputs from government,

industry, and the academic sector. COMTEC-2000 better defines and implements policies and research and development programs that will capitalize on commercial advances in computer technology and also satisfy computer technology needs unique to the Air Force through the year 2000. The specific plans for the FY 1981 project efforts in support of COMTEC-2000 are currently being developed for starting in FY 1981. Additional funds in FY 1981 through FY 1985 have been programmed in this project above the levels previously planned, specifically to satisfy the needs identified in COMTEC-2000.

4. FY 1982 PLANNED PROGRAM: System refinements for automatic testing of specifications will be complete. The research and development computer facility will continue to be funded. Reliability and maintainability techqniques for improving systems software availability will continue and a general reliability model will be demonstrated. Control methods to eliminate distributed systems errors will continue and microprocessor systems handbooks will be completed. Automatic programming features which are proven fruitful will transition to advanced development. Support of the technology begun in FY 1981 for COMTEC-2000 will continue.

5. PROGRAM TO COMPLETION: This is a continuing program.

6. MILESTONES: Not applicable.

7. RESOURCES: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	4,508	5,200	7,200	8,000	Continuing	Not applicable

8. COMPARISON WITH FY 1980 BUDGET DATA:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Proj #5581, Information Sciences Technology	4,596	4,500	5,100	5,400	Continuing	Not Applicable

Increased emphasis will be placed on this project to best meet the Air Force computer technology needs for the next twenty years (See Item 3, FY 1981 PROGRAM).

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FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element 62703F
DoD Mission Area: Environmental and Life Sciences (ED) #522

Title: Personnel Utilization Technology
Budget Activity: Technology Base #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4,303	4,500	5,600	6,200	Continuing	Not Applicable
06EH	Laboratory Support	2,890	3,500	3,800	4,400		
2077	Personnel Management Systems Development	203	38	200	300		
7719	Selection & Classification Technology	647	583	1,100	750		
7734	Force Structure and Utilization	563	379	500	750		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force has a continuing need for quality men and women who can operate, maintain, and interact with high-technology equipment. The Air Force requires people with imagination, ingenuity, and the drive to get things done. Moreover, the Air Force faces serious problems in recruiting and retaining pilots and technical personnel. The effects of these shortfalls as well as early departures will be felt well into the future. This MANPOWER AND PERSONNEL RESEARCH program covers best ways to select from the service eligible population those individuals who are most likely to complete flying or technical training and those who have the highest potential for becoming long-term productive performers in their job assignments. Included are methods for matching persons to jobs that meet career choices and operational mission requirements, structuring work tasks into jobs and into occupational career fields, analytical techniques that forecast impacts on the force from changes in personnel policy, and a personnel data management analysis capability. The effective use and retention of service personnel is critical because the service eligible population is smaller than it has been in past years. A special effort is the development of a new Civilian Appraisal System required by the Civil Service Reform Act of 1978 (CSRA 1978). The Air Force Civilian Appraisal System is, among all Federal agencies, the analytically-based system which best meets required operational characteristics. Immediate benefits under this program are technologies which aid procurement and optimal assignment of individuals best qualified for Air Force Service. Longer term benefits include a decrease in the gross cost of accessions, reduction in training turnover and costs as a function of reduced attrition in training, and increased retention of quality personnel. This research will lead to better utilization of all Air Force personnel. Operation and maintenance of the Air Force Human Resources Laboratory (AFHRL), Brooks AFB TX, is partially funded in this program.

Program Element: #62703F
DoD Mission Area: Environmental and Life Sciences (ED) #522

Title: Personnel Utilization Technology
Budget Activity: Technology Base #1

BASIS FOR FY 1981 RDT&E REQUEST: This program funds efforts designed to: develop and evaluate the usefulness of non-traditional measures of aptitude interest; determine factors which relate to effective crew performance; continue studies that make it easy to identify personnel that are not likely to adapt to military service; assess measures that quantify and evaluate pilot stress levels and the relationship of stress to training performance and combat effectiveness; develop an Air Force civilian appraisal system; continue updating and refining the Armed Services Vocational Aptitude Battery (ASVAB) in which the Air Force Human Resources Laboratory has lead responsibility within the Department of Defense, continue the development, demonstration, and evaluation of computerized measurement systems in selection and classification of personnel; structure the force on the basis of skills, knowledge, training, and grades required to perform the work load through optimized person-job-match programs; forecast the probable outcomes of alternative policy deicisons on the personnel and manpower systems; design and establish a center for the collection, analysis, maintenance, and ready retrieval and reporting of wide variety of historical and current information describing all airmen and officer occupations; develop the components and subsystems for a computer-assisted training decision system to facilitate decisions about training settings and schedules; update personnel and training research data banks; and continue work on a data base that cross references informational systems.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #62703F
DoD Mission Area: Environmental and Life Sciences (ED) #522

Title: Personnel Utilization Technology
Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: This program element addresses work in the human resources category of MANPOWER AND PERSONNEL research. This program element is the major vehicle for Research and Development (R&D) efforts in the area of personnel utilization which support the Air Force personnel system and all Air Force commands, as well as other Department of Defense elements. Cost avoidance totaling many times the investment may be realized each year by applying the concepts developed within this program. Specific objectives and developments include: measurement of those factors that influence enlistment, career decisions, and adaptation to service life; development of an appraisal system for civilian employees; development of procedures to assure equal economic opportunity for all persons entering the force; support of the Armed Services Vocational Aptitude Battery - its preparation, use, and evaluation as directed by DoD Directive 1304.12, December 4, 1972; development of a computer-assisted testing program for personnel procurement and assignment programs; definition of the skills, aptitudes, and training needed to perform the tasks in a job; measurement of the impact of assigned work tasks on career decisions and productivity; development of improved computer-based models for personnel and manpower planning; and improvement of mathematical and statistical techniques for analyzing experimental data and personnel information. This program element provides technical support to other Air Force and DoD agency programs and receives partial reimbursement for the services provided. In the case of basic research accomplished by the laboratory, full reimbursement is provided by Program Element 61102F. The project break reflects the best estimate considering those anticipated reimbursements, but may require adjustment to the degree that reimbursements are actually earned.

RELATED ACTIVITIES: Interrelationships of service programs are contained in the Training and Personnel Technology Advisory Group (TAG). Related Program Elements are: 61102F - Defense Research Sciences; 62205F - Training and Simulation Technology; 63751F - Innovations in Training and Education; 62763N - Naval Personnel Support Technology; 63707N - Manpower Control System Development; 62717A - Army Perosnnel and Manpower Technology; and 63731A - Military Personnel Performance Development. Current work in adaptive test development is based upon an Office of Naval Research (ONR) contract program with the University of Minnesota; Armed Services Vocational Aptitude Battery (ASVAB) work is accomplished in conjunction with R&D agencies of the Army and Navy; this program is involved in the joint service preparation of the Technology Advisory Group (TAG). In the Personnel Resources Management area, Army, Navy and Air Force are responding to reduced availability of male enlistment age personnel in somewhat similar fashions, as personnel are being developed and refined in each service.

WORK PERFORMED BY: The program is managed by the Air Force Human Resources Laboratory (AFHRL), Brooks AFB TX. Exploratory development is carried out by the Manpower and Personnel Division of the Laboratory. The total contract effort ($1,413) for FY 1979 was conducted by the following contractors or institutions: Education Development Corp., Austin TX; Personnel Decisions Research Institute, Minneapolis MN; Research Application, Inc., Potomac MD; CONSAD Research Corp., Pittsburgh PA, Orincon, La Jolla CA; Kentron International, Ft. Worth TX; Scientific Systems, Inc., Cambridge MA; Kinton, Inc., Alexandria VA; McFann, Gray and Associates, Carmel CA; Advanced Research Resources Organization, Washington DC; Applied Science Associates, Inc., Valencia PA; Psych Systems, Inc., Baltimore MD; Texas A&M Research Foundation, College Station TX; Psychometrics, Inc., Los Angeles CA; University of Dayton, Dayton OH; Technology, Inc., San Antonio TX; Advance Research Resources Organization, Washington DC; and Aerospace Systems, Inc., Burlington MA.

Program Element: # 62703F
DoD Mission Area: Environmental and Life Sciences (ED) #522

Title: Personnel Utilization Technology
Budget Activity: Technology Base #1

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Significant accomplishments include: development of a ground-based screening system for undergraduate pilots which will lower the attrition rate and reduce screening costs; development of a prototype portable psychomotor testing device for pilot selection; development and validation of the Air Force Officer Qualifying Test (AFOQT) which includes improved composites for selection of pilots and navigators; development and validation of the Armed Services Vocational Aptitude Battery (ASVAB); standardization and norming of the Air Force Vocational Interest Career Examination (VOICE) that is used in career counseling and job placement decisions; developing a screening system for the security police; demonstration of a computerized adaptive testing system at the Armed Forces Entrance and Examination Station (AFEES); development of a selection test for predicting success in the dental laboratory specialist course; several prototype components of the Civilian Appraisal System were developed and field-tested; development and implementation of a Pre-Enlistment Person-Job-Match system to maximize personnel productivity by coordinating the individual enlistee's career aspirations with the needs of the Air Force; development of the non-aircrew officer grade evaluation system for application by management engineering teams which will permit improved determination of grade requirements; successful simulation of 91 specialties and 16 military bases to cover a five year period by Integrated Simulation Evaluation Model (ISEM) which will lead to the ability to simulate the response characteristics of the Air Force military personnel system as it responds to policy changes in a dynamic environment; recommendations were given to Air Force Military Personnel Center (AFMPC) concerning the best way to realign 100 Air Force Specialties; a preliminary design of the National Skills Market was prepared; maintained an Air Force personnel data base to allow models of the AF personnel system to be developed and tested; and completed quick response analytic studies of the personnel system for Air Force headquarters personnel managers.

2. FY 1980 Program: The planned Research and Development (R&D) efforts include extensive work on the development and testing of the Civilian Appraisal System; continued research on computer-managed measurement; development of an automated testing system; development of experimental measures for officer selection and classification; identification of management strategies to enhance optimum personnel productivity and retainability; continued monitoring of enlisted accession quality and performance; revision and validation of the Armed Services Vocational Aptitude Battery, Air Force Officer Qualifying Test, and the Air Force Vocational Interest Career Examination; identification of the impact of changes in recruitment strategies and operating policies on force structure; continue enhancement of the pre-enlistment portions of the automated Person-Job-Match (PJM) system; develop approaches for modeling the interface between the Air Force and the National Skills Market; refine the Integrated Simulation Evaluation Model and demonstrate the model's capability to assess the outcomes of various high level policy options; begin developing the components and subsystems for a computer-assisted training decision system to facilitate decisions about training settings and schedules; continue development of the Occupational Research Data Bank that will consolidate many different types of information from various sources into one location; continue maintenance of Air Force personnel data files; and design a data base and information retrieval system which will cross-reference data elements with layouts of personnel and training research data bases to reduce the response time required to develop historical trend information regarding the force.

3. FY 1981 Planned Program: The planned Research and Development (R&D) efforts include development and evaluation of the usefulness of non-traditional measures of aptitude interest, reading and learning ability for the selection and assignment of Air Force personnel; the search for new input sources for rated personnel, validation studies of operational and experimental test devices, continued evaluation of ethnic composition, quality and quantity of Air Force accessions; continued support of the ASVAB research program; development of specific selection systems for specialties such as air traffic control personnel and flight control operators; implementation and evaluation of the effectiveness of the individual components of the civilian appraisal system; continued development and improvement of operational test batteries; further development and evaluation of computerized adaptive testing methodologies; further study on the development of valid performance criteria; begin effort to evaluate the impact of personnel assignments in non-traditional areas to improve utilization of all AF personnel; begin research to determine how easy it is for an airman to transfer from one specialty to another so that on-the-job and technical school training costs will be reduced; continue developing an Occupational Research Data Bank that will reduce the research time spent by scientists in finding data; complete a survey of retrained enlisted personnel to compare retrained performance to first-termers; complete a study to determine aptitude requirements of 200 Air Force Specialties to improve the assignment of personnel to a specialty that is compatible to their qualifications; complete a study to determine how to find the correct strength and stamina requirement for a given specialty; continue development of a National Skills Market Model that will predict the demand and supply of labor skills required by the Air Force; continue improving the ability of the Integrated Simulation Evaluation Model to predict the effect of policy changes so that decision makers can review alternatives before decisions are made; and update personnel and training research data bases to provide the basis for validation of improved personnel selection and assignment procedures.

4. FY 1982 Planned Program: Planned efforts include the review and assessment of a fully implemented AF Civilian Performance and Appraisal System; the design and development of a mobile self-contained testing facility; continued expansion of the development, demonstration, and evaluation of computerized measurement systems in selection and classification along with efforts to combine individual tests into batteries administered under computer control; development of improved job criterion measures and validation of a number of operational selection and classification devices; assessment of measures to quantify and evaluate pilot stress levels and their relationship to training performance and combat effectiveness; continued research into adaptability, motivation, and retention of personnel; validation of measurement instruments f officer selection and assignment in both aircrew and line officer categories; continuing research to determine how easy it is to cross train from one specialty to another; continue developing the training decision system model; complete a study that will show the impact on the Air Force of realigning the aptitude requirements for enlisted specialties based on Air Force Human Resources Laboratory research; complete the development of an enlisted Person-Job-Match system for first-term airmen; start research to determine the correct officer educational requirements for a given specialty; start work to develop a prototype task analysis data bank that will improve on-the-job training by eliminating unnecessary duplication between work centers; continue research on labor supply and demand of Air Force Skills; and continue the enhancement of the Integrated Simulation Evaluation Model.

Program Element: #62763F
DoD Mission Area: Environmental and Life Sciences (ED) #522

Title: Personnel Utilization Technology
Budget Activity: Technology Base #1

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3,700	4,200	4,800	5,100	Continuing	Not Applicable
06EH	Laboratory Support	2,747	3,000	3,500	3,400		
2077	Personnel Management Systems Development	386	200	325	400		
7719	Selection & Classification Technology	321	400	488	600		
7734	Occupational & Career Management	246	600	487	700		

The FY 1981 budget of $5,600K is 500K above the FY 1980 estimate. This increase will be used to complete development of a new civilian performance appraisal system as required by the Civil Service Reform Act of 1978. This law requires the system to be implemented and operational by 1 Oct 81.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62704F
DOD Mission Area: Electronic & Physical Sciences, 521

Title: Very High Speed Integrated Circuits
Budget Activity: Technology Base #1

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	30,430	34,251	41,138	107,036	212,855

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops two generations of very high speed integrated circuits suitable for rapid deployment in military systems. The major applications of these integrated circuits will be digital signal processing for radar, electronic countermeasures, communications, missile navigation and guidance, acoustic sensor and image sensor systems. This program is necessary because commercial applications for integrated circuits do not require the speed, signal processing orientation, nor operation in a military environment.

BASIS FOR FY 1981 RDT&E REQUEST: Provides funds for definition, design, fabrication and test of first generation very high speed integrated circuit (VHSIC) chips and definition, design, and long lead-time process and processing equipment development for second generation VHSIC chips. Also provides funds for ancillary efforts such as computer aided design development, non-optical lithography equipment development, and chip tester development.

OTHER APPROPRIATION FUNDS:

Program Element: 62704 Title: Very High Speed Integrated Circuits
DOD Mission Area: Electronic & Physical Sciences, 521 Budget Activity: Technology Base #1

DETAILED BACKGROUND AND DESCRIPTION: The overall objective of this tri-service effort is to develop two new generations of very high speed integrated circuits (VHSIC) suitable for rapid deployment in military systems. Specific objectives are to develop: (1) new and/or improved chip architecture to minimize customization; (2) fault tolerance; (3) on-chip test; (4) processing speeds of 50-100 times greater than present integrated circuits; (5) a 10-fold reduction in size, weight, power, failure rate and life cycle costs: (6) computer-aided-design tools for VHSIC chip designs: (7) advanced lithographic equipment and dry processing techniques for 0.5-0.8 micrometer minimum feature size devices: (8) special high-speed test equipment for VHSIC chips; and (9) chip sets for system demonstrations of the improved performance capability of VHSICs. Fight high priority Air Force system candidates have been identified for consideration, with four from the Army and eight from the Navy. The program is divided into four phases. Phase 0 will be a 9 month program definition to define specific technical goals and detailed approaches to the latter parts of the program. Areas to be considered are: (1) architectural studies to define functional cells, chip design and test vehicle specifications; (2) computer-aided-design (CAD) system definition; (3) tester specifications; (4) interface studies; (5) device design and modeling; (6) process development specifications; (7) determination of lithographic technology; and (8) analysis of system demonstrations. Phase I will be a 3 year program to develop the first generation (1.25 micrometer minimum feature size) technology to the pilot line stage together with the architecture, design and fabrication of chips and functional modules or electronic brassboards for system demonstrations. In addition, second generation (0.5 micrometer minimum feature size) technology will be developed to demonstrate the feasibility of these devices. Phase II will be a two year effort to build system demonstrations in 1.25 micrometer technology and extend 0.5 micrometer technology to the pilot line stage. Phase 3 is a six year concurrent effort consisting of a number of independent technologies which support the main line effort in Phase 0, I, and II. These independent technology programs will be short programs concentrated on specific technical problems critical to the general VHSIC technology, such as: sub-micrometer lithography and test equipment.

RELATED ACTIVITIES: This is a tri-service program with oversight executed by the Office of the Under Secretary of Defense for Research and Engineering. Related activities include: Aircraft Avionics, 62202A; Electronic and Electron Devices, 62705A; Electron Device Technology, 62762N; Aerospace Avionics, 62204F; Command, Control & Communications, 62702F, Tactical Electronic Warfare Technology, 62715A; RPV Supporting Technology, 62732A; Aircraft Avionics Equipment, 63207A; Avionics, 63202N; Advanced Electron Device Development, 63742N; Airborne Electromagnetic/Optical Systems, 63797N; Advanced Avionics for Aircraft, 63203F; Space Vehicle Subsystems, 63401F; Advanced Space Communications, 63431F; Electronic Warfare Technology, 63718F; Advanced Communications Technology, 63727F; and Air-to-Air Identification of Non-Cooperative Targets, 63742F.

Program Element: 62704F
DOD Mission Area: Electronic & Physical Sciences, 521

Title: Very High Speed Integrated Circuits
Budget Activity: Technology Base #1

WORK PERFORMED BY: The Air Force Avionics Laboratory (AFAL) Wright-Patterson AFB OH administers the work performed under this program. Parts of the work are contracted by AFAL, other parts are contracted by Naval Electronics Systems Command, Washington DC, and further parts are contracted by the Army Electronics Device and Technology Laboratory, Ft. Monmouth NJ. In addition to technical expertise from these organizations technical experts from the following organizations are used: Naval Research Laboratory, Naval Ocean Systems Command, Army's Research and Development Command, and Rome Air Development Center. This is a new program element in FY 1980 and at this writing had no contractors.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. FY 1979 and Prior Accomplishments. This is a new program element in FY 1980.

2. FY 1980 Program. The Definition Phase (Phase 0) of the program will be carried out. Areas to be considered are (1) architectural studies to define functional cells, chip design and test vehicle specifications; (2) computer aided design (CAD) system definition; chip tester specifications; interface studies; (3) device design and modeling; (4) process development specifications; (5) determination of lithographic technology; and (6) analysis of systems demonstrations. Phase III will also start and will run concurrently. Aspects such as novel CAD or architectural approaches, chip testability and tester fabrication, novel processing equipment, submicrometer lithography technology, and submicrometer metrology will be investigated.

3. FY 1981 Planned Program: The Phase I effort starts. First generation chip (1.25 micrometer minimum feature size) architectures will be defined, processing technology will be refined. Lithography equipment design for submicrometer feature sizes will be frozen. Long lead developments for critical path second generation (0.5 micrometer minimum feature size) will be completed. Phase 0 developments will continue providing an infusion of developments ancillary to the main effort.

4. FY 1982 Planned Program: First generation processing technology development will be completed and the first generation pilot line will start operation. Second generation architecture definition will be completed. Phase 0 will continue with ancillary short term efforts.

5. Program to Completion: In FY 1983 the first generation demonstration subsystems will be completed and delivered. Second generation chip sets will be designed. In FY 1984 first generation brassboard demonstrations will be conducted. Phase II begins. Second generation modules will be fabricated and tested. In FY 1985 the second generation pilot line begins production. The Phase III effort spans the entire program feeding in new ideas and ancillary efforts.

Program Element: 62704F
DOD Mission Area: Electronic & Physical Sciences, 521

Title: Very High Speed Integrated Circuits
Budget Activity: Technolcgy Base #1

6. Milestones:

	Date:
Complete program definition	4th quarter FY 1980
Begin Phase I	1st quarter FY 1981
Complete first generation chip architecture	3rd quarter FY 1981
Begin first generation pilot line	3rd quarter FY 1982
Complete second generation chip architecture definition	3rd quarter FY 1982
Begin Phase II	1st quarter FY 1984

7. Comparison with FY 1980 Budget: This program element was not in the FY 1980 budget. VHSIC funding for FY 80 was requested in 62204F, Aerospace Avionics; 62767N, Very High Speed Integrated Circuits; and 62782A, Very High Speed Integrated Circuits. In response to Congressional suggestion, the Services and the Office of the Under Secretary of Defense for Research and Engineering decided the program would be better managed, would avoid the appearance of duplication, and would have better visibility if all the funds were in a separate funding line. It is expected that the program (and its requested funding) will transition to 63452, Very High Speed Integrated Circuits, in FY 1982.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63202F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Aircraft Propulsion Subsystems Integration (APSI)
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	13,200	19,000	13,500	21,500	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the design, development, and test of new techniques aimed at successful propulsion/airframe integration and compatibility, and improved installed performance in advanced aircraft. The scope of the program includes work on: (1) advanced inlet, fan, power turbine, engine control and nozzle components; (2) integrated testing of these components with advanced gas generators (i.e., Joint Technology Demonstrator engine); (3) methods to reduce engine life cycle cost; (4) definition of engine inlet/exhaust system installation design criteria and propulsion integration technologies; and (5) engine structural design criteria through hardware fabrication and test. These efforts will ensure stall-free engine operation over a broad mission envelope. Proper attention to the efforts under this program will provide aircraft systems with the potential for longer range, higher cruise speed with lower specific fuel consumption, excess power for successful engagements, high sortie rates with reduced maintenance, and reduced life cycle cost.

BASIS FOR FY 1981 RDT&E REQUEST: Level II Joint Technology Demonstrator Engine (JTDE) efforts incorporating extended performance verification and structural/diagnostic test and evaluation will be initiated. Extensive performance and turbine structural/diagnostic tests will be conducted on a small engine JTDE. Piggyback engine tests will provide final verification of life cycle cost models previously developed under this program. Critical variable cycle engine technology demonstrations will focus on verification of operating characteristics through slave engine tests of full scale hardware at sea level and altitude conditions. This request will provide for: (1) final Level I mechanical integration tests on a large engine JTDE; (2) small engine JTDE extended performance and structural/diagnostic test and evaluation; (3) hardware fabrication/refurbishment in support of impending Level II structural/diagnostic and extended performance characterization on two large engine JTDE; (4) infrared/radar cross section concept model wind tunnel test and evaluation; (5) piggyback engine tests of components designed for reduced life cycle cost; (6) slave engine test and evaluation of advanced exhaust nozzle concept(s); (7) initiation of new propulsion system/airframe structural correlation efforts; and (8) initial rig/environmental test of an advanced composite fan.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #63202F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Aircraft Propulsion Subsystems Integration (APSI)
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: This program provides for the development and functional demonstrations for those advanced technologies which are necessary to assure propulsion and airframe compatibility, and permit the attainment of advanced performance objectives in future aircraft systems. The scope of this program includes: (1) the development of advanced components related to inlets, fans, power turbine, augmentors, controls and exhaust nozzles; (2) the overall integration of these components with the basic advanced gas generators to form a demonstrator engine to define the flowpath and assess the durability/life aspects of the engine concepts; (3) the development of methods to reduce engine life cycle costs by 20-25 percent; (4) the definition and verification of the methodology to structurally design, analyze, and test turbine engines to achieve increased engine durability; and (5) the definition of improved inlet/engine/exhaust system installation design criterion and propulsion integration techniques. The components being developed will provide the basis for 10-20 percent reduction in specific fuel consumption, 10-15 percent increase in stall margins, 15-20 percent reduction in engine weight, increased life/durability, 15-30 percent reduction in engine life cycle cost and greater airflow matching potential when compared to the most modern engines currently in the inventory. These benefits can be traded off against one another to meet the specific needs of systems of interest. This program provides both the critical technology baseline for future system development and a source of data for ensuring the orderly resolution of any propulsion system problems encountered with development engines.

RELATED ACTIVITIES: The exploratory development base for this program is provided by Aerospace Propulsion Program Element 62203F, Materials Program Element 62120F, and Aerospace Flight Dynamics Program Element 62201F. Close technical coordination is maintained with the Air Force Flight Dynamics Laboratory, Aerospace Structural Materials Program, Program Element 63211F, and with the Air Force Materials Laboratory. This program is closely related to the Advanced Turbine Engine Gas Generator program, Program Element 63216F, which is managed from the same office and provides the core gas generator development efforts. This program is thoroughly integrated with the Navy component work under Program Element 63210N, Advanced Aircraft Propulsion Subsystem, which is developing compatible components for a cooperative Air Force/Navy demonstration of advanced engine technology. The Air Force and the Navy currently have a formal Memorandum of Understanding covering efforts under the Joint Technology Demonstrator Engine (JTDE) program. Close coordination is maintained with related efforts conducted by the Army and National Aeronautics and Space Administration.

WORK PERFORMED BY: This program is managed by the Air Force Aero Propulsion Laboratory, Wright-Patterson AFB, OH. The current contractors involved in this program and their work areas are: Detroit Diesel Allison Division of General Motors, Indianapolis, IN (Advanced Fan Aerodynamics, Joint Technology Demonstrator Engine, Reduced Cost Concepts); Garrett AirResearch, Phoenix, AZ (Low Cost Component Development); General Electric, Evendale, OH (Joint Technology Demonstrator Engine, Variable Cycle Engine, Reduced Cost Components, Structural Methodology); McDonnell Douglas, St. Louis, MO (Inlet/Aircraft Drag Investigation, Propulsion Simulator); Pratt & Whitney Aircraft, West Palm Beach, FL (Variable Cycle Engine, Structural Design Criteria, Joint Technology Demonstrator Engine); Teledyne CAE, Toledo, OH (Low Cost Component Development, Joint Technology Demonstrator Engine, Structural Methodology); Rockwell International, Los Angeles, CA (Inlet/Nozzle Flight Validation).

Program Element: #63202F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Aircraft Propulsion Subsystems Integration (APSI)
Budget Activity: Advanced Technology Development #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: During FY 1979, two Joint Technology Demonstrator Engines (JTDE) completed initial flowpath testing. Limited sea level testing of the one configuration verified the mechanical integration of the low spool components (i.e., fan and fan turbine) with the gas generator from the Advanced Turbine Engine Gas Generator (ATEGG) program. Fundamental performance characteristics were documented to establish the baseline for future work. The reduced life cycle cost component assessment was continued. Results from the life cycle cost model studies will be used to identify the high cost components. Reduced cost component designs were completed during this time period. Considerable effort was applied to the structural design and methodology program during this time period. "Piggyback" life prediction environmental tests were conducted on ATEGG hardware to determine the environment to which the selected components were exposed under actual operation. The results of these tests will be used to initiate accelerated component rig tests. Initial wind tunnel tests were conducted on advanced non-axisymmetric nozzle model configurations, and a comparison was made of the resulting effects on base drag reductions of the design options. New start efforts were initiated in the following areas: JTDE performance/structural testing and variable cycle technology (VCT) test and evaluation. Priority was given to the JTDE follow-on because this effort builds upon the work to be completed in FY 1979/1980, and emphasizes comprehensive flowpath testing and limited durability/life testing. The variable cycle technology test and evaluation focused on design and fabrication of system oriented VCT hardware. Infrared/Radar cross-section efforts focused on acquiring computer models to assess the payoffs of various reduction/suppression approaches, and to quantify the payoffs in a mission-oriented scenario.

2. FY 1980 Program: Four contractual efforts previously begun will be completed during this time period. The reduced cost components program will culminate with the fabrication and performance verification testing of selected components. Fabrication will confirm that reduced cost components can be successfully fabricated and rig testing will verify that these components specifically designed to reduce life cycle cost by 10-30 percent can withstand the engine operating conditions. The structural design and development program will climax with comprehensive environmental rig testing which will run the selected components to destruction. The test results will be used to verify that failure modes and durability can be accurately predicted, verified, and prevented through adequate design practice. Level I testing in the JTDE program to demonstrate the mechanical integrity of integrated low spool/gas generator hardware will culminate with the initial test of a large engine JTDE configuration. Efforts will continue on the four new starts begun in FY 1979. Emphasis will be on translating designs into hardware and in preparation of future engine/rig tests. The JTDE program will concentrate on additional hardware fabrication for two large engine JTDE in preparation for an initial performance test on one and structural testing on the other. Structural diagnostic testing will be initiated on a small engine JTDE to determine the actual operating environment of the engine. Component designs will be completed on the composite fan and the variable cycle technology, and hardware fabrication will be completed. Infrared/Radar cross-section design analysis will be completed and hardware fabricated for wind tunnel testing.

Program Element: #63202F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Aircraft Propulsion Subsystems Integration (APSI)
Budget Activity: Advanced Technology Development #2

3. FY 1981 Planned Program: Efforts during this time period will concentrate on the completion of critical test effort under the Joint Technology Demonstrator Engine (JTDE) program, system responsive components program, and propulsion integration. JTDE test efforts will be directed toward the demonstration and assessment of integrated component performance and structural design characteristics in a more severe turbine engine test environment on a small JTDE and initial mechanical integration test on a large engine JTDE. Emphasis will be placed on the assessment of engine propulsion system compatibility and structural durability potential under sea-level conditions, and/or limited inlet conditions of high temperature and pressure. Variable cycle engine technology demonstrations will culminate in the slave engine tests of full-scale hardware to assess the operating characteristics and assess the potential payoffs against mission needs. Both sea-level/altitude tests will be conducted on the hardware to assess both the performance and structural aspects over a broad mission envelope. Rig testing of the composite fan will be accomplished. Testing will focus on determining the foreign object damage (FOD) tolerance of the advanced design. Controlled environmental conditions will permit close monitoring of the performance and structural characteristics prior to JTDE testing of the hardware. Efforts under the infrared(IR)/Radar cross-section (RCS) investigations will lead to wind tunnel testing of concept models for suppression/reduction of IR/RCS. Results of these tests will be a definition of the trades/sensitivity associated with various concepts and will establish a framework for future full-scale hardware fabrication and test. Three new efforts will be initiated: (a) life cycle cost/damage tolerance design assessment to assess the criteria for replacement for cause and the associated life cycle cost implications; (b) engine durability assessment program to define the test criteria for various structural/life tests and to define the criteria for combined effects testing; and (c) an advanced exhaust nozzle program to assess a two-dimensional nozzle and/or an advanced material nozzle in a full-scale engine test. Nozzle fabrication will be conducted in this time period.

4. FY 1982 Planned Program: During this time period, JTDE testing will focus on Level II demonstrations to initiate flight weight augmentor/duct burner and exhaust nozzle hardware, and extensive structural characterization. Structural diagnostics testing and accelerated life testing will result in accurate characterization of the operational environment of JTDE components, and the data base required to correlate predicted versus actual structural characteristics. Two large engine JTDE and one small engine JTDE will undergo testing. A third large engine JTDE will be assembled and instrumented prior to testing in FY 1983. System responsive component efforts will address three efforts, two previously initiated and one new start. Variable cycle engine component operational potential will be assessed through altitude altitude testing at Arnold Engineering Development Center. This testing, when combined with previous sea level tests, will provide a full aasessment of the hardware over a complete engine operating envelope. The composite fan FOD testing will be completed and a structural audit conducted. An advanced material low pressure turbine design, fabrication and test program will be initiated to investigate the potential of a eutectic turbine with 50-100 degree increased bulk metal temperature capability over current designs. Assessment will include a tradeoff between increased temperature capability and increased life. Life cycle cost/damage tolerance design tradeoffs will be conducted on hot section turbine components. Rig testing will be accomplished during this time period. A new start will be initiated to assess propulsion system/airframe structural integration. Emphasis will be on assessing the effects of external loads on the

structural characteristics of an operating engine, and on determining the impact of combined loads on the airframe/engine structural interface. A follow-on Infrared/Radar cross-section effort will be directed toward fabrication of full-scale hardware for "piggyback" testing on slave engine testing.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	10,000	13,200	14,000	14,200	Continuing	Not Applicable

Congress added $5.0 million in FY 1980 for additional hardware and durability testing in the Joint Technology Demonstrator Engine (JTDE) effort. Funds were reduced in FY 1981 to fund an offset in Program Element 63215F, Aviation Turbine Fuels Technology. FY 1982 resources have been increased to fund increased JTDE testing at all contractors to initiate comprehensive structural evaluation of hardware designs and to conduct integrated propulsion system testing.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63203F
DoD Mission Area: Electronic and Physical Sciences (ATD), #551

Title: Advanced Avionics for Aircraft
Budget Activity: Advanced Technology Development, #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11,178	8,300	14,900	18,700	Continuing	N/A
666A	Advanced Aircraft Navigation	3,000	2,100	3,300	4,400		
69CK	Advanced Devices	1,900	2,500	3,000	3,500		
69DF	Advanced Weapon Delivery	6,228	3,700	8,600	10,800		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The increasing sophistication of the threat characterized by the European conflict scenario requires advances in avionics technology if we are to neutralize our adversary's numerical superiority. This program element is one of the Air Force's principal sources of Advanced Development Avionics Technology. The principal products include feasibility demonstrations of air-to-air and air-to-ground avionics systems which increase aircraft survivability, decrease the cost/kill and increase kills/sortie. Other products include precise position location in high electronic countermeasure (ECM) threat environments and selected electronic devices for avionics systems/subsystems. The feasibility demonstrations of the products in this program are then transitioned to Engineering Development for weaponization.

BASIS FOR FY 1981 RDT&E REQUEST: The objective of this program is to satisfy the performance, reliability, maintainability and cost of ownership demands of future avionics systems. The program element is divided into the following three projects: Advanced Aircraft Navigation (666A); Advanced Devices (69CK); and Advanced Weapon Delivery (59DF). The Advanced Aircraft Navigation 666A project will evaluate the High Anti Jam (AJ) performance of the Global Positioning System (GPS) User Equipment, demonstrate the capability of the integrated inertial reference assembly, and continue the development of an integrated navigation antenna. The GPS Generalized Development Model (GDM), a modular GPS UE AJ testbed, will continue testing in the GPS Evaluator to determine its full range of anti-jam capabilities. The GPS Evaluator is capable of simulating five satellites and has a programmable ECM threat generator capable of producing a wide variety of threat scenarios. The effort on GPS AJ is due to the projected broad application of GPS Equipment (i.e., 9000 aircraft), many operating in high ECM environments. A joint effort with the Navy will continue with the development of Integrated Sensor Assemblies (ISA). The ISA effort will demonstrate the capability of using a small number of inertial instruments to provide all the inertial data required for navigation, flight control and weapon delivery. The Advanced Devices Project (69CK) emphasizes development of devices for which there is a military requirement but no commercial market. Examples of these include: development of infrared focal plane arrays which increase the resolution of Electro-Optical Systems by a Program factor of three, increase sensitivity by a factor of two, and processess the data on chip doing away with the

many connections to the cryogenic cooler; the development of silicon nitride radomes which possess the increased physical and electrical properties required for hypersonic cruise missiles; the development of advanced magnetic bubble memories as replacements of spaceborne recorders; the development of a solid state power supply at 10 Gigahertz using gallium arsenide diode power combining technology. The Advanced Weapon Delivery (69DF) project will include the major tasks listed below: The Advnced Strike Radar Technology (ASRAT) effort will initiate a program on slow moving target indication and track modes in a selected test bed. The algorithms developed under the ASRAT program will be transferred to Program Element 64412, Common Multimode Radar, for engineering implementation. The Integrated Fire Flight Control program (IFFC) will initiate flight testing in the F-15B aircraft. The IFFC flight testing will demonstrate tne feasibility of: integrating fire and flight control systems; reducing pilot workload and improving accuracy and survivability during ballistic weapon delivery. The Infrared Search and Track System (IRSTS) will initiate the construction of the hardware for the flight demonstration. The IRSTS will demonstrate the feasibility of an advanced long range detection and tracking system. The 2nd Generation Forward Looking Infrared (FLIR) program will reduce the size of the FLIR pod from 18" to 12" while increasing the resolution of the sensor by a factor of two. The FLIR pod will complete flight testing and be transferred to engineering development. This program will use detectors from the Device Project 69CK. The algorithm developed under the missile launch envelope program will undergo initial flight demonstration; flight test planning will continue to evaluate the algorithm in simulated combat conditions.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63203F
DoD Mission Area: Electronic and Physical Sciences (ATD), #551

Title: Advanced Avionics for Aircraft
Budget Activity: Advanced Technology Development, #2

DETAILED BACKGROUND AND DESCRIPTION: The European Scenario with its massed armor, ground mobile counter air, and numerically superior air force has increased the demand for more sophisticated avionics systems. In this threat environment, air to ground attack must be conducted beyond the strike envelopes of the ground air defenses requiring systems with increased acquisition and weapon delivery range. These new avionic systems must also be able to attack multiple targets per pass to counter the adversary's numerical superiority. The air to air engagement is similarily characterized by the need to increase the kill/sortie to offset our numerical inferiority. The electronic counter measure (ECM) threat is postulated to be so severe that highly sophisticated signal processing techniques will be required to determine position from our radio navigation systems. The products of this program are the feasibility demonstration of avionics systems/subsystems capable of performing in the above environment and additionally decreasing the cost/kill to offset our numerical inferiority. This program element is the principal source of advanced development avionics equipment in the Air Force. Additionally it has the sole Advanced Device Project within the Air Force. The emphasis on Advanced Devices is placed on those devices which are critical to the performance of avionics systems but are not commercially available.

Project 666A: The Air Force is currently planning to install a Global Positioning System (GPS) receiver in virtually every aircraft in the fleet: Many of these aircraft will be operating in severe ECM environments. This project is addressing alternatives to increase the Anti-Jam (AJ) Performance of GPS receiver to greater than decibel jam to signal ratio; this is being accomplished by the development of a modular GPS receiver designed to accept advanced signal processing techniques. The Generalized Development Model (GDM) will then be integrated with the CPS evaluator to determine the AJ margin of new signal processing techniques. The project also addresses the integration of aircraft navigation units with the goal of reducing weight size and cost. The development of a set of inertial sensors usable for both navigation, weapon delivery, and flight control is an example of these efforts. Another is the work on a common L Band antenna for communication and navigation systems.

Project 69CK: The requirement to develop electron devices with increased capability and reduced cost is apparent by the increased complexity and cost of avionics equipment. The development of Magnetic Bubble Memories to replace the Magnetic Drum Memory will reduce the volume by a factor of six and the cost per bit stored by a factor of ten. The development of high power gallium arsenide diode power combining technology in the result of a demonstrated need for high average power solid state transmit amplifer for missile applications. The solid state amplifier will offer high average power solid state transmit amplifier for missile applications. The solid state amplifier will offer advantages in weight, volume, reliability and low primary voltage. The development of selected advanced devices has the potential to significantly decrease the life cycle cost of avionics suites while increasing the systems capability.

Project 69DF: Future engagement tactics dictate the requirement to develop acquisition systems which can detect targets at longer ranges. The Advanced Strike Radar Technology (ASRAT) program will demonstrate the slow moving

target (velocity- detection and track (less than meters error. The ASRAT technology will be transferred to Program Element 64412 Common Multimode Radar for implementation. The increased target detection accuracy will decrease the number of missions flown against medium to hard targets by factors of The 2nd Generation Forward Looking Infrared (FLIR) effort is directed toward doubling the target recognition range of current FLIR systems. Secondary objectives include reduction in pod diameter from 18" to 12" (reduced aerodynamic drag) and weight from 1200 to 300 pounds. The advent of the small maneuverable fighter and the sophisticated ground defense has resulted in highly dynamic fighter engagements. The Integrated Fire Flight Control program is blending the pilot and fire control inputs to provide increased accuracy in air-to-air engagements and increased survivability through nonlinear air-to-ground weapon delivery profiles. The highly dynamic fighter engagements have also led to significant errors in the missile launch envelopes thus causing a missile to be fired when the kill probability is small while missing other high kill probability launch opportunities. The missile launch envelope algorithms and displays will be developed to display the target kill probability taking into account the dynamics of the attacking and target aircraft.

RELATED ACTIVITIES: The new technology for these advanced developments is established under P.E. 62204F, Aerospace Avionics. This program element provides technology products which have application in PAVE MOVER (P.E. 63747F). Aircraft Avionics Equipment Development (P.E. 64201F), NAVSTAR Global Positioning System (GPS) (P.E. 63421F), Integrated Digital [illegible]cs (P.E. 64219), Air-to-Air Identification of Non-Cooperative Targets (P.E. 63742F), Flight Vehicle Tec[illegible] (P.E. 63205) and Reconnaissance Sensors/Process Technology (P.E. 63208F). The technical program content is co[illegible]nated with Navy (63202N) and Army (63207A) programs responding to similar objectives.

WORK PERFORMED BY: The Air Force Avionics Laboratory, Wright-Patterson AFB, OH, under the overall management of the Air Force Systems Command, provides program management for projects in this Program Element. Contractors include: Collins, Cedar Rapids, IA for the GPS Generalized Development Model; ITT, Nutley, NJ, for the GPS Evaluator; Texas Instruments, Dallas, TX for the Magnetic Bubble Memory; and Hughes Aircraft, Culver City, CA for the Ifra-red Focal Plan Arrays, Multimode Radar Signal Processor and Radar Gun Director.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In 1975 the Forward Looking Advanced Multimode Radar (FLAMR) flight test program successfully demonstrated the feasibility of a high resolution Synthetic Aperture Radar. Real time digital processors, the key to autonomous airborne operations, which h are used in high performance radar systems such as the F-15 AN/APG-63, were first developed within this program element. Low Light Level TV and Forward Looking Infrared (FLIR) sensors which are major advances in capability upgrading of the B-52 aircraft were developed within this program element. Flight and laboratory testing of the Gimballed Electrostatic Aircraft Navigation System

demonstrated precision accuracy. The Micro-Navigator flight test demonstrated the feasibility of using electrostatic gyros in a strapdown configuration for medium accuracy inertial systems. Improvements in modeling and Kalman filter techniques have led to the optimum integration of inertial systems with other navigation systems such as a Doppler, Long Range Navigation and Global Positioning System. A solid state weapon delivery computer developed by the Advanced Devices Project was used by the Navy in the Angle Rate Bombing System validation flight tests.

2. FY 1980 Program: 666A Flight test of the flexible GPS GDM test bed will be continued to demonstrate alternate receiver technologies in an Electronic Counter-Measures (ECM) environment. The GDM will be evaluated in the GPS Evaluators to determine the full range of anti-jam performance. Threat scenarios will be modeled to investigate alternate jam resistant technologies for new receiver designs. The GPS Null Steering Antenna will be fabricated and undergo flight evaluation; a low cost antenna with effective anti-jam performance is the goal of this program. 69CK The advanced traveling wave tube effort will be completed with the delivery and test of tubes in bands 5, 6 and 7. The design and goal is to provide the identical output power with 30% less input power and increase the life expectancy by a factor of five. The Infrared focal plane array effort will be completed with the transition of the device to the Second Generation Forward Looking Infrared Program in Project 69DF. Efforts will be initiated on millimeter wave tubes for electronic countermeasure and radar applications, high density two micron magnetic bubble memories, radomes and multipurpose large scale integration processors. 69DF The Advanced Strike Radar Technology effort will be initiated to demonstrate both near and far term objectives. The near term objectives (2 years) will be to demonstrate the slow moving target detection and track. The far term objectives (4 years) include very high resolution for target classification, closed loop terrain following/avoidance and high electronic countermeasures resistance. The Integrated Fire Flight Control (IFFC) is determining the feasibility of blending fire and flight control for both air-to-air and air-to-ground. The IFFC hardware will be fabricated and tested in the laboratory environment (HOT BENCH). The Radar Gun Director Flight Evaluation will be completed. The gun director will be transfereed to Program Element 64212F Aircraft Equipment Development for Engineering Development. The 2nd generation Forward Looking Infrared Sensor will begin flight evaluation. The Missile Launch Envelope program will complete the ground validation of the algorithms and displays. Flight test planning and coordination will commence to evaluate the algorithms and displays under simulated combat flight conditions.

3. FY 1981 Planned Program: 666A The Global Positioning System (GPS) technology effort using the Generalized Development Model (GDM) and the evaluator will continue with the addition of the optimal GPS/Inertial Navigation System integration demonstration. The Integrated Reference Assembly (IRA) effort will be designed and ground tested. The objective of the IRA is to supply the inertial data required for navigation, flight control and weapon delivery from a set of redundant sensors. This effort is jointly funded by the Navy and Air Force. An effort on a common L-band antenna is continuing to investigate a common antenna for radio navigation and communication systems. 69CK The effort on radomes will continue to investigate doubly curved silicon nitride radome which will be capable of maintaining its structural integrity and microwave transmission properties under the mechanical and thermal

stress of hypersonic flight. The effort on two-micron bubble memories will continue with the overall objective being the development of a high speed memory (data rate - 2-8 megabits per second) having 10,000 hours mean-time-between-failure and a cost of less that $25,000. The efforts on millimeter wave tubes and multipurpose large scale processors will continue. 69DF The Advanced Strike Radar Technology (ASRAT) effort will flight demonstrate slow moving target detection and track and transfer the algorithms to PE 64412 Common Multimode Radar. The ASRAT program will initiate efforts toward meeting the long range goals of high resolution for target classification, automatic terrain following/avoidance and resistance to electronic countermeasures. The Integrated Fire Flight Control hardware will begin flight evaluation using the F-15B aircraft. Ground evaluation of the equipment developed under the Infrared Search and Track System (IRSTS) will be initiated. The IRSTS goal is detection of target at range of miles. A new effort will be initiated in Advanced Technology Survivable Radars (ATSR). The ATSR effort will investigate and demonstrate bistatic operation in the high resolution mode The inherent advantages of having non-radiating high resolution radars will give the element of surprise back to the aircraft and will lead to incresed survivability and probability of target destruction. The flight test evaluation of the algorithms and displays developed by the Missile Launc Envelope Program will be initiated.

4. FY 1982 Planned Program: 666A The Integrated Reference Assembly ground testing will be completed and flight test Planning will be initiated. The flight test hardware will be fabricated for the flight test. The common L-Band antenna for both radio-navigation and communication will be fabricated and delivered for evaluation. The Global Positioning System (GPS) Evaluator will be used to evaluate advanced signal processing technology which is resistant to electronic jamming and the optical integration of GPS/Inertial Navigation Systems. 69CK The effort on radomes will be completed with the delivery of doubly curved silicon nitride radomes. The radomes will be evaluated with respect to their mechanical and electrical properties. The effort on two micron bubble memories will be completed with the delivery of prototype devices for test and evaluation. The efforts on high power GaAs diodes power combining technology and a Advanced radar signal processor will be completed with the delivery and and evaluation of prototype hardware. The Metal-Nitride-Oxide-Semiconductor effort on memories will be continued along with other microwave and information processing devices. 69DF The F-15B flight evaluation of algorithms and displays developed under the Missile Launch Envelope Program will be completed and turned over for engineering development. The Advanced Strike Radar Techonology will modify an existing radar to demonstrate closed loop terrain following/avoidance, and high resolution for target classification. The Infrared Search and Track program will begin flight evaluation of the equipment developed during earlier phases of the program. The Advanced Technology Survivable Radar will develop and fabricate hardware for flight evaluation in subsequent years. The initial demonstration will emphasize high resolution and real time auto focus.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

Program Element: #63203F
DoD Mission Area: Electronic and Phsical Sciences (ATD), #551

Title: Advanced Avionics for Aircraft
Budget Activity: Advanced Technology Development, #2

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11,069	11,900	12,000	17,200	Continuing	N/A
666A	Advanced Aircraft navigation	2,800	3,000	2,100	4,200		
69CK	Advanced Devices	1,700	1,900	2,500	3,000		
69DF	Advanced Weapon Delivery	6,569	7,000	7,400	10,000		

The overall Program Element funding for FY 1981 has been reduced by $2,300 million. The one million dollars reduction in Project 666A was achieved by delaying the start of the Integrated Sensor Assembly program six months and delaying the completion of the common L-band antenna effort by six months. The $1.400 million reduction in Project 69DF was achieved by cancelling of the All Weather Tactical Strike System (AWTSS). The AWTSS program projected a $10 million overrun on a $13 million contract in February 1979 and was terminated in March 1979.

Project #69DF
Program Element: #63203F
DoD Mission Area: Electronic and Physical Sciences (ATD), #551

Title: Advanced Weapon Delivery
Title: Advanced Avionics for Aircraft
Budget Activity: Advanced Technology Development. #2

DETAILED BACKGROUND AND DESCRIPTION: The European Scenario with its massed armor, ground mobile counter air, and numerically superior air force has incresed the demand for more sophisticated avionics systems. In this threat environment, air to ground attack must be conducted beyond the strike envelopes of the ground air defense; thus requiring systems with increased acquisition and weapon delivery range. These new avionic systems must also be able to attack multiple targets per pass to counter the adversary's numerical superiority. The air-to-air engagement is similarly characterized by the need to increase the kills/sortie to offset our numerical inferiority. The Advanced Strike Radar Technology (ASRAT) program will demonstrate the slow moving target velocity) detection and track (less than meters error). The ASRAT technology will be transferred to Program Element P.E. 64412 Common Multimode Radar for implementation. The increased target detection accuracy will decrease the number of missions flown against medium to hard targets by factors of The 2nd Generation Forward Looking Infrared (FLIR) effort is directed toward doubling the target recognition range of current FLIR systems. Secondary objectives include reduction in pod diameter from 18" to 12" (reduced aerodynamic drag) and weight from 1200 pounds to 300 pounds. The advent of the small maneuverable fighter and the sophisticated ground defense has resulted in highly dynamic fighter engagements. The Integrated Flight Control program is blending the pilot and fire control inputs to provide increased accuracy in air-to-air engagements and increased survivability through non-linear air-to-ground weapon delivery profiles. The highly dynamic fighter engagements have also led to significant errors in the missile launch envelopes thus causing missiles to be fired when the kill probability is small while missing other high kill probability launch opportunities. The missile launch envelope algorithms and displays will be developed to display the target kill probability taking into account the dynamics of the attacking and target aircraft. A new radar will be investigated to increase the survivability of attacking aircraft and thereby increase the probability of target destruction. The Advanced Survivable Radar Technology program will investigate the use of bistatic radars for air-to-ground attack. The bistatic approach would allow the attack aircraft to detect targets without giving away his position i.e., non-emitting attack radar.

RELATED ACTIVITIES: The technology base for these advanced developments is established in PE 62204F, Aerospace Avionics. This project demonstrates the weapon delivery component and subsystem technology required for advanced future weapon systems and for improvements to existing weapon systems. This effort provides for the demonstrated technology necessary for Night Attack Program (PE 63249), Aircraft Avionics Equipment Development (PE 64201F), Common Multi-Mode Radar (PE 64412F), Reconnaissance Sensor/Processing Technology (PE 63208F) and Flight Vehicle Technology (63205F).

Project #69DF
Program Element: #63203F
DoD Mission Area: Electronic and Physical Sciences, #551

Title: Advanced Weapon Delivery
Title: Advanced Avionics for Aircraft
Budget Activity: Advanced Technology Development, #2

WORK PERFORMED BY: The Air Force Avionics Laboratory, Wright-Patterson AFB, OH, an organization of the Air Force Systems Command, provides the Air Force program management of this project. Contractors include Hughes Aircraft, Culver City, CA, for the Radar Gun Director; Rockwell International, Anaheim, CA, for 2nd Generation Forward Looking Infra-red program; VEDA Inc, Arlington, VA for Missile Launch Envelope and McDonnell Douglas, St Louis, MO for the Integrated Fire Flight Control.

1. FY 1979 and Prior Accomplishements: The F-111D Mark II avionics originated in this project. The Initial development of many night sensors used in Southeast Asia were performed in this project. The Forward Looking Advanced Multi-mode Radar flight tests demonstrated high quality synthetic aperture radar imagery in real-time using digital processing techniques. Flight testing of advanced infrared and active television system provided quantitative performance data necessary for further development of electro-optical systems. The feasibility of the Electronically Agile Radar was demonstrated in this project. Within recent years the program emphasis has been divided between sensor and weapon delivery tasks for tactical close air support and interdiction, and the advanced radar efforts in support of advanced and strategic aircraft weapon delivery systems.

2. FY 1980 Program: The Advanced Strike Radar Technology effort will be initiated to demonstrate both near and far term objectives. The near term objectives (2 years) will be to demonstrate the slow moving target detection and track. The far term objectives (4 years) include very high resolution for target classification, closed loop terrain following/avoidance and high electronic countermeasure resistance. The Integrated Fire Flight Control (IFFC) is determining the feasibility of blending fire and flight control for both air-to-air and air-to-ground. The IFFC hardware will be fabricated and tested in the laboratory environment (HOT BENCH). The Radar Gun Director Flight Evaluation will be completed. The gun director will be transferred to Program Element 64212F Aircraft Equipment Development for Engineering Development. The 2nd generation Forward Looking Infrared Sensor will begin flight evaluation. The Missile Launch Envelope program will complete the ground validation of the algorithms and displays. Flight test planning and coordination will commence to evaluate the algorithms and displays under simulated combat flight conditions.

3. FY 1981 Planned Program: Advanced Strike Radar Technology (ASRAT) effort will flight demonstrate slow moving target detection and track and transfer the algorithms to PE 64412 Common Multimode Radar. The ASRAT program will initiate efforts toward meeting the long range goals of high resolution for target classification, automatic terrain following/avoidance and resistant to electronic countermeasures. The Integrated Fire Flight Control hardware will begin flight evaluation using the F-15B aircraft. Ground evaluation of the equipment developed under the Infrared Search and Track Search System (IRSTS) will be initiated. The IRSTS goal is detection of target at ranges

of miles. A new effort will be initiated in Advanced Technology Survivable Radars (ATSR). The ATSR effort will investigate and demonstrate bistatic operation in the high resolution mode . The inherent advantages of having non-radiating high resolution radars will give the element of surprise back to the aircraft and will lead to increased survivability and probability of target destruction. The flight test evaluation of the algortihms and displays developed by the Missile Launch Envelope Program will be initiated.

4. FY 1982 Planned Program: The F-15B flight evaluation of algorithms and displays developed under the Missile Launch Envelope will be completed and turned over for engineering development. The Advanced Strike Radar Technology will modify an existing radar to demonstrate closed loop terrain following/avoidance, and high resolution for target classification. The Infrared Search and Track program will begin flight evaluation of the equipment developed during earlier phases of the program. The Advanced Technology Survivable Radar will develop and fabricate hardware for flight evaluation in subsequent years. The initial demonstration will emphasize high resolution and real time focus.

5. Program to Completion: This is a continuing program.

6. Milestone: Not Applicable

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
69DF	Advanced Weapon Delivery	6,278	3,700	8,600	10,800	Continuing	N/A

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
69DF	Advanced Weapon Delivery	6,569	7,000	7,400	10,000	Continuing	N/A

The $1.400 million reduction in Project 69DF was due to the cancellation of the All Weather Tactical Strike System (AWTSS). The AWTSS program projected a $10 million overrun on a $13 million contract in February 1979 and was terminated in March of 1979.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63205F
Title: Flight Vehicle Technology
DOD Mission Area: Engineering Technology (ATD) #553
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	10,000	8,900	7,900	6,000	Continuing	Not Applicable
2506	Control of Flight	9,000	8,200	7,600	5,600		
2507	Vehicle Equipment		500		200		
2508	Aeromechanics	1,000	200	300	200		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program will mature and demonstrate in flight new aeronautical technologies to reduce risk and permit early transition of these technologies to current and future Air Force weapon systems. This Air Force program is devoted to the development and demonstration of specific advanced aeronautical technologies. Areas of technology investigated are Aerodynamics, Flight Control, Vehicle Equipment, and Aeromechanics. A portion of this program develops the aeronautical technologies to be integrated and demonstrated in PE 63245F, Advanced Fighter Technology Integration, under project 2061, Fighter Attack Technology (AFTI/F-16).

BASIS FOR FY 1981 RDT&E REQUEST: Continue contractual programs on conventional Integrated Flight/Fire Control and Digital Flight Control. Flight testing of conventional Integrated Flight/Fire Control will be initiated using an F-15 as a test vehicle. Continue development of the digital flight control system supported by flight demonstration under PE 63245F, Advanced Fighter Technology Integration. In addition, design and simulation of Integrated Flight/Fire Control III for subsequent demonstration in the Advanced Fighter Technology Integration program will be accomplished. New start candidates under consideration for FY 1981 start include Closed-Loop Environmental Control system, Atmospheric Electricity Hazards Protection, and Active Fighter Flutter Suppression.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #63205F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Flight Vehicle Technology
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: Exploratory development efforts accomplished under Program Element 62201F, Aerospace Flight Dynamics, over the past ten years have identified a number of promising aeronautical technologies that offer large improvements over current fighter systems. It has also become apparent that these technologies must be demonstrated in flight before they will be utilized in future Air Force systems. A conscious effort was made to consolidate flight testbed requirements in order to reduce demonstration costs. Therefore, several tasks within this program are directly supported by the Advanced Technology Demonstration in PE 63245F, Advanced Fighter Technology Integration. The Flight Vehicle Technology program will develop and in some cases demonstrate in flight a number of different aeronautical technologies which include Digital Flight Control System, Integrated Flight/Fire Control, Direct Force Control, Pilot/Vehicle Control and Display Interface, Closed-Loop Environmental Control System, Atmospheric Electricity Hazards Protection, and Active Fighter Flutter Suppression.

RELATED ACTIVITIES: This program develops technologies for demonstration in PE 63245F, Advanced Fighter Technology Integration. Technology Base inputs are received from PE 62201F, Aerospace Flight Dynamics, and PE 62102F, Materials. The Digital Flight Control development is jointly funded by the U.S. Navy. Further, the entire Advanced Fighter Technology Integration program including elements of this program is a joint program with National Aeronautics and Space Administration and is managed under an approved Memorandum of Understanding. Lastly, the Integrated Flight/Fire Control Task is a joint development effort with the Air Force Avionics Laboratory.

WORK PERFORMED BY: This program is managed by the Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, OH. Contractors are McDonnell Douglas Corporation, St Louis, MO; and General Dynamics Corporation, Ft Worth, TX.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Progress on the McDonnell Douglas contract to develop conventional Flight/Fire Control has proceeded according to schedule. Preliminary design of the system was completed and detail design initiated. This level of design will be completed in early FY 1980 for late FY 1980 flight testing. The technology development of Digital Flight Control, Integrated Flight/Fire Control III, and Pilot Vehicle Control and Display Interfaces for integration and demonstration in the Advanced Fighter Technology Integration program is on schedule at General Dynamics. Preliminary design of the Digital Flight Control and Pilot Vehicle Control and Display Interface technologies have been completed. Detail design of those systems was initiated in August 1979. The critical design review to conclude those design efforts will be held in March 1980 and the technologies flight tested in FY 1981. The winglets program to reduce the drag for the KC-135 aircraft entered flight testing at Edwards Air Force Base. Flight testing will conclude in FY 1980 and validate the eight percent drag reduction found in wind tunnel testing.

Program Element: #63205F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Flight Vehicle Technology
Budget Activity: Advanced Technology Development #2

2. FY 1980 Program: Development of the Conventional Integrated Flight/Fire Control will continue. Hardware-in-the-loop simulation, ground testing, and airworthiness testing will be completed to support Class II modification of the F-15 flight test vehicle. Flight testing will be initiated in late FY 1980. Detail design of the triplex, multimode Digital Flight Control for demonstration in the Advanced Fighter Technology Integration program (PE 63245F) will be completed for a critical design review in March 1980. Hardware and software fabrication will follow. These will be completed in early FY 1981 for flight test initiation in July 1981. The Winglets Technology Development program will be completed and transitioned to PE 11142F for engineering development at the Aeronautical Systems Division. Validation of the drag reduction at cruise for the KC-135 offers substantial savings in operating costs for the KC-135 fleet. In addition, a new start will be selected from the Closed-Loop Environmental Control system, Atmospheric Electricity Hazards Protection, and Active Fighter Flutter Suppression new start candidates.

3. FY 1981 Planned Activity: The Conventional Integrated Flight/Fire Control flight test program will be completed and test aircraft demodified. This technology will provide a proven design option for retro-fit in existing aircraft and provide the data base for the Integrated Flight/Fire Control III portion of the Advanced Fighter Technology Integration (AFTI/F-16) program. This Integrated Flight/Fire Control program will feature the Direct Force Control and weapon line pointing modes associated with the AFTI/F-16 program. Fabrication of a flight worthy Digital Flight Control system and the necessary controls and displays will be completed. The AFTI/F-16 test aircraft will be modified and ground testing completed in order to initiate flight testing in July 1981. The initial design of the Integrated Flight/Fire Control III program for the AFTI/F-16 will begin. Development of the new start selected in FY 1980 will continue.

4. FY 1982 Planned Program: Phase One flight testing of the Digital Flight Control system will be completed. Detail design and fabrication of the Integrated Flight/Fire Control III system, Phase II, will be completed and the Advanced Fighter Technology Integration F-16 test aircraft modified. Initiation of the second phase of the flight testing will commence in July 1982. Also, development of the new start selected in FY 1980 will continue.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Program Element: #63205F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Flight Vehicle Technology
Budget Activity: Advanced Technology Development #2

7. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5,500	9,000	8,900	9,300	Continuing	Not Applicable
2506	Control of Flights	3,600	8,000	8,200	7,500		
2507	Vehicle Equipment	600		500	1,700		
2508	Aeromechanics	1,300	1,000	200	100		

The difference between the 1980 and 1981 RDT&E Descriptive Summary budget data for FY 1981 represents a decision to recompete the Closed-Loop Environmental Control System in the Vehicle Equipment project with other mature new start candidate programs. The new start selected in FY 1980 from the available candidates will be determined by highest technological payoff and/or most urgent user need. FY 1981 project funding may be readjusted depending on which candidate is selected.

Project: #2506 Title: Control of Flight
Program Element: #63205F Title: Flight Vehicle Technology
DOD Mission Area: Engineering Technology (ATD) #553 Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: Exploratory development efforts accomplished under Program Element 62201F, Aerospace Flight Dynamics, over the past ten years have identified a number of promising aeronautical technologies that offer large improvements over current fighter systems. It has also become apparent that these technologies must be demonstrated in flight before they will be utilized in future Air Force systems. A conscious effort was made to consolidate flight testbed requirements in order to reduce demonstration costs. Therefore, several tasks within this program are directly supported by the Advanced Technology Demonstration in PE 63245F, Advanced Fighter Technology Integration. This project will develop and in some cases demonstrate in flight a number of different aeronautical technologies which include Digital Flight Control System, Integrated Flight/Fire Control, Direct Force Control, and Pilot/Vehicle Control and Display Interface.

RELATED ACTIVITIES: This program develops technologies for demonstration in PE 63245F, Advanced Fighter Technology Integration. Technology Base inputs are received from PE 62201F, Aerospace Flight Dynamics, and PE 62102F, Materials. The Digital Flight Control development is jointly funded by the U.S. Navy. Further, the entire Advanced Fighter Technology Integration program including elements of this program is a joint program with National Aeronautics and Space Administration and is managed under an approved Memorandum of Understanding. Lastly, the Integrated Flight/Fire Control Task is a joint development effort with the Air Force Avionics Laboratory.

WORK PERFORMED BY: This program is managed by the Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, OH. Contractors are McDonnell Douglas Corporation, St Louis, MO; and General Dynamics Corporation, Ft Worth, TX.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Progress on the McDonnell Douglas contract to develop conventional Flight/Fire Control has proceeded according to schedule. Preliminary design of the system was completed and detail design initiated. This level of design will be completed in early FY 1980 for late FY 1980 flight testing. The technology development of Digital Flight Control, Integrated Flight/Fire Control III, and Pilot Vehicle Control and Display Interfaces for integration and demonstration in the Advanced Fighter Technology Integration program is on schedule at General Dynamics. Preliminary design of the Digital Flight Control and Pilot Vehicle Control and Display Interface technologies have been completed. Detail design of those systems was initiated in August 1979. The critical design review to conclude those design efforts will be held in March 1980 and the technologies flight tested in FY 1981.

2. FY 1980 Program: Development of the conventional Integrated Flight/Fire Control will continue. Hardware-in-the-loop simulation, ground testing, and airworthiness testing will be completed to support Class II modification of the F-15 flight test vehicle. Flight testing will be initiated in late FY 1980. Detail design of the triplex, multimode Digital Flight Control for demonstration in the Advanced Fighter Technology Integration program (PE 63245F) will be completed for a critical design review in March 1980. Hardware and software fabrication will follow. These will be completed in early FY 1981 for flight test initiation in July 1981.

Project: #2506 Title: Control of Flight

Program Element: #63205F Title: Flight Vehicle Technology

DOD Mission Area: Engineering Technology (ATD) #553 Budget Activity: Advanced Technology Development #2

3. FY 1981 Planned Activity: The Conventional Integrated Flight/Fire Control flight test program will be completed and test aircraft demodified. This technology will provide a proven design option for retro-fit in existing aircraft and provide the data base for the Integrated Flight/Fire Control III portion of the Advanced Fighter Technology Integration (AFTI-F-16) program. This Integrated Flight/Fire Control program will feature the Direct Force Control and weapon line pointing modes associated with the AFTI/F-16 program. Fabrication of a flight worthy Digital Flight Control system and necessary controls and displays will be completed. The AFTI/F-16 test aircraft will be modified and ground testing completed in order to initiate flight testing in July 1981. The initial design of the Integrated Flight/Fire Control III program for the AFTI/F-16 will begin.

4. FY 1982 Planned Program: Phase One flight testing of the Digital Flight Control system will be completed. Detail design and fabrication of the Integrated Flight/Fire Control III system, Phase II, will be completed and the Advanced Fighter Technology Integration F-16 test aircraft modified. Initiation of the second phase of the flight testing will commence in July 1982.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	9,000	8,200	7,600	5,600	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: Not applicable, no change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63208F
DoD Mission Area: Electronic and Physical Sciences (ATP), #551

Title: Reconnaissance Sensors/Processing Technology
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,650	6,400	6,900	7,700	Continuing	Not Applicable
665A	Reconnaissance Sensors/ Processing Technology	3,650	6,400	6,900	7,700	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Program Element 63208F is a continuing Advanced Development Program Element that exploits new technologies to satisfy future reconnaissance requirements. Project 665A emphasizes the development of real and near-real time reconnaissance capabilities. This program is providing the technology base and validated concepts for new and improved reconnaissance sensors as well as the technology base required for LANTIRN like systems. The objective is to provide alternatives for the future.

BASIS FOR FY 1981 RDT&E REQUEST: This program is comprised of advanced developments for real and near-real time reconnaissance sensor systems along with the inherent processing for timely data exploitation. Activities in FY 1981 include, among others, continuation of developments and validations for: automatic data processing and data handling to automate and expedite the exploitation of large quantities of reconnaissance data; automatic target cueing and classification sensor technology; and second generation Forward Looking Infrared technology and demonstration. The increased level of funding in FY 1981 over that of FY 1980 is required for conceptual validation and demonstration of these systems exploiting available and developing technologies. These concepts and systems, when validated, shall provide new alternatives for future reconnaissance systems.

OTHER APPROPRIATION FUNDS: Not applicable.

Project: #665A
Program Element: #63208F
DoD Mission Area: Electronic and Physical Sciences (ATP), #551

Title: Reconnaissance Sensors/Processing Technology
Title: Reconnaissance Sensors/Processing Technology
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: The activities conducted within this program exploit new technologies to meet reconnaissance requirements. The objective is to advance technology and improve the time responsiveness of reconnaissance sensor systems in order to provide real and near-real time information to tactical commanders during day, night and all-weather conditions for effective strike and surveillance of enemy forces. The program includes advanced development of real and near-real time sensor systems, with both airborne and ground processing, for the detection, location and classification of targets concealed by camouflage, foliage, or adverse weather conditions. This program will provide the necessary technology base and concept validation for new and improved reconnaissance sensor systems. The requirements for these reconnaissance systems are identified in various requirements documents established by the operational commands.

RELATED ACTIVITIES: Exploratory development efforts are phased into this program from Program Element (PE) 62204F, Aerospace Avionics. Equipment developments from this program are transitioned into engineering development PEs such as 64710F, Reconnaissance Equipment; 64756F, Side Looking Airborne Radar; and 63747F, PAVE MOVER. Coordination with the Army and Navy on related advanced development work is accomplished by direct liaison between corresponding levels of program management. PE 63203F, Advanced Avionics for Aircraft, is jointly funding the Second Generation Forward Looking Infrared (FLIR) Technology Demonstration. PE 63203F will be providing $320,000 in FY 1980 and $900,000 in FY 1981. This support is planned to pursue the strike avionics aspects of FLIR technology as well as the reconnaissance applications.

WORK PERFORMED BY: Program management is the responsibility of the Air Force Systems Command through the Air Force Avionics Laboratory, Wright-Patterson Air Force Base, OH, with participation of the Rome Air Development Center, Griffiss AFB, NY. Major contractors are: Control Data Corp., Minneapolis, MN, for long wavelength radar (Integrated Multi-Frequency Radar-IMFRAD); Fairchild Camera, Mountain View, CA, for long range low contrast imagery (Long-Range Electro-Optical Reconnaissance System-LOREORS); Perkin-Elmer Corp., Wilton, CT, for Target Cueing/Classification System (3-D Target Cuer); and Hughes Aircraft Co., Culver City, CA, for Second Generation FLIR Technology Demonstration. In addition to these, six other contractors are anticipated to be involved in other program activities in FY 1981.

Project: #665A
Program Element: #63208F
DoD Mission Area: Electronic and Physical Sciences (ATP), #551

Title: Reconnaissance Sensors/Processing Technology
Title: Reconnaissance Sensors/Processing Technology
Budget Activity: Advanced Technology Development #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Developed and proven technologies for new reconnaissance sensors and for improvements to existing systems that were provided under this program include: an infrared line scan night sensor system for the RF-4C; an inflight laser-line-scan radar data recorder; a digital processor for the Side Looking Airborne Radar (SLAR) which was transferred in FY 1976 to Program Element (PE) 63746F, SLAR; initial flight tests of an integrated multi-frequency radar (IMFRAD) for detection of targets concealed by foliage; an initial feasibility demonstration of a multi-antenna moving target surveillance radar which was transferred to PE 63747F, PAVE MOVER, for further development; and an Electronic Wide Angle Camera System to provide a data linkable, near-real time reconnaissance sensor using charge coupled devices (CCD). Testing and fabrication of the Electronic Solid-State Wide Angle Camera System, based on CCD techniques, was completed in FY 1979.

2. FY 1980 Program: Fabrication of the Long Range Electro-Optical Reconnaissance System for imaging ultra-low contrast targets at long stand-off distances was initiated in FY 1977 and will be completed in FY 1980. The initial automatic screening work conducted under the Automatic Image Screening (AIS) and the Augmented Target Screener Subsystem investigations will be further pursued in FY 1980. Other activities in FY 1980 include continuation of the Automatic Target Cueing/Classification Sensor development; the Second Generation Forward Looking Infrared (FLIR) Technology Demonstration; and a new effort in data handling for real/near-real time sensors. Additional initiations in FY 1980 include the follow-on to IMFRAD entitled Concealed Target Detection (CONTAD); follow-on to the FLIR Technology Demonstration, entitled Advanced Target Acquisition; and the Sensor Integration program to exploit multi-spectral data.

3. FY 1981 Planned Program: Testing will continue for Auto Image Screening, Auto Target Cueing/Classification Sensor, CONTAD, Advanced Target Acquisition, and Data Handling. These LANTIRN-like technologies support both reconnaissance and strike requirements. In addition, studies for an All Weather Identification System will be initiated to integrate various sensor and processing technologies to provide a day/night, all weather detection, location and identification capability.

4. FY 1982 Planned Program: Advanced development will be completed for the Auto Target Cueing/Classification Sensor, Auto Image Screening and Data Handling. Development activities shall continue for CONTAD and the All Weather Identification System. A new development to be initiated in FY 1982 is the advanced Image Recording System, a wide band recorder, which is to be based on laser recording techniques.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

Project #665A
Program Element: #63208F
DoD Mission Area: Electronic and Physical Sciences (ATP), #551

Title: Reconnaissance Sensors/Processing Technology
Title: Reconnaissance Sensors/Processing Technology
Budget Activity: Advanced Technology Development #2

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,850	3,650	6,400	7,400	Continuing	Not Applicable
665A	Reconnaissance Sensors/ Processing Technology	3,850	3,650	6,400	7,400	Continuing	Not Applicable

The current estimate for FY 1981 is $500 thousand less than the estimate submitted in the FY 1980 President's Budget. This decrease is due to a deferral in initiation of the All Weather Identification System development.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63211F
Title: Aerospace Structures & Materials
DoD Mission Area: Engineering Technology (ATD), #553
Budget Activity: Advanced Technology Development #2

RESOURCES: (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	14,990	13,800	18,600	21,800	Continuing	Not Applicable
69CW	Advanced Composites	5,090	5,700	7,200	10,500		
486U	Advanced Metallic Structures	5,.00	4,610	7,300	6,600		
2100	Laser Hardened Materials	4,550	3,490	4,100	4,700		
2202	Improved Windshield Protection	150					

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program validates and demonstrates new structural concepts and new materials developments as options for application in aerospace systems. This is accomplished through the design, development, fabrication, and test of advanced metallics and nonmetallic structures which use new materials, advance design concepts, and improved methods of fabrication. Aircraft, missile, and satellite structures, which are representative in scale and complexity of actual components, are built and tested to complete the validation process. This program demonstrates the required technology to improve structural integrity, provide damage tolerant and durable structures, and produce aerospace weapon systems with minimum cost, weight, and technical risk. This is the only Air Force program which, prior to consideration for application on aircraft and space vehicles, demonstrates the feasibility of the latest improvements in materials capability, structural design concepts, and fabrication technology.

BASIS FOR FY 1981 RDT&E REQUEST: Effort will be accomplished in certifying composite aircraft structures for 20-30 years service life. Space and missile applications of composite materials will be continued. An advanced titanium structure, with the potential of a 30 percent reduction in acquisition costs, will continue with testing. Effort to validate fiber reinforced metallic structures will be continued and expanded. The laser hardened materials program will be continued with emphasis on satellite applications.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #63211F
Title: Aerospace Structures & Materials
DoD Mission Area: Engineering Technology (ATD), #553
Budget Activity: Advanced Technology Development #2

DETAILED DESCRIPTION: These projects validate new materials and structural concepts for airplanes, turbine engines, missiles and satellites. The objective is to improve structural integrity, reduce the costs of new systems, and provide more durable structures that will eventually reduce in-service costs. Successful accomplishment of this objective is determined through design, fabrication, ground and, as appropriate, flight test of significant structural components. The program consists of three tasks: Advanced Composites which exploits advanced composite materials technology for primary structure on aircraft, missiles, spacecraft, and air-breathing propulsion systems; Advanced Metallic Structures using existing and advanced metallic materials for increased structural reliability and reduced costs, with new emphasis on metal matrix composites; and Laser Hardened Materials developing structural materials, transparencies, coatings and radomes resistant to laser radiation.

RELATED ACTIVITIES: The other military services and the National Aeronautics and Space Administration (NASA) conduct related programs. Coordination with these organizations and industry is accomplished through joint planning, working level committees, reviews of contractors' Independent Research and Development programs, and full disclosure of completed work through the media of technical reports and seminars. Related programs are: Aerospace Flight Dynamics (Program Element 62201F): Materials (Program Element 62102F); Aerospace Propulsion (Program Element 62203F); Manufacturing Technology (Program Element 78011F); Advanced Radiation Technology (Program Element 63605F); and Satellite Systems Survivability (Program Element 63438F). Technology demonstrated in this program element has potential application for essentially every major Air Force acquisition program.

WORK PERFORMED BY: This program is jointly managed by the Air Force Materials Laboratory and the Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, OH. The major contractors for the program include: Northrop Corporation, Hawthorne, CA; The Boeing Company, Seattle, WA; General Electric, Evendale, OH; Grumman Aerospace, Bethpage, Long Island, NY; McDonnell Douglas, St. Louis, MO and Long Beach, CA: AVCO Corporation, Lowell, MA: General Electric Co., Philadelphia, PA: Honeywell, Inc., Minneapolis, MN; Goodyear Aerospace Corporation, Litchfield Park, AZ; Raytheon Corporation, Waltham, MA; Hughes Space Systems, El Segundo, CA; TRW, Inc., Redondo Beach, CA; Vought Corporation, Dallas, TX; Rockwell International, Los Angeles, CA; General Dynamics Corporation, San Diego, CA; and McDonnell Douglas, Huntington Beach, CA. There are a total of 22 contracts, with a total of 16 contractors.

Program Element: #63211F
DoD Mission Area: Engineering Technology (ATD), #553

Title: Aerospace Structures & Materials
Budget Activity: Advanced Technology Development #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 And Prior Accomplishments: Advanced Composites - Detail design and fabrication of the Advanced Ballistic Reentry Vehicle substructure were completed. Designs have been developed for application of advanced composites to strategic missile structures and satellite main body structure. Significant structural weight savings are projected. Advanced Metallic Structures - The full-scale hardware test component in the Primary Adhesively Bonded Structures Technology program has been fabricated, and four lifetimes of structural fatigue testing have been successfully completed. This program demonstrated at least 30% fabrication cost savings and will also result in improvements in corrosion and fatigue resistance through elimination of mechanical fasteners Ten full size YC-14 nose/landing gear bulkheads have been produced as castings under the Cast Aluminum Structures Technology program. A 30% reduction in acquisition cost is projected for cast structure. as compared to conventional assembled sheet and machined plate metal structures. Laser Hardened Materials

Design guidelines have been developed for the Global Positioning System and Defense Meteorological Satellite Program satellite systems to provide future design criteria and to guide the hardening programs. Testing has been completed on a subscale aircraft canopy that was laminated to achieve environmental durability, laser hardness, and bird impact resistance. Windshields - A computer aided design process for development of an improved bubble canopy has been developed and successfully applied. Improved windshield program effort has been concluded with the publication of a Design Handbook.

2. FY 1980 Program: Advanced Composites Program - Full-scale test articles of the Advanced Ballistic Reentry Vehicle substructure will be complete. Detail design and fabrication effort will continue for wing/fuselage critical component. Propulsion related component effort will be continued. Advanced Metallic Structures - The Primary Adhesively Bonded Structure component and the Cast Aluminum Structures Technology program will both complete final tests. The Built-up Low Cost Advanced Titanium Structure efforts will complete detail design and begin fabrication of airframe center fuselage section. An effort will be initiated to apply built-up, low cost advanced titanium structure technology to the fabrication of a strategic missile shroud. Laser Hardened Materials - Efforts to validate satellite subsystem hardening against ground based threats will continue using full scale

components to ensure functional and space environment compatibility. Developed hardened components will be evaluated in a laser facility under development by Space Division.

New effort will be initiated to extend hardening concepts

3. FY 1981 Planned Program: Fabrication of the composite missile structure will be completed. Testing of the composite satellite equipment support module will be continued. The program on composite wing/fuselage critical component will progress to fabrication and development of qualification testing methods. The Built-up Low Cost Advanced Titanium Structure program will continue with testing of the full-scale component. A major new effort will be started on selectively reinforced airframe structure as part of the new metal matrix composite thrust. The validation of

Laser hardened canopy/windshield effort will initiate flight testing.

4. FY 1982 Planned Program: Testing of full-scale composite missile structure articles and systems verification testing of the equipment support module will be completed. The Built-up Low Cost Advanced Titanium Structure program will complete fatigue testing. Metal matrix composite demonstration efforts will continue on airframe, propulsion and spacecraft components.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

Program Element: #63211F
DoD Mission Area: Engineering Technology (ATD), #553

Title: Aerospace Structures & Materials
Budget Activity: Advanced Technology Development #2

7. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate
	TOTAL FOR PROGRAM ELEMENT	21,000	14,990	13,800	20,000
69CW	Advanced Composites	6,230	5,090	5,700	8,110
486U	Advanced Metallic Structures	8,200	5,200	4,610	7,140
2100	Laser Hardened Materials	5,670	4,550	3,490	4,750
2202	Improved Windshield Protection	900	150		

The only significant change occurred in the estimate for FY 1981 due to overall Air Force Advanced Technology Development funding prioritization. The $1.4M reduction will result in delay of efforts on composites for Radar Absorbing Structure and laser hardening of aircraft and missiles. In addition, a planned new start on composite advanced rotor development will be deferred.

Project: #69CW
Program Element: #63211F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Advanced Composites
Title: Aerospace Structural Materials
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: The purpose of this project is to develop advanced composites technology for aerospace applications. The light weight, high strength and high stiffness properties of advanced composites make this class of materials extremely attractive candidates for weight or stiffness critical designs. These advantages permit structural weight reductions and engineering design improvements which would not be feasible with conventional metal structures. This project has two major thrusts: materials and engineering design development and hardware demonstrations. The materials and engineering design development area results in new material systems of lower cost and develops the substantiating and supporting technology required to assure the suitability of these materials in systems applications. Hardware demonstrations are conducted to demonstrate the feasibility of a fully integrated concept of materials design and manufacturing, and to achieve the anticipated weight savings, flight worthiness and other potential advantages. Over the next ten years, the output of this project is expected to make composite structures less costly than metal items, while providing significant increased performance options to the aircraft, missile and engine designer.

RELATED ACTIVITIES: This program is related to Materials (Program Element 62102F), Aerospace Flight Dynamics (Program Element 62201F), and Aerospace Propulsion (Program Element 62203F). Coordination is accomplished with the Army, Navy, National Aeronautics and Space Administration, and industry through joint planning, technical symposia, professional societies, reviews of contractors' Independent Research and Development Programs, and technical reports.

WORK PERFORMED BY: Work is jointly performed by the Air Force Materials Laboratory and the Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base OH. The major contractors for the program include: Northrop Corporation, Hawthorne CA; Grumman Aerospace, Bethpage, Long Island NY; McDonnell Douglas, St Louis MO; General Electric, Evendale OH; The Boeing Company, Seattle WA; Rockwell International, Los Angeles CA; AVCO Corporation, Lowell MA; and Pratt and Whitney, West Palm Beach, FL.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Techniques have been successfully developed to shield composites from electromagnetic pulses. The validity of these techniques was verified when avionics equipment was installed and tested in composite YF-16 forward fuselage section. No major problems were encountered. Six directionally solidified eutectic low pressure turbine blades were successfully run in a J101 ground test engine test for sixteen hours. Preliminary designs for the wing/fuselage critical components program were developed; two basic concepts, the blended wing body and the bolted-on through wing were investigated. Preliminary designs for the application of composites to deployment module/platform, upper stage missile structure, two-stage Inertial Upper Stage and satellite main body structure indicate significant structural weight savings relative to baseline designs are possible. Completion of the Advanced Ballistic Reentry Vehicle substructure offers a 20-24 percent reduction in weight, thus making possible reentry vehicles with higher payload and extended range. Full scale test articles of a composite advanced maneuvering reentry vehicle substructure were fabricated, and qualification testing will be conducted so as to provide a flight test capability. Detail design efforts for a composite reentry vehicle deployment module were initiated. Structural

validation programs were started for both a composite upper stage missile structure and a satellite equipment support module. Based on completed preliminary design, a detailed design and design development was initiated for the composite wing/fuselage critical validation phase. Design development and fabrication of the Boron-Aluminum fan blade for the F100 engine has been completed.

2. FY 1980 Program: Detail design and design development testing for a composite reentry vehicle deployment module will be completed. Detail design and manufacturing methods verification of the composite missile structure will be completed, and fabrication will be initiated. The equipment support module program will complete detail design, fabricate a full scale test article and initiate structural verification tests. An effort to demonstrate the payoff of advanced composite structure for the Inertial Upper Stage vehicle will be initiated. The wing/fuselage critical components program will complete detail design, continue structural design development testing, initiate fabrication of major critical test components and start the development of accelerated structural qualification test methods. Development of cost-effective durability qualification methods will also be undertaken. The eutectic turbine blade program will complete an alternative design study and begin fabrication.

3. FY 1981 Planned Program: Fabrication of full scale composite reentry vehicle deployment module and upper stage test articles will be completed. Static and dynamic validation tests will be performed. The equipment support module program will complete structural verification testing and will initiate systems verification testing. Detail design and fabrication of advanced composite Inertial Upper Stage structure and wing/fuselage components will continue. Fabrication and test evaluation of the eutectic turbine blades will be completed and preparation for engine ground testing will be started. New starts in the areas of space based surveillance, leading to hardware development, and radar absorbing structure will be initiated.

4. FY 1982 Planned Program: Programs on the composite equipment support module and missile upper stage will be completed. Composite optical support structure, radar absorbing structure and wing/fuselage components will continue. New efforts in flight safety/damage tolerant structure and advanced maneuvering reentry vehicle will be initiated.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Program: #69CW
Program Element: #63211F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Advanced Composites
Title: Aerospace Structural Materials
Budget Activity: Advanced Technology Development #2

7. Resources: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
69CW	Advanced Composites	5,090	5,700	7,200	10,500	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
69CW	Advanced Composites	6,230	5,090	5,700	8,110	Continuing	Not Applicable

The only significant change to the program occurred in the estimate for FY 1981. The reduction from $8.1M to $7.2M due to overall Air Force Advanced Technology Development funding prioritization, reflects a small delay in the initiation of a new program on radar absorbing structure, and deletion of a planned new start on composite advanced rotor development.

Project: #486U
Program Element: #63211F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Advanced Metallic Structures
Title: Aerospace Structures & Materials
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the design, fabrication, test and evaluation of aircraft primary structures utilizing the latest metal alloys and advanced structures technology. Objectives are reduced acquisition and maintenance costs and increased structural integrity. To demonstrate that advanced technology can satisfy these objectives, major assemblies such as wing carry-through structures, fuselage sections and wing structures are built and tested. This program was initiated in FY 1971 because of structural problems that existed with current inventory aircraft. It has been continued to demonstrate that new technology can significantly improve the structural integrity of future aircraft and to identify new approaches to reduce airframe costs.

RELATED ACTIVITIES: This program is related to Aerospace Flight Dynamics (Program Element 62201F), Materials (Program Element 62102F), Aerospace Propulsion (Program Element 62203F), and the Mechanics Subelement of Defense Research Sciences Program (Program Element 61102F). Coordination with the Army, Navy, National Aeronautics and Space Administration, and industry is accomplished through such methods as: membership on National Aeronautics and Space Administration Advisory Committees; various professional societies; and reviews of contractors' Independent Research and Development Programs. Triservice coordination is also accomplished during preparation of both the Materials and Structures Technology Coordinating Papers.

WORK PERFORMED BY: Work is jointly performed by the Air Force Flight Dynamics Laboratory and the Air Force Materials Laboratory, Wright-Patterson Air Force Base OH. Management of the program is accomplished by the Air Force Flight Dynamics Laboratory. Contractors are: McDonnell Douglas, Long Beach CA and St Louis MO; Rockwell International, Thousands Oaks CA; and The Boeing Company, Seattle WA.

PROGRAM ACCOMPLISHMENTS AND FUTUPE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Advanced Metallic Air Vehicle Structure Program was completed. This structure made the first utilization of a new aluminum and steel alloy for aircraft use and also introduced a newly developed thermal processing treatment for a titanium alloy. The Primary Adhesively Bonded Structure Program has completed fabrication and four lifetimes of fatigue testing. Development and test of this structure has demonstrated that adhesive bonding of primary fuselage structure can result in at least 30% cost saving compared to existing fabrication techniques. The fuselage baseline was selected because adhesive bonding can significantly reduce fastener corrosion and fatigue cracking. The built-up, low cost advanced titanium structure program to demonstrate that the cost of very expensive titanium structures can be reduced has moved to the full scale component design and fabrication phase. The object is a 50% cost and 30% weight reduction over current practice. The approach will be to design and demonstrate a structure that minimizes machining, drilling, and piece parts and utilizes advanced fabrication methods such as superplastic forming. The program to demonstrate Lower Cost by Substituting Steel for Titanium verified that a new, high strength, high toughness steel could be used to replace large titanium fittings, with 30% cost savings and 11% weight savings.

Project: #486U
Program Element: #63211F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Advanced Metallic Structures
Title: Aerospace Structures & Materials
Budget Activity: Advanced Technology Development #2

2. FY 1980 Program: The cast aluminum structures technology program will be completed, having successfully demonstrated fabrication of the large bulkhead component and fatigue/damage tolerance capability. The built-up, low cost advanced titanium structure program will continue with the fabrication of a full scale center fuselage test component. Application of this titanium fabrication technology to a strategic missile shroud will be initiated. Trade-off studies of metal matrix composites applied to airframe/missile structure will be initiated. Design development for available metal matrix-advanced fiber combinations, and an advanced reinforced titanium fan blade effort will be initiated, in support of the metal matrix composite new thrust.

3. FY 1981 Planned Program: The built-up, low cost advanced titanium structure program will complete fabrication of the center fuselage test components and fatigue testing will be initiated. The titanium strategic missile shroud program will be completed. Efforts will be started on the demonstration of advances in materials and structu technology for improved airframe structures of operational aircraft. Metal matrix composite programs for titanium blades and selectively reinforced airframe structure will be continued. A full scale airframe/missile metal matrix structural componenet demonstration effort will be initiated.

4. FY 1982 Planned Program: The built-up low cost advanced titanium structure program will continue with fatigue and damage tolerance testing. Operational aircraft structural improvement demonstration will continue, as will metal matrix composite demonstration efforts. A program to demonstrate the improvements in durability of structure made from aluminum alloy powder will be initiated.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
486U	Advanced Metallic Structures	5,200	4,610	7,300	6,600	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: The current FY 1981 estimate is $0.160M higher than that in the FY 1980 RDT&E Descriptive Summary due to inflation.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63215F
DoD Mission Area: Engineering Technology (ATD), #553

Title: Aviation Turbine Fuel Technology
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING) ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,675	2,800	4,400	2,900	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This energy conservation related program will produce aviation turbine fuel specifications for fuels derived from low quality petroleum crudes and non-petroleum sources such as oil shale and coal. The program will concentrate on the hardware implications of the transition to non-petroleum derived fuels. Turbine engine performance and durability parameters will be compared to fuel processing costs, yields, and fuel properties from companion programs. Fuel costs will be systematically traded with hardware support costs to determine the fuel specification limits most advantageous to the Air Force.

BASIS FOR 1981 RDT&E REQUEST: Performance and durability testing of turbine engine afterburners will continue with emphasis on durability testing. Testing of turbine engine main combustors and turbines will be continuing throughout FY 1981 and completing in FY 1982. Auxiliary Power Units will begin testing in FY 1981. These component level tests of contemporary turbine engines using both can-annular and full annular combustors will lead to the full-scale engine testing in FY 1982.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #63215F
DoD Mission Area: Engineering Technology (ATD) #553

Title: Aviation Turbine Fuel Technology
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: Numerous studies have predicted large shortfalls in petroleum production in relation to consumption patterns. Aviation fuel costs have already risen drastically since 1973, and the Air Force annual aviation fuel bill is about $1.6 Billion (aviation fuel consumption has been reduced by one third since 1973; however, the annual cost has risen to two and one half times the 1973 levels in spite of the consumption reduction). Also, poorer quality petroleum crudes (Alaskan crudes as an example) make poor stock for our current specification fuels. In the past bidders' quantities far exceeded demands; however, current JP-4 purchases have surfaced availability problems due to scarcity of better quality crudes. Much of the petroleum now converted to aviation fuel is imported crude. We are now importing fifty percent of our nation's petroleum consumption. By utilizing our domestic source of oil shale we can improve our defense posture through increased availability and security of our sources while improving our balance of payments problem. Initially, this program will test variable quality, synthetically derived aviation fuels in sub-scale and full-size component tests. Later, full-scale engine testing and flight testing of current Air Force aircraft will be used to determine what fuel property changes can be made without incurring unreasonable system support costs. At our current consumption rates, a savings of one cent per gallon in fuel processing cost equates to a cost avoidance of $38 million annually. It is not unreasonable to expect cost avoidances of over $100 million annually. Shale oil crude is an excellent source for aviation fuels; however, it has properties that lead to special processing considerations. Fortunately, the same "cure" for treating the unsaturates (aromatics) and for removing nitrogen can be accomplished by hydrogenation (adding hydrogen under heat and pressure). This program will evaluate what amount of processing is necessary to allow shale derived fuels to be used in current turbine engines.

RELATED ACTIVITIES: This program receives inputs from Program Element (PE) 62203F, Aerospace Propulsion; PE 62102F, Materials; and PE 61102F, Defense Research Sciences. Technical evaluations for contract source selection and milestone decisions will be made using an evaluation team composed of Air Force, Department of Energy (DOE) and National Aeronautics and Space Administration (NASA) personnel. This program and the companion exploratory development programs in PE 62203F are coordinated with NASA (Lewis Research Center) and DOE (Laramie Energy Research Center). The DOE (Bartlesville Energy Research Center) is performing fuels stability investigations on shale derived fuels for the Air Force. NASA Lewis is conducting cooperative planning with the Air Force Aero Propulsion Laboratory to assure the military and civilian synthetic fuels efforts are complimentary. The Army, Navy and Air Force synthetic fuels programs are coordinated through the Under Secretary of Defense for Research and Engineering. Test fuel planning in cooperation with the DOE is being coordinated through the Defense Mobility Fuels Office. Test fuels acquisition, transportation and storage is being handled by the Defense Fuels Supply Center of the Defense Logistics Agency.

Program Element: #63215F
DoD Mission Area: Engineering Technology (ATD), #553

Title: Aviation Turbine Fuel Technology
Budget Activity: Advanced Technology Development #2

WORK PERFORMED BY: Work is managed and performed by the Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base (WPAFB), OH. Other Air Force organizations involved are Aeronautical Systems Division, WPAFB, OH and Air Force Materials Laboratory, WPAFB, OH. The majority of the work will be conducted under contracts to qualified bidders. Current contractors are: Ashland Petroleum Company, Ashland, KY; General Electric Aircraft Engine Group, Evendale, OH; Pratt and Whitney Aircraft Group, Government Products Division, West Palm Beach, FL; Sun Oil (SunTech Group), Marcus Hook, PA; UOP Process Division, Des Plaines, IL.

1. FY 1979 and Prior Accomplishments: This program began identification of degradation of performance and durability of contemporary turbine engines such as the F100, TF39, J79, and J85, caused by steady state, transient and cyclic operations with variable quality shale derived fuels and variable quality petroleum fuels. The mainburner and turbine component work started in FY 1979. Sector burner and full size component rig testing and analysis was initiated to test a range of fuel qualities and to provide durability data. Testing is being done under contract to major turbine engine manufacturers. Combustor testing began to determine characteristics of ignition, fuel injector location, heat release rates, pattern factor, temperature distribution, radiant heat transfer, carbon formation and cooling requirements. Turbine testing also began to determine characteristics of metal temperatures, thermal gradients, cooling requirements, and erosion of coatings. The shale processing trade-off studies were initiated, the Phase I paper studies are complete at all contractors and Phase II laboratory confirmation is proceeding on schedule.

2. FY 1980 Program: The mainburner and turbine component efforts will continue. Component testing of augmentors (afterburners) will be initiated to characterize combustion efficiency, light-off, plume and emissions (smoke, NO_x, unburned hydrocarbons, infrared signatures). Durability and performance parameters will also be recorded and analyzed. The augmentor testing will require both sea level and simulated altitude conditions.

3. FY 1981 Planned Program: Mainburner, turbine and augmentor component testing will continue through FY 1981. Testing on auxiliary power units will be initiated. These small turbine engines use the same fuels the parent aircraft use and will experience similar effects of varying fuel quality.

4. FY 1982 Planned Program: Mainburner, turbine, augmentor and auxiliary power unit testing will continue through FY 1982. Ground testing of full-scale engines will also be initiated in FY 1982 followed by an Operational Validation Program consisting of flight testing in Operational Squadrons.

5. Program to Completion: This is a continuing program.

Program Element: #63215F
Title: Aviation Turbine Fuel Technology
Mission Area: Engineering Technology (ATD), #553
Budget Activity: Advanced Technology Development #2

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data: ($ in thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	0	1,000	2,800	2,800	Continuing	Not Applicable

Funds were added in FY 1979 for two purposes: To initiate contracts with processing contractors to evaluate shale derived fuel yields (availability) and cost trade-offs with varying fuel specification parameters, and to purchase shale derived test fuels ($1,745 thousand for processing trade-off studies and $930 thousand for test fuels). No changes have been made in the FY 1980 budget level.

The increase in FY 1981 is a coordinated position to accelerate service programs to be able to utilize commercial shale derived fuels in FY 1983. The component and full-scale engine testing efforts are being accelerated to provide a sound basis for the operational use of shale derived aviation fuel at selected Air Force bases. The program is being reviewed in FY 82 and the outyears to support an Operational Validation program in the 1983-1984 time period.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63216F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Advanced Turbine Engine Gas Generator (ATEGG)
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	18,000	30,000	25,700	28,800	Continuing	Not Applicable

BRIEF DESCRIPTION OF PROGRAM ELEMENT AND MISSION NEED: This program ensures that there is a continuous development and demonstration of the most advanced turbine engine high pressure core components. Advanced compressors, combustors and high pressure turbines are integrated into gas generators in which the performance, durability and cost aspects of these core engine technologies can be assessed. A building block approach is utilized to systematically assess both the independent component characteristics and the interactive interdependent component characteristics under the most realistic operating environment. This critical integrated hardware demonstration enhances the early low risk transitio of these technologies to engineering development. Advanced aircraft and/or growth aircraft systems are dramatically affected by propulsion related capability such as performance, reliability, durability and life cycle cost. These features are directly translated to thrust/weight; specific fuel consumption at cruise and in after burner; stall-free operation; matched cycle performance within a mission envelope; ease of maintenance; lower acquisition cost; and increased reliability/durability. Proper attention to these propulsion features will ensure that advanced aircraft systems can achieve longer range, higher payload, increased maneuverability, and increased sortie rate, or trade-off an of these characteristics depending on their relative importance.

BASIS FOR FY 1981 RDT&E REQUEST: Competitive gas generator options will continue to be pursued by four contractors during this period. Emphasis will be placed on continued enhancement of durability oriented testing of hardware design with special attention to accelerated life testing. Gas generator component designs/redesigns and testing will focus o these efforts prerequisite to the definition and full scale development of the next generation fighter engine in the mi to late 1980s time period. The focus will be on conducting those environmental control tests and accelerated life test required to verify the structural design system of the advanced components. For the first time, this testing will make possible an accurate correlation between the predicted and actual design life of engine hardware. During this period, five builds/tests will be conducted on large engine gas generators and two builds/tests will be conducted on a small engine gas generator. In FY 1981, each contractor will have two complete gas generators, one for flowpath definition testing and a second for dedicated durability/life testing. This milestone was achieved due to Congressional action in FY 1980 which added $10.0 million to this program.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #63216F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Advanced Turbine Engine Gas Generator (ATEGG)
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: This Advanced Development Program will ensure that turbine gas generator technology is available to meet the requirements of future aircraft propulsion systems. To ensure that these needs can be met requires a better definition of the engine's operating environment; advanced designs that maximize the tradeoffs between performance and life characteristics within this environment; and effective test and measurement techniques to verify this capability. The gas generator is the basic building block of the engine and it consists of a compressor, a combustor, and a turbine to power the compressor. The objective of this program is to provide the continued evolution of the most advanced core engine technologies (compressors, combustors, and high pressure turbines) into an advanced gas generator in which the performance, cost and durability aspects can be assessed in a real engine environment. This critical hardware demonstration will enhance the early low risk transition of these technologies to engineering development where they can be applied to growth systems and/or new systems. The technologies are scalable, flexible, and applicable to a wide variety of potential systems applications. Flight size, flight weight gas generators are initially tested to define flow path characteristics. Once the flow path has been characterized and mechanical integrity verified, the gas generators are subjected to accelerated life testing to characterize the structural aspects of the advanced component designs. New component technologies are introduced on a step-by-step basis so that their individual performance/structural characteristics can be assessed and so that the relationship (effect) of the new component on other components and the integrated gas generator can be accurately assessed.

RELATED ACTIVITIES: Gas generator and other engine component feasibility and practicality is demonstrated initially in Exploratory Development under Program Element 62203F, Aerospace Propulsion. The other engine subsystems such as fans, controls and afterburners which, when added to the basic gas generator complete the engine, are demonstrated in advanced development under Program Element 63202F, Aircraft Propulsion Subsystems Integration. Programs conducted by the Navy, National Aeronautics and Space Administration, Federal Aviation Administration, and the Army provide component technology which supports the ATEGG program. Projects within the Navy Advanced Aircraft Propulsion Subsystem Program Element 63210N, directly complement some ATEGG efforts.

WORK PERFORMED BY: The program is managed by the Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, OH. Four turbine engine contractors are currently involved in this effort: The Detroit Diesel Allison Division of General Motors, Indianapolis, IN; Teledyne CAE, Toledo, OH; General Electric, Evendale, OH; and Pratt and Whitney, West Palm Beach, FL.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Every commercial and military engine which has been developed since about 1967 has contained technology which was initially assessed in the Advanced Turbine Engine Gas Generator (ATEGG) program. This program is the only Department of Defense program for the integrated gas generator testing of advanced turbine engine technologies. The unique four contractor demonstration concept has proven itself through aggressive pursuit of performance goals which, when compared to operational engines, have demonstrated dramatic improvements in pressure ratio (higher pressure ratio in 50 percent fewer stages than current designs); combustor heat rise (1000°F increase in a combustor

that is 20 percent shorter than current configurations); turbine rotor inlet temperature (a 1000°F increase over curre engines); and gas generator size and weight (20-30 percent decrease over current configurations). Since FY 1977, increasing emphasis has been placed upon demonstrating enhanced durability/life characteristics in advanced component designs, especially in combustor and turbine hardware. Comprehensive accelerated life testing to assess the time-dependent durability aspects of designs has become an integral part of the test program for each gas generator design. During this time period, increased structural diagnostic testing was conducted at all contractors. This testing focus on isolation/identification of life limited components. Gas generators are heavily instrumented in order to adequatel assess flowpath components. This structural diagnostic testing is prerequisite to future more complex structural test Specific large engine gas generator accomplishments include: (a) continued the design/fabrication on three high throu flow gas generator designs; (b) verified the gas generator performance for one gas generator prior to transition to Joint Technology Demonstrator Engine testing, including 76 hours of gas generator hot testing; (c) verified the fifth generation turbine design for one gas generator including one hour operation at design turbine temperature; (d) comple the first structural environment control test to measure the exact operating environment of a high pressure turbine component (this test is a key to accelerated life testing); and (e) demonstrated advanced instrumentation techniques capable of doubling the data acquisition in structural diagnostic testing. Small engine gas generator efforts resulte in the completion of all structural diagnostic testing prerequisite to more complex environmental control test. Seven thermal cycles were completed, and three and one-half hours of gas generator operation at design turbine rotor inlet temperature (TRIT) were accomplished.

2. FY 1980 Program: During this time period, the first accelerated life test will be conducted. In this testing, the gas generator hardware will be cycled to visible distress. Results of this testing will make possible for the first ti an accurate correlation between the predicted and actual life of a component. This testing is considered absolutely essential to the low risk transition of advanced gas generator technology/hardware to growth and/or new development systems. Testing conditions will be designed to assess the effects of time-dependent life-limiting factors (i.e., low cycle fatigue, creep, stress rupture, etc.). Use of increased instrumentation, more thorough post-test analysis/correl tion, and more rigorous testing are essential elements in the process to adequately assess the design methodology and t determine the structural potential of the hardware. Gas generator efforts at the large engine contractors include: (a) turbine accelerated life testing (including 2000 thermal cycles) and completion of high through flow (HTF) gas generator design and fabrication at one contractor; (b) turbine environmental control testing and initial flowpath test and evaluation of a high through flow (HTF) gas generator design and fabrication at one contractor; and (c) compressor environmental control test, turbine structural diagnostics test and completion of fabrication of an HTF gas generator a a third contractor. Small engine gas generator efforts include turbine structural environmental control testing, investigation of the effects of variable turbine cooling on the high pressure turbine, and initial hardware fabrication of a new three-stage compressor gas generator design.

3. FY 1981 Planned Program: During this time period, three new gas generator designs will undergo initial flowpath definition testing. A total of seven major gas generator builds/tests will be accomplished. Large engine gas generato efforts will focus on the assessment of HTF gas generators. Two large engine gas generator designs will complete a

maturation process which includes comprehensive flowpath documentation and durability/life testing. This will signal a major milestone for advanced gas generator technology assessment. Specific efforts will include: (a) turbine vane environmental control testing and initial HTF flowpath testing at one contractor; (b) turbine environmental control test/structural assurance cyclic test and initial HTF flowpath testing at a second contractor; and (c) design and initial fabrication of a new HTF compressor and turbine accelerated life test on a new rapid solidification rate/radial wafer turbine blade (three lifetimes when compared to current operational blades) at a third contractor. All large engine contractors will be fabricating additional hardware needed for extended structural tests of gas generators. Small engine gas generator efforts will be aimed at the initial flowpath testing on a new gas generator with a three-stage compressor, vaporizer plate combustor, and high rim speed turbine. This new gas generator will represent a 20 percent reduction in size compared to current small engine gas generators. An environmental control test/structural assurance cyclic test will be conducted on a small gas generator to determine the individual failure effects and cumulative failure effects (i.e., ordering effects) of various time dependent failure modes. During this time period, additional hardware fabrication will be complete which will provide each contractor with two gas generators. This milestone will permit dedicated durability/life testing.

4. FY 1982 Planned Program: One large engine gas generator and a small engine gas generator will complete the maturation process which includes comprehensive flowpath documentation followed by extensive durability/life testing. During this period, a testing milestone will be achieved: each contractor will conduct at least two major builds/tests for the first time in the history of the program. All contractors will be conducting accelerated life testing on gas generators. Specific large engine efforts will include: (a) turbine vane/combustor accelerated life testing (including 2000 thermal cycles) and additional HTF gas generator component assessment at one contractor; (b) combustor accelerated life testing and initial flowpath testing of a five-stage compressor HTF gas generator at a second contractor; and (c) turbine accelerated life test, and more comprehensive flowpath testing of an HTF gas generator with cooling flow modulation at a third contractor. Small engine gas generator efforts include turbine blade/combustor accelerated life testing and additional flowpath performance test and new component design/integration on a three-stage gas generator.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

Program Element: #63216F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Advanced Turbine Engine Gas Generator (ATEGG)
Budget Activity: Advanced Technology Development #2

8. Comparison with FY 1980 Budget Data:

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	16,400	18,000	20,000	25,500	Continuing	Not Applicable

Congress added $10 million to this program in FY 1980 to fabricate additional sets of research and development hardware for use in the more strenuous durability testing. FY 1981 reflects changes for inflation.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63227F
Title: Advanced Simulator Technology
DoD Mission Area: Environmental and Life Sciences (ATD), #552
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2,900	2,000	3,200	4,500	Continuing	Not Applicable
1958	Training Simulation Technology Integration	500	0	0	0	0	6,200
2363	Advanced Tactical Air Combat Simulation	2,400	2,000	3,200	2,400	1,900	13,300
2364	Advanced CIG Sensor/ Visual Simulation	0	0	0	2,100	7,200	9,300

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Currently, air-to-air, air-to-ground, and terrain-following simulator training is limited by lack of visual display brightness, resolution, and image fidelity. This program element supports work in the training and personnel category of TRAINING DEVICES AND SIMULATION. It develops subsystems to improve the performance capabilities of flight simulators, with special emphasis on developing and demonstrating improved image generation and visual display techniques. In the visual display area, significant improvements in display resolution, brightness, and number of interactive moving targets will be possible with the development of light-valve projector technology. Advanced image generation techniques will be developed and tested for feasibility. The simulation technology developments funded and managed through this program will advance the state-of-the-art for tactical air combat visual displays, removing many existing simulator training limitations.

BASIS FOR FY 1981 RDT&E REQUEST: Funding supports the continuation of Project 2363, Advanced Tactical Air Combat Simulation, through the development of critical visual system components. This project advances the visual display technology that will lead to significantly improved tactical air combat and mission training capabilities in flight simulators for both air-to-air combat and air-to-surface weapons delivery. These advanced techniques will provide improved resolution, increased brightness, and color imagery. They are also expected to reduce the weight of visual displays compared to current systems such as the Advanced Simulator for Pilot Training (ASPT) located at Williams AFB AZ.

OTHER APPROPRIATED FUNDS: Not applicable.

Program Element: #63227F Title: Advanced Simulator Technology
DoD Mission Area: Environmental and Life Sciences (ATD),#552 Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: The program supports the Air Combat Tactics Training thrust by the Air Force Human Resources Laboratory. It provides for the development and demonstration of simulation devices for improved low-cost flight training, concentrating on advancement of visual display and image generation technology for fighter/attack aircraft simulators. Project 2363 will fund developments in visual display optics and image projection and in Computer Image Generation (CIG) technology. Reductions in the cost and weight of display optics will be made through development of hologram optics, which includes a color holographic replacement for the heavy, costly glass spherical-mirror beam splitters. Significant display image projection improvements, especially in image resolution and brightness, will be possible with the development of light-valve projector technology, which will also provide a multiple, independent, high-resolution target display capability. That capability will eliminate the projected need for complex systems that track head or eye movement and display high-resolution imagery in the designated, small field-of-view area. Substantial improvements will be provided in Computer Image Generated scene quality, including advances in scene detail and update rate, and reductions in scene distortion. Those improvements will result from advances in edge-oriented CIG technology to produce a 32K edge-equivalent display (current state-of-the-art is a 6-12K edge-equivalent display). Project 2364,scheduled for initiation in FY 1982, is designed to develop a revolutionary, non-edge CIG concept that can be incorporated into a visual system capable of meeting future requirements for increased scene detail, including realistic terrain, large high-resolution displays, and a high-quality Defense Mapping Agency (DMA) data base interface. The simulation technology advancements funded and managed by this Program Element will accelerate the state-of-the-art for tactical air combat visual displays, and provide simulator subsystems to train improved air combat readiness.

RELATED ACTIVITIES:Related program elements (PE): PE 61102F, Defense Research Sciences; PE 62205F, Training and Simulation Technology; PE 63751F, Innovations in Education and Training; PE 64227F, Flight Simulator Development, PE 63738A, Non-Systems Device Development; and PE 63720N, Education and Training. Both at the working and headquarters levels, there is a continuing interface and close coordination among the Army, Navy and Air Force on simulation for training purposes. The Air Force Human Resources Laboratory, as Air Force Systems Command Laboratory focal point for training simulation technology, has the responsibility to maintain an awareness of all significant research and development being conducted by other Department of Defense, National Aeronautics and Space Administration, and industrial organizations; to eliminate redundancy; and to assist in updates of the Air Force Simulator Master Plan. Interservice cooperative efforts are illustrated by a current Memorandum of Agreement which established a joint projector and Computer Image Generation (CIG) technology development program between the Air Force and the U.S. Army/ Program Manager for Training Devices, and by an on-going effort to develop silicon light-valve projector technology which is jointly funded by the Naval Training and Equipment Center and the Air Force Human Resources Laboratory.

WORK PERFORMED BY: The program is performed by the Air Force Human Resources Laboratory through the Advanced Systems Division, Wright-Patterson AFB OH. Major contractors are: Farrand Optical Co., Valhalla NY; Hughes Aircraft Co., Fullerton CA; Electronic Systems Products, Titusville FL; Singer (Link Division) Binghampton NY; General Electric Co., Daytona Beach FL; LMT Sodern, France

Program Element: #63227F Title: Advanced Simulator Technology
DoD Mission Area: Environmental and Life Sciences (ATD),#552 Budget Activity: Advanced Technology Development#2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Project 1958 was completed in FY 1979, providing promising technologies in the visual display and image projection areas. Two developments in optics were accomplished. First, a color holographic lens was developed to replace currently used glass beamsplitters. This technology will provide substantial size and weight savings with no loss in image clarity. Second, a wide field-of-view refractive optics system was developed for large-cabin simulators. This system will offer advances in refractive optics by reducing image and color distortion, and will provide for an enlarged eye window. Two noteworthy advances in image projection technology were also developed. A color liquid-crystal light-valve projector was completed and is serving as a demonstration of progress in light-valve projector technology. Although this medium-resolution demonstration device has no high-resolution moving target capability, further advancements are planned in Project 2363 which would enable the light-valve projector to serve as the projection device for operational Air Force fighter/attack training simulators. Development of a medium-resolution, color projector was also completed. This device could serve as a wide field-of-view projector for large-cabin aircraft simulators.

2. FY 1980 Program: Two breadboard demonstration projectors will be completed. Each device will illustrate a different approach to the light-valve projection concept. Both projectors will incorporate advanced electronics to insert a high-resolution target into the scene. Design of the advanced Computer Image Generation (CIG) system will also begin.

3. FY 1981 Program: Advanced CIG system design will continue. Projector technology development will begin evaluation of the breadboard demonstration models. After the most promising design has been selected, production of a research and development projector will begin. Light-valve projectors providing color, increased brightness, improved resolution, and multiple, interactive, moving targets will remove major obstacles to high-fidelity tactical air combat simulation. In turn, this will enable the Air Force to train sophisticated air-to-air and air-to-ground combat tactics in a dynamic simulator combat environment. This environment will provide a totally unique and valuable training situation, not present in any existing training facility or program.

4. FY 1982 Program: The light-valve projector development effort will be completed in FY 1982, which will make the technology available for incorporation into simulator procurement programs for existing aircraft, such as the A-10 and F-16. Computer Image Generation efforts will emphasize expanded scene detail and elimination of anomalies. Holographic optic development will also be pursued. This program was delayed during FY 1980 and 1981 to allow for acceleration of projector technology. A new unique CIG program will be initiated to develop a revolutionary CIG concept, system design, and hardware. That effort will significantly enhance CIG terrain representation for gradual contour alterations, subtle shading changes, and texture detail currently impossible to present using existing CIG technology. Furthermore, these CIG advances will incorporate a capability to interface with the Defense Mapping Agency data base and provide a technology that will substantially reduce CIG system costs by perfecting a means for economically storing and creating complex images. These simulation technology advances will significantly expand

tactical combat simulator capabilities. They will provide the foundation for an interactive, air-to-air and air-to-ground tactical combat simulator environment, which will include the capability necessary to display the visual cues for training air-to-air and air-to-surface weapons delivery against specific simulated enemy targets and threats.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data: Descriptive Summary was not submitted for PE 63227F in FY 1980 because no funding was requested in the FY 1980 President's Budget. The $2.0M of FY 1980 funding was added by Congress. FY 1981 funding reflects restoration of full-scale development of advanced visual display and image generation techniques.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63245F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Advanced Fighter Technology Integration (AFTI)
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	6,500	9,200	10,400	10,300	Continuing	Not Applicable
2061	Fighter Attack Technology (AFTI/F-16)*	2,160	3,400	3,600	4,700		
2462	Special Programs	2,900					
2568	Mission Adaptive Wing (AFTI/F-111)**	1,440	5,800	6,800	5,200		
2632	Advanced Survivable Fighter Technology				400		

*Formerly "Technology Set I (AFTI/F-16)"
**Formerly "Technology Set II (AFTI/F-111)"

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This technology base program will develop and demonstrate in flight, separately and in combination, advanced aeronautical technologies that can substantially enhance the combat potential and improve the survivability of our future military fighter/attack aircraft. The technologies demonstrated apply to the air superiority and air-to-surface missions. Project 2061 receives technologies developed from PE 63205F, Flight Vehicle Technology, under project 2506, Control of Flight. This program will demonstrate those mature technologies in flight, singularly and in combination, on an F-16 research testbed. This cost-saving feature reduces the testbed requirements for technology demonstration to a single testbed resource and addresses technology integration at the earliest development opportunity. Project 2568 will develop the technologies necessary to demonstrate in flight the variable camber Mission Adaptive Wing concept on an F-111 test vehicle.

BASIS FOR FY 1981 RDT&E REQUEST: Continue contractual program on AFTI/F-16 to complete all design activities, hardware fabrication, and modification to the F-16 test aircraft in preparation for flight testing in July 1981. Also, continue contractual program on AFTI/F-111 to complete detail design and hardware fabrication for initial flight testing in August 1982.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #63245F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Advanced Fighter Technology Integration (AFTI)
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: Exploratory development efforts accomplished under Program Element 62201F, Aerospace Flight Dynamics, over the past 10 years have identified a number of promising aeronautical technologies that offer large improvements over current fighter systems. It has also become apparent that these technologies must be demonstrated in flight before they can be confidently used in future Air Force systems. Additionally, the integration of technologies into flight vehicles offers further effectiveness. This program will develop and flight test advanced technology aircraft that use a number of different aeronautical technologies. Candidate technologies include direct side force control, direct life control, weapon line pointing, drag modulation, digital flight control, integrated flight/fire control, advanced pilot/vehicle interface, smooth skin variable camber wing, new materials and structures, and advanced airframe configurations.

RELATED ACTIVITIES: This program is related to Program Element 63205F, Flight Vehicle Technology, and Program Element 62201F, Aerospace Flight Dynamics. Both projects, 2061 and 2563, are joint programs with the National Aeronautics and Space Administration and are managed by a signed Memorandum of Understanding. The Digital Flight Control Task in Project 2061 is jointly funded by the Navy.

WORK PERFORMED BY: This program is managed by the Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, OH. Contractors are General Dynamics Corporation, Fort Worth, TX; and The Boeing Company, Seattle, WA. There are two active contracts in this program.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Project 2061. A competitive contract was awarded to General Dynamics for development of fighter attack technologies using a preproduction F-16 test and evaluation research aircraft. Technologies being developed include triplex digital flight control system, integrated flight/fire control system, direct force control and weapon line pointing, and pilot/vehicle interfaces. The first phase provides for development and flight demonstration of the flight control system, direct force control and weapon line pointing, and pilot/vehicle interface. The second phase will add the integrated flight/fire control and remaining pilot/vehicle interfaces. The preliminary design for phase one has been completed on schedule and detail design initiated. Project 2568. A contract was competitively awarded to Boeing Seattle on 1 February 1979 to develop a smooth skin, variable camber wing system titled Mission Adaptive Wing. Preliminary design was initiated with a forecast completion in May 1980. Formal agreements with the National Aeronautics and Space Administration were completed on both the fighter attack and mission adaptive wing projects.

2. FY 1980 Program: Project 2061. Complete detail design of flight control, hydraulics, canards, inlet, dorsal equipment fairing, and crew station. Fabricate hardware and initiate modification of F-16 No. A-6 test aircraft. Project 2568. The preliminary design of the Mission Adaptive Wing will be completed and a Preliminary Design Review (PDR) will be hold in May 1980. Detail design will be initiated upon successful completion of the PDR. The design configuration uses the transonic aircraft technology F-111 No. 13, including its supercritical wing box, as the flight test demonstrator aircraft.

Program Element: #63245F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Advanced Fighter Technology Integration (AFTI)
Budget Activity: Advanced Technology Development #2

3. FY 1981 Planned Activity: Project 2061. Complete modifications to F-16 test aircraft and initiate flight testing of the digital flight control system, direct force control, and weapon line pointing in July 1981. The preliminary design of the integrated flight/fire control system will be completed. Project 2568. The design activity for the smooth skin, variable camber leading and trailing wing edges will be completed and required hardware will be fabricated. Modifications to the F-111 test aircraft will be initiated. Preliminary design of the active flight control system will be initiated.

4. FY 1982 Planned Program: Project 2061. The initial flight test will be completed for the digital flight control system, direct force control (direct side force and direct lift), and weapon line pointing. Integrated flight/fire control will be designed, fabricated and the test F-16 aircraft modified. Initiation of the second phase of flight testing will commence in July 1982. Project 2568. Modification of the test F-111 aircraft will be completed and flight testing initiated in August 1982. Detail design of the active flight control for the second phase of the flight testing (FY 1984) will be completed and hardware fabricated. Project 2682. A new start effort will be initiated to develop advanced survivable fighter technologies. A technology set will be determined and a competitive contract awarded.

5. Program to Completion: This is a continuing technology base program.

6. Milestones: Not applicable.

7. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,000	7,300	9,200	14,100	Continuing	Not Applicable
2061	Fighter Attack Technology (AFTI/F-16)*	700	3,000	5,200	8,700		
2462	Classified Program	7,000	3,000				
2568	Mission Adaptive Wing (AFTI/F-111)**	300	1,300	4,000	5,400		

*Formerly "Technology Set I (AFTI/F-16)"
** Formerly "Technology Set II (AFTI/F-111)"

The difference between the 1980 and 1981 RDT&E Descriptive Summary Budget Data results from an Air Force decision to withdraw a contract option for the high acceleration cockpit. Additionally, a reallocation between projects was necessary to accommodate final negotiation on both the fighter attack technology (F-16) and mission adaptive wing (F-111) contracts.

Project: #2568 Title: Mission Adaptive Wing (AFTI/F-111)
Program Element: #63245F Title: Advanced Fighter Technology Integration
DOD Mission Area: Engineering Technology (ATD) #553 Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: Exploratory development efforts accomplished under Program Element 62201F, Aerospace Flight Dynamics, over the past 10 years have identified a number of promising aeronautical technologies that offer large improvements over current fighter systems. It has also become apparent that these technologies must be demonstrated in flight before they can be confidently used in future Air Force systems. Additionally, the integration of technologies into a flight vehicle offers further effectiveness. This program will develop and flight test an advanced technology aircraft that uses a number of different aeronautical technologies. The technologies include smooth skin variable camber wing, new materials and structures, and advanced airframe configurations.

RELATED ACTIVITIES: This program is related to Program Element 62201F, Aerospace Flight Dynamics. Project 2568 is a joint program with the National Aeronautics and Space Administration and is managed by a signed Memorandum of Understanding.

WORK PERFORMED BY: This program is managed by the Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, OH. The contractor is The Boeing Company, Seattle, WA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A contract was competitively awarded to Boeing Seattle on 1 February 1979 to develop a smooth skin, variable camber wing system titled Mission Adaptive Wing. Preliminary design was initiated with a forecast completion in May 1980. Formal agreements with the National Aeronautics and Space Administration were completed on both the fighter attack and mission adaptive wing projects.

2. FY 1980 Program: The preliminary design of the Mission Adaptive Wing will be completed and a Preliminary Design Review (PDR) will be held in May 1980. Detail design will be initiated upon successful completion of the PDR. The design configuration uses the transonic aircraft technology F-111 No. 13, including its supercritical wing box, as the flight test demonstrator aircraft.

3. FY 1981 Planned Activity: The design activity for the smooth skin, variable camber leading and trailing wing edges will be completed and required hardware will be fabricated. Modifications to the F-111 test aircraft will be initiated. Preliminary design of the active flight control system will be initiated.

4. FY 1982 Planned Program: Modification of the test F-111 aircraft will be completed and flight testing initiated in August 1982. Detail design of the active flight control for the second phase of flight testing (FY 1984) will be completed and hardware fabricated.

5. Program to Completion: This is a continuing technology base program.

Project: #2568
Program Element: #63245F
DOD Mission Area: Engineering Technology (ATD), #553

Title: Mission Adaptive Wing (AFTI/F-111)
Title: Advanced Fighter Technology Integration
Budget Activity: Advanced Technology Development #2

6. Milestones: Not applicable.

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	1,440	5,800	6,800	5,200	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2568	Mission Adaptive Wing*	300	1,300	4,000	5,400	Continuing	Not Applicable

*Formerly Technology Set II (AFTI/F-111)

The difference between the 1980 and 1981 RDT&E Descriptive Summary Budget Data results from a reallocation between projects to accommodate final negotiations on both the Fighter Attack Technology and Mission Adaptive Wing contracts.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63246F
Title: Aircraft Subsystem Technology
DOD Mission Area: Engineering Technology (ATD), #553
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,450	2,600	1,800	3,000	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides for the functional demonstration of aircraft subsystems for both current and future Air Force operational needs. Technologies which have historically received little attention during initial systems development, but which have significant impact on the safety, reliability, maintainability, performance and cost of the weapon system are evaluated under a real system environment. Flight size, flight weight subsystem concepts in the areas of fire protection, lubrication, engine diagnostics, and advanced power systems are designed, fabricated and tested to the extent necessary to reduce development risk and to provide system designers with hardware options to achieve performance objectives in present and future aircraft. For example, most operational aircraft have unprotected fuel tanks. The cost to the Air Force in lives and aircraft lost to fires and explosions is enormous. Detection of fires which do occur is critical, and prevention of fire and explosions can preclude many catastrophic situations. There is no other Air Force program element to fill these needs.

BASIS FOR FY 1981 RDT&E REQUEST: The FY 1981 program is a continuation of efforts begun in FY 1978. The Fuel Tank Inerting System and Permanent Magnet Variable Speed Constant Frequency Starter/Generator program will be in ground testing prior to planned flight testing in FY 1981-1982.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #63246F
DOD Mission Area: Engineering Technology (ATD), #553

Title: Aircraft Subsystem Technology
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: This program provides the final proof-of-concept demonstration needed to transition the most promising exploratory subsystems technology into engineering development. The program addresses both current operational deficiencies and the needs of future Air Force systems. It provides a new generation of subsystem hardware for use in weapon systems in many cases supplanting equipment little changed in the last 20 years because low risk alternatives were not available. The resultant hardware will, with engineering development to optimize it for a specific application, be suitable for use in a wide variety of aircraft. Much is suitable for retrofit into aircraft in service or incorporation into those now in production, and all can be applied to future systems. The program will demonstrate superior concepts for: (1) preventing and detecting aircraft fires and for minimizing fire damage; (2) simplifying powerplant design by reducing or eliminating the need for oil lubrication; (3) replacing "maintenance by schedule" with "maintenance when needed" by the use of improved engine diagnostic and health monitoring systems; and (4) generating and distributing electrical and mechanical power aboard aircraft. It provides the mechanism for the methodical application of new subsystems technology to systems at minimum risk to potential users. Investment risk is low, since technical feasibility has been proven in extensive exploratory efforts during the past ten years.

RELATED ACTIVITIES: Program Element 62203F, Aerospace Propulsion, provides the exploratory development base for the program. Personnel of the Aeronautical Systems Division's Deputy for Engineering will actively participate in all phases of the program, since they are the primary "customer" for its end products. The Air Force Materials, Avionics, and Flight Dynamics Laboratories, Wright-Patterson AFB OH, will participate in the power distribution efforts, since they represent major power systems users. The latter laboratory will also join in assessing the effectiveness of the hazard protection concepts. Activity in aircraft fire protection will draw upon exploratory efforts of the Federal Aviation Administration, the Navy, and the National Aeronautics and Space Administration. This program will serve as a feeder element for Program Element 64212F, Aircraft Equipment Development, and Program Element 64708F, Other Operational Equipment.

WORK PERFORMED BY: The program is managed by the Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, OH. Contractors include Garrett of Torrance, CA (fire protection); General Dynamics of Ft Worth, TX (fire protection); General Electric, Erie, PA (electrical generator); and AVCO Lycoming of Stradford, CT (Auxiliary power unit). There are 4 contractors with 4 contracts.

Program Element: #63246F
DoD Mission Area: Engineering Technology (ATD), #553

Title: Aircraft Subsystem Technology
Budget Activity: Advanced Technology Development #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: During FY 1978, efforts were initiated to design, fabricate and demonstrate: (1) a self-contained inert gas generator system to protect aircraft fuel tanks from explosions induced by either natural or hostile ignition sources and (2) a permanent magnet variable speed constant frequency power generation system. The fire detection system design was approved ans Phase II (testing) was initiated. The advanced auxiliary power unit (APU) design is complete and assembly is complete. The majority of the testing of the APU was accomplished during FY 1979. A turbine engine monitoring system for the A-10 was evaluated in flight test.

2. FY 1980 Program: The auxiliary power unit and fire detection system efforts will be completed during FY 1980. The variable speed constant frequency power generator and fuel tank inerting system will be well along in the development phase. There are no new starts in FY 1980.

3. FY 1981 Planned Program: Test hardware fabrication and ground testing will be accomplished on both the fuel tank inerting and variable speed constant frequency power generator systems. Increased emphasis on the variable speed constant frequency generator has forced a cancellation of flight testing of the inerting system. There are no new starts in FY 1981.

4. FY 1982 Planned Program: Ground test and flight design of the fuel tank inerting system will continue. The electrical generator system will go to flight tests. New starts are planned in fire suppression systems, integrated power units, and digital hydraulic actuators.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Program Element #63246F	2,450	1,500	2,600	1,800	Continuing	Not Applicable

Additional funds ($950 thousand) were programmed into FY 1979 to perform a flight test evaluation of an experimental A-10 turbine engine monitoring system.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63247F
Title: Modular Automatic Test Equipment (MATE)
DoD Mission Area: Electronics and Physical Sciences, #551
Budget Activity: Advanced Technology Development, #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,400	5,300	13,800	28,400	57,700	108,600

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program addresses the need to improve the automatic test equipment (ATE) used to maintain electronic systems. The current methods used to specify, design, build and support ATE have resulted in a proliferation of equipments, inadequate operational reliability and supportability, and excessive life-cycle costs. Aircraft availability (force readiness) has suffered because of malfunctioning ATE at all levels of maintenance. The Air Force now spends over $800 million annually on ATE development, acquisition, and support. Forty percent of Air Force software support resources are dedicated to the maintenance of ATE software-there are over 100 different types of computers in automatic test systems using over 40 different programming languages. On the F-15 and F-16 programs alone, the Air Force will spend over 1 billion ($500 million on each program) to acquire unique test equipment for each aircraft. The MATE program will propose needed improvements to Air Force development, acquisition, and support policies and procedures. It will develop design guides to ensure that future electronic systems are designed and manufactured so that faults can be isolated easier using a combination of built-in test and external ATE. The MATE program will investigate ways of reducing the cost of developing the software (Test Program Sets) used to test complex analog and digital electronic systems. And, under the MATE program, a family of modular equipments and software which can be configured in multiple ways and used to test many different weapon systems at all levels of maintenance will be developed.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for completion of the two MATE system definition contracts that were awarded in June 1978, and for the initiation of the four year MATE system development contract. The MATE system definition contracts will define and demonstrate alternate approaches for the design, acquisition, and use of modular automatic test equipment and software. The MATE system development contract will be awarded to one of the two contractors based on the results of the demonstration phase. The resulting software support system and hardware test equipment modules will be used to configure the automatic test equipment for a weapon system. This real world application of the lessons learned during the three year system definition phase will establish the basis for reducing the cost of future automatic test equipment hardware and software through the development of additional modules (or purchase of commercial equipment) as required. In addition, several efforts to improve our ability to write and validate test programs (software) will continue through FY 1981.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63247F
DoD Mission Area: Electronics and Physical Sciences, #551

Title: Modular Automatic Test Equipment (MATE)
Budget Activity: Advanced Technology Development, #2

DETAILED BACKGROUND AND DESCRIPTION: The requirement for automatic test equipment (ATE) to maintain sophisticated electronic systems has been confirmed by government and industry studies conducted over the past several years. It is agreed that ATE is essential to mission effectiveness-without proper functioning avionics, combat aircraft do not fly. Although the Air Force spends over $800 million annually to design acquire, and support ATE, the equipment is complicated to operate, malfunctions often, and is difficult to maintain. Faults in electronic equipment detected at the flight line or intermediate shop too often cannot be duplicated when the equipment is returned to the depot for repair. Hence, equipment is recycled in the supply lines and not available for use on aircraft. The studies also identified proliferation of test equipment as a reason for the high cost and unreliablity of ATE. For example, there are over 100 different computers in the Air Force ATE inventory each with its own unique maintenance and repair manuals and spare parts list. Air Force attempts to solve ATE problems through management initiatives have not been effective. The MATE program was established and funded in FY 1978 to integrate management and technical answers to ATE problems. The MATE program will demonstrate that a family of ATE modules (hardware/software) can be specified and used to support a wide variety of aircraft at all levels of maintenance with a reduction in life-cycle cost over that associated with current practices. Once the concept is demonstrated, the program will develop the necessary specifications, standards, and management/acquisition tools needed to implement MATE. A core architecture for the ATE family will be established and the hardware/software interface requirements defined. Programming aids and software verification/validation tools that will reduce the cost of test programs will be developed. Guidebooks will be written to help program managers make intelligent ATE-related decisions early in the program development cycle. Techniques for trade studies to allow, among other things, the most cost-effective design of equipment for testability and the selection of ATE will be provided. Lessons learned from the MATE and software development efforts will be applied to weapon systems currently undergoing development. Future weapon system development programs will be directed to use MATE as soon as the required specification, standards, and guidebooks are finalized.

RELATED ACTIVITIES: The Joint Logistics Commanders (JLC) have established a panel on automatic testing and approved a formal plan of activities needed to solve the joint Services' testing problems. This JLC effort is closely tied to the Industry/Joint Services Automatic Testing Project. The MATE Program Office (PO) is directed to stay abreast of these efforts and is currently programming to accomplish over 50 percent of the tasks identified. The Navy assigned a fulltime representative to the MATE Program Office in early 1979 to make sure MATE stays attuned to their needs. Army and Navy personnel are currently participating in program task definition, source selections and design reviews. MATE is being supported by technology programs in Army, Navy, and Air Force Laboratories. The Navy developed built-in test design guides and the fault isolation/fault detection work being done at the Air Force Rome Air Development Center (RADC) will provide a basis for decisions concerning the partitioning of test functions between the ATE and built in test equipment. Supporting program elements include: PE 62204F, Aerospace Avionics,

Project No. 2003, Avionics System Design Technology, and Project No. 6069, Electronic Device and Circuit Technology; and PE 63243F, Digital Avionics Information Systems (DAIS). To prevent duplication of actions all cognizant Army, Navy and Air Force organizations are continually supplying inputs to the MATE program planning and design review. Operating command requirements are being made available to various Air Force, Army, and Navy development and laboratory organizations. The MATE program has been following the joint service common language effort and will use Ada to achieve commonality in MATE implementation and leverage in distribution of MATE software where feasible.

WORK PERFORMED BY: This program is being implemented by the Support Equipment Program Office of the Aeronautical Systems Division at Wright-Patterson AFB, OH. Supporting laboratories are the Air Force Avionics Laboratory located at Wright-Patterson AFB, OH and the Rome Air Development Center at Griffiss AFB, NY. The two system definition contractors are the Sperry Corporation, Great Neck, Long Island, NY, and the Westinghouse Electric Company, Hunt Valley, MD.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: This program began in FY 1978. Major Air Force activities during this period were directed at structuring a program that would solve existing automatic test equipment problems, be responsive to future requirements, and stay in tune with previous and current efforts of the Joint Logistics Commanders and the Industry/Joint Services project. The MATE program objectives and plans were established and briefed to interested Army, Navy and Air Force agencies and to numerous industrial groups. The MATE system definition contract statements of work were prepared, a competition involving over 20 major corporations was conducted and two contracts were awarded in June 1978. The MATE system definition contractors have completed the survey/study and study/verification phases.

2. FY 1980 Program: The MATE system definition contractors will demonstrate their candidate system designs for MATE. Each contractor will show that the design, development, acquisition, and operational guides that he developed can be used to produce a MATE system to test Army, Navy, and Air Force equipment. The automatic test equipment software verification/validation and digital test program generation contracts will be awarded.

3. FY 1981 Planned Program: During this period the Air Force will complete the MATE concept demonstration, select a system definition, and award a single contract for the development of MATE engineering modules and a software support system for test program development. Contracts for automatic test program generation and automated validation and verification of software will continue.

4. FY 1982 Planned Program: The MATE system development contract will continue. The results of the automatic test program generation contracts and the automated validation/verification efforts will be fed into the MATE system development effort to support the design of the ATE support software system.

Program Element: #63247F
DoD Mission Area: Electronics and Physical Sciences, #551

Title: Modular Automatic Test Equipment (MATE)
Budget Activity: Advanced Technology Development, #2

5. Program to Completion: The specifications, standards, and handbooks for MATE will be completed, tested and applied to a weapon system development program. The test program generation and verification/validation efforts will be completed.

6. Milestones:

Event	Date
Start Adv Dev	Aug 76
MATE Syst Contract Award	Jun 78
Start Automatic Test Equipment Software Efforts	Mar 79
Sys Definition Complete	Sep 80
Eng Models Contract Award	May 81
MATE Syst Prod Specs Available	Mar 83
Handbooks and Standards Complete	1984
Complete Automatic Test Equipment Software Efforts	1984

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,500	3,400	5,300	15,200	74,400	99,800

The FY 1981 funding requirements projected in the FY 1980 budget have been reduced based on updated requirements. The total estimated costs have increased due to inflation and the addition of funding in FY 1985 to support the application of MATE modules, software, handbooks, and management techniques to new weapon systems.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63250F
Title: Lincoln Laboratory
DOD Mission Area: Electronic and Physical Sciences (ATD) #551
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	19,700	19,100	21,600	23,900	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Lincoln Laboratory Program is a high technology research and development effort conducted through the provisions of a cost reimbursement contract with Massachusetts Institute of Technology. Lincoln Laboratory is operated as a Federal Contract Research Center with manpower control administered by the Department of Defense. The fundamental objective is to maintain a stable technology base in advanced electronics from which military systems may be developed. Utilizing this advanced electronics base, Lincoln actively engages in advanced research, primarily in the area of satellite communications, tactical technology, space surveillance, and radar techniques. Lincoln also provides technical advice and consultation to the military services and defense agencies.

BASIS FOR 1981 RDT&E REQUEST: This request will provide funds for a highly professional staff required to develop and maintain an advanced electronics technology base and conduct advanced research essential to national defense. Satellite communications technology development is planned and is directed toward support of future strategic and general purpose satellite communications systems. Space object surveillance and identification technology development and system support efforts are planned to be continued. Planned tactical technology developments include airborne radar for surveillance of ground targets, advanced ground radar techniques, jam-resistant tactical communications and support in applying the technology to developing systems. Research in radar techniques and development of radar system trade-offs is also planned.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63250F
Title: Lincoln Laboratory
DOD Mission Area: Electronic & Physical Sciences (ATD) #551
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: Lincoln Laboratory was established in 1951 by the Air Force with participation by other agencies of the Department of Defense. The primary mission is to conduct research and development pertinent to national defense, with particular emphasis on advanced electronics. The Lincoln program extends from fundamental investigations in science through the development of electronic devices and components to the design, development, and field demonstration of concept models containing the new technology. Lincoln actively engages in advanced research, primarily in the areas of satellite communications, tactical technology, space object surveillance and identification, and radar techniques. Lincoln also provides technical advice and consultation to the military services and defense agencies.

In order to provide policy and program guidance to the management of Lincoln Laboratory, a Joint Advisory Committee (JAC) has been established. The Commander, Air Force Systems Command (AFSC), is the Chairman; the Director, Defense Advanced Research Project Agency (DARPA), a senior officer from the Army and a senior officer from the Navy are members. The Committee is supported by an Executive Group chaired by the Director of Sciences and Technology, AFSC, with members from the Army, Navy, DARPA and Defense Communications Agency (DCA).

RELATED ACTIVITIES: Additional efforts in the following areas are planned to be funded by the respective program elements: home-on jam, 63741F, Defense Suppression; re-entry systems, 63311F, Advanced Ballistic Re-entry System; electro-optical devices and systems, 12424F, Spacetrack/61102F, Defense Research Sciences/63428F, Space Surveillance Technology; satellite communications, 33601F, Air Force Satellite Communications System/33126K, Long-Haul Communications (DCS)/63431F, Space Communications; sensor collection, 63428F, Space Surveillance Technology/31022F, Scientific and Technical Intelligence/31015F, Technical Sensor Collection; tactical nulling antennas, 64754F, Joint Tactical Information Distribution System/63727F, Advanced Communications Technology; speech processing, 33401F, COMSEC/33126K, Long-Haul Communications System (DCS); moving target indicator technology, 63747F, Low Visibility Moving Target Acquisition Strike; precision location strike system, 64742F, Precision Location Strike System; surface acoustic wave and charged coupled device, 61102F, Defense Research Sciences (Army augmented); submillimeter technology, 61102F, Defense Research Sciences (Army augmented).

WORK PERFORMED BY: Lincoln Laboratory, Lexington, MA, is operated as a special laboratory of the Massachusetts Institute of Technology under contract with the Air Force and is designated a Federal Contract Research Center. General policy and program guidance is provided by the JAC in accordance with the provisions of the Department of Defense Plan for Administration of Lincoln Laboratory, dated 27 May 1975. The JAC is chaired by the Commander, Air Force Systems Command, with senior members from the Army, Navy and the DARPA.

Program Element: #63250F Title: Lincoln Laboratory
DOD Mission Area: Electronic & Physical Sciences (ATD) #551 Budget Activity: Advanced Technology Development #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Lincoln Laboratory's significant accomplishments include: design of the Semi-Automatic Ground Environment (SAGE) System; development of the Distant Early Warning (DEW) Line and Ballistic Missile Early Warning Systems (BMEWS) radar technology; design of foliage penetration Moving Target Indicator (MTI) radars; development and testing of penetration aids for ballistic missile re-entry systems; development and fabrication of Lincoln Experimental Terminals (LET-1 through LET-4) and a series of Lincoln Experimental Satellites (LES-1 through LES-9) including the successful launch of LES-8 and LES-9 which demonstrated advanced military communications technology and system capabilities; the continued development of solid state technology and data systems which have supported the other major programs conducted by Lincoln Laboratory; a study of the use of a Microwave Landing Guidance System for air traffic control; and the development and demonstration of a Lincoln Training System designed to facilitate self instruction of technical subjects with a potential reduction in the cost of technical training. Tactical technology efforts were continued in millimeter-wave techniques for terminal homing, home-on-jamming techniques, and technology for weapon guidance and control that can operate in a severe jamming environment.

2. FY 1980 Program: Lincoln is continuing efforts in the advanced electronics research area on electro-optical devices such as tunable infrared lasers, infrared imaging devices and high speed photodiode detectors and integrated optical circuits. A submicrometer technology effort is devoted to exploring x-ray lithography techniques for fabricating advanced devices having dimensions well below 1 micron. Research is also continuing on microwave devices involving both semi-conductor and surface acoustic wave devices, microelectronics and digital integrated circuits for use in such areas as radar signal analysis, speech processing and satellite communications systems. The satellite communications program is developing the technology to permit more effective military communications systems. The current efforts are directed toward a survivable communications technology and on the conceptual design of a general purpose military satellite system. In the radar techniques area, the Multiple-Aperture Surveillance Radar developed to improve detection of slow moving ground targets from a moving aircraft is being demonstrated and evaluated as a candidate for a radar surveillance and strike system. The guidance and control of air-to-surface weapons against mobile targets in a high-threat environment is being investigated. Support to the Ground Electro-Optical Deep Space Surveillance Program and development of advanced electro-optical camera and star/satellite processors will continue.

3. FY 1981 Planned Program: The Laboratory's advanced electronics effort will continue to provide a technology base that supports mission programs and includes advanced development in digital integrated circuits and solid state areas such as electro-optical semiconductor devices, quantum electronics, surface acoustic wave devices, microwave semiconductor devices and microelectronics. The x-ray lithography techniques for fabricating advanced devices will be continued, as will infrared laser and infrared detector investigations. Technology development will be continued in support of the strategic and general purpose satellite communications systems. In the space surveillance area, a high-sensitivity electronic image camera using charged coupled device technology will be evaluated. The tactical

Program Element: #63250F
DOD Mission Area: Electronic & Physical Sciences (ATD) #551

Title: Lincoln Laboratory
Budget Activity: Advanced Technology Development #2

technology program areas of effort include airborne radar development for surveillance of ground targets, advanced ground radar, jam-resistant guidance and control systems, development of terminal homing techniques based on target signature, jam-resistant tactical communications and support in applying the technology base to developing systems. Various ground moving target detection options and radar system trade-offs will be investigated in the radar techniques area.

4. FY 1982 Planned Program: The advanced electronics technology base efforts in solid state electronics and digital electronics will continue. Satellite communications technology will continue in support of strategic and general purpose satellite communications systems. The tactical technology program will be continued. Advanced radar techniques and technology transfer to developing programs is also planned.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	19,600	18,200	19,100	21,000	Continuing	Not Applicable

The Lincoln Laboratory line is programmed to maintain a stable technology manpower base consistent with Director of Defense Research and Engineering Memorandum, Air Force Implementation Plan for Management of Federal Contract Research Centers (FCRCs), 21 April 1977. Accordingly, the FY 1981 funding request has been increased to maintain the FY 1980 manpower level.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63302F
DOD Mission Area: Engineering Technology (ATD), #553

Title: Advanced Missile Propulsion
Budget Activity: Advanced Technology Development

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,655	7,000	8,500	9,300	Continuing	Not Applicable
2445	Advanced Airbreathing Propulsion	635	4,000	4,000	3,000		
6339	Air Launched Missile Propulsion	1,661	1,600	500	1,000		
6340	Space Systems Propulsion	134	1,000	2,500	2.300		
6341	Ballistic Systems Propulsion	1,175	400	1,500	3,000		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The performance, cost reliability and service life of advanced rocket and airbreathing (ramjet) propulsion concepts will be assessed, and propulsion options made available for future system development. The scope of the program includes comprehensive integrated propulsion system testing at both sea level and altitude in ground and/or flight tests. These concept demonstrations will provide advanced propulsion for tactical, strategic and space systems applications. The result will be increased performance through increased launch range and/or reduced missile weight or size for tactical missiles, and increased payload for space launched and ballistic missiles.

BASIS FOR THE 1981 RDT&E REQUEST: During this period five efforts will be pursued. The ducted rocket effort will provide up to a 100% range increase over the baseline Advanced Medium Range Air-to-Air Missile (AMRAAM) in the same 300 pound weight limit class. A second effort will provide the AMRAAM with an option for an advanced reduced smoke/two pulse motor in time for consideration in engineering development. A new effort will be started to demonstrate advanced propulsion for a 2000 pound class missile with the capability to deliver a conventional warhead to 300 NM range. An effort applying advanced ballistic missile technology to the Inertial Upper Stage (IUS) for the Space Shuttle and the Titan 34D will be continuing. Applying this technology to both IUS stages would provide for a 20 to 30% payload growth. Advanced solid propellants containing fluorine compound with advanced technology inert components would provide a 11% throw-weight increase for a block change in MX or an upgrade in Minuteman. Development of this propellant will be continuing during FY 1981.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #63302F Title: Advanced Missile Propulsion

DOD Mission Area: Engineering Technology (ATD), #553 Budget Activity: Advanced Technology Development

DETAILED BACKGROUND AND DESCRIPTION: This program element will fully evaluate advanced rocket and airbreathing (ramjet) propulsion concepts, and provide for early demonstration and orderly transition, with minimum risk, of these technologies to engineering development of air launched, space and ballistic systems. Emphasis will be placed on early assessment of the performance, cost, reliability and service life of propulsion options for growth and/or new systems developments. The concepts validated under this program will provide significantly decreased life cycle cost in addition to a major expansion of mission capability over current operational systems. Demonstration of full-scale flight weight propulsion systems for air launched, space launched, and ballistic rocket systems will be conducted under the most realistic systems oriented conditions. Major production cost savings are expected for rocket systems from the use of new binders, commercially available materials, improved grain design, and improved manufacturing methods and techniques. Improvements in life cycle cost are expected from service life technology which has more closely defined reasonable thermal and mechanical environmental limits Flight demonstration of the ducted rocket propulsion concept will provide the class of beyond visual range tactical missiles with higher average speed to target, increased payload capability, longer range, and/or smaller size than systems currently in development. Demonstration of engine performance, missile performance limits, propulsion cost, and engine reliability will be an integral part of this ramjet program. A demonstration effort for a motor in the Advanced Medium Range Air-to-Air Missile (AMRAAM) size will include reduced smoke propellant to reduce aircraft and missile detectability and the radial burning pulse concept to provide for more end game maneuverability. A space propulsion effort will address the need to improve the payload capability of Air Force space launch vehicles and the opportunity to use technology spin-off from ballistic missiles. High energy propellants, high performance nozzles, and lightweight cases will result in greater than 20% payload increase for Space Shuttle launches. Technology in solid propellants and inert components that was considered too high risk to enter MX development will be demonstrated in this program. These technologies, when applied in the third stage, can provide an additional 11% throwweight increase.

RELATED ACTIVITIES: Programs to demonstrate component feasibility and practicality are initially accomplished in exploratory development under Program Element (PE) 62302F, Rocket Propulsion, and Program Element 62203F, Aerospace Propulsion. Work on rocket and ramjet propulsion by the services and National Aeronautics and Space Administration (NASA) is coordinated through the Joint Army-Navy-NASA-Air Force (JANNAF) Interagency Propulsion Committee. In addition, the Office of the Under Secretary of Defense for Research and Engineering reviews and coordinates all services' programs through the auspices of the Propulsion Technology, Missiles and Space Vehicles Technology Coordinating Paper. This program element provides technology for the following program elements. PE 63306F, Defense Suppression Weapons Advanced Technology; PE 63313F, Advanced Missile Subsystems Demonstration; PE 63314F, Strategic Bomber Enhancement; PE 63317F, Theater Ballistic Missile, PE 63370F, Advanced Medium Range Air-to-Air Missile; and PE 64312F, MX.

Program Element: #63302F
DOD Mission Area: Engineering Technology (ATD), #553

Title: Advanced Missile Propulsion
Budget Activity: Advanced Technology Development

WORK PERFORMED BY: The Air Force Rocket Propulsion Laboratory, Edwards Air Force Base, CA, will manage the overall program. The Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, OH, is a co-participant and will manage the airbreathing propulsion programs under Project 2445. All work will be done under contract to qualified bidders. A list of contractors/bidders includes the following: Hughes Aircraft Company, Canoga Park, CA; Areojet Solid Rocket Company, Sacramento, CA; Atlantic Research Corporation, Alexandria, VA; Hercules Incorporated, Cumberland, MD and McGregor, TX; McDonnell Douglas, St. Louis, MO; Martin Marietta, Orlando, FL; Thiokol Chemical Corporaton, Huntsville, AL; United Technologies Corporation (Chemical Systems Division), Sunnyvale, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The first effort started under this program element in FY 1977 was a contract with United Technologies CSD to provide for improved orbit transfer motor with the capability to increase weight of satellites in the NAVSTAR size by 200 pounds. This effort was completed in September 1979. The fixed fuel flow ducted rocket effort was started in September 1978 with a contract issued to Hughes Aircraft. The baseline flight vehicle design and aerodynamic test series were completed in June 1979. The Chemical Systems Division (CSD) of United Technologies Corporation was selected in August 1979 as the engine subcontractor. A contract with Thiokol Corporation was issued in December 1979 to demonstrate technique to lower the production cost of rocket motors by greater than thirty percent. The nozzleless motor concept was selected and the design entered verification testing in June 1979. Hercules Incorporated was selected in July 1978 to incorporate the radial pulse and reduced smoke propellant concepts into motor designs compatible with the two Advanced Medium Range Air-to-Air Missile (AMRAAM) prime contractors approach. Heavyweight motor testing was completed in November 1979. Two expulsion/tankage concept evaluations by Aerojet General Corporation and Rockwell International Corporation were started in September 1977. These concepts provided the technology base for the MX post boost propulsion system.

2. FY 1980 Program: Freejet testing of the ducted rocket engine will be started and the design of the integral solid rocket booster will be completed and motor testing started. The ducted rocket concept will provide an extended range propulsion option for a possible follow-on to the AMRAAM. Although the Soviets have used the ducted rocket successfully in the SA-6 and several European countries are pursuing programs for use in surface-to-surface systems, this will be its first application to air-launched missiles. Like other ramjet concepts, the ducted rocket uses solid propellant booster to reach cruise speed. Unlike other concepts such as Advanced Strategic Air Launched Missile (ASALM) and the Navy Advanced Low Volume Rocket Ramjet (ALVRJ), the ducted rocket sustainer uses a fuel-rich solid propellant grain. The low cost motor demonstration effort will be completed. This effort has demonstrated technology that will allow a 30% reduction in the cost for tactical motors. The advanced pulse motor concept, meeting AMRAAM design constraints, will be tested in flightweight configuration demonstrating design adequacy and allowing the concept to enter Preliminary Flight Rating Testing. Two new efforts will be initiated: (1) an advanced kick motor for the Inertial Upper Stage (IUS) will focus on demonstrating technology which will allow payload growth of more than 20% over the current design; (2) an advanced technology upper stage motor effort will provide the technology to increase throw weight of Intercontinental Ballistic Missiles by 11% when compared to MX baseline design.

Program Element: #63302F — Title: Advanced Missile Propulsion

DOD Mission Area: Engineering Technology (ATD), #553 — Budget Activity: Advanced Technology Development

3. FY 1981 Planned Program: During this period the fixed fuel flow ducted rocket engine freejet testing will be completed. This airbreathing engine will be flight tested in PE 63313F and will demonstrate the capability to increase the launch range of a missile such as the Advanced Medium Range Air-to-Air Missile (AMRAAM) by up to 100%. Preliminary Flight Rating Test (PFRT) of a reduced smoke two pulse rocket motor will be completed providing the AMRAAM with a higher performance propulsion option. An effort will be started that will demonstrate a solid rocket motor for a standoff missile capable of delivering a conventional warhead to 300 nautical miles range. An effort incorporating ballistic missile propulsion technology into the small Inertial Upper Stage (IUS) motor will be continuing with the objective of providing greater than 10% payload increase. Design and analysis of the advanced technology upper stage motor will be completed. The 52 inch diameter motor with 7,000 pounds of propellant will demonstrate an 11% throwweight increase over MX technology.

4. FY 1982 Planned Program: Flight testing of the ducted rocket will be initiated. Six flights over a flight envelope of five to seventy thousand feet are planned. Funding for this flight phase will be through PE 63313F. The demonstration of a technology improvement (variable fuel flow) for the ducted rocket will be started. This technology will add 25% low altitude and 100% high altitude range capability over the standard ducted rocket. The tactical standoff missile motor effort will be continuing. Ground testing of this motor will address producability and reliability as well as demonstrating the motor's performance. Component testing of the growth IUS motor will be continued. Propellant properties for the advanced technology upper stage motor will be verified during this time period. These properties will include propellant processability, curability, mechanical properties, burning characteristics, and aging capability.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,600	3,530	7,000	9,600	Continuing	Not Applicabl
2445	Advanced Airbreathing Propulsion		500	4,000	4,500		
6339	Air Launched Missile Propulsion	1,100	1,500	1,800	800		
6340	Space Systems Division	1,000	400	1,000	2,500		
6341	Ballistic Systems Propulsion	500	1,130	200	1,800		

Program Element: #63302F
DOD Mission Area: Engineering Technology (ATD), #553

Title: Advanced Missile Propulsion
Budget Activity: Advanced Technology Development

Project Number	Title	Comparison with FY 1980 Budget Data
2445	Advanced Airbreathing Propulsion	During FY 1979 the subcontract for the ducted rocket engine came in at three million dollars more than estimated and cost growth for other components also occurred. To accommodate this growth the fixed fuel flow engine effort was stretched one year and planned flights reduced to six. The variable fuel flow effort was planned to start in FY 1981 but has been delayed until FY 1982.
6339	Air Launched Missile Propulsion	Procurement of long lead time hardware components was authorized in the Advanced Medium Range Air-to-Air Missile (AMRAAM) sized motor effort in order to protect the option of proceeding into a Preliminary Flight Rating Test of both the Hughes and Raytheon compatible motor designs. This will prevent any appearance of favoring either prime until after one has been selected to go into full scale engineering development.
6340	Space Systems Propulsion	The IUS effort was scheduled to start in FY 1979. The start was delayed to FY 1980 in order to gain competition during source selection.
6341	Ballistic Systems Propulsion	During testing of the tankage and propellant feed system for the MX design, some technical problems appeared in the propellant expulsion system. After design fixes were incorporated, a dynamic test series was added in order to reduce the risk in the MX engineering development which stretched program completion into FY 1980. Due to the funding profile, the Advanced Technology Upper Stage Motor effort has been restructured to work only in high energy propellants during FY 1981 with work on inert components moved to out years.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 63601F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Conventional Weapons Technology
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	22,470	21,000	23,500	24,900	Continuing	Not Applicable
670A	Ordnance Technology	5,500	4,015	5,400	5,600	Continuing	Not Applicable
670B	Air-to-Surface Guided Weapons Technology	12,670	13,150	12,700	13,200	Continuing	Not Applicable
670E	Air-to-Air Technology	2,200	1,935	3,000	3,300	Continuing	Not Applicable
670F	Aircraft Gun Technology	2,100	1,900	2,400	2,800	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Includes Air Force advanced development effort for technology base demonstrations of advanced non-nuclear aircraft armament and weapons guidance technology. New weapons concepts and new technology applications are developed and tested to demonstrate feasibility, effectiveness and operational potential. This program serves as the basis for follow-on system development and advanced prototyping programs.

BASIS FOR FY 1981 RDT&E REQUEST: This is a many-faceted program which will: 1) Continue conventional weapons developments initiated in FY 1980 and prior years; 2) Complete other investigations and demonstrations initiated in prior years; and 3) Initiate promising new technology demonstrations maturing from exploratory development programs and advance these to related prototype demonstration programs. Specifically, increased funding is required to continue advanced development of millimeter-wave guidance and infrared sensor applications for an improved anti-armor capability, to support the development of tactical all weather guidance technologies and to provide options for improvement in the performance and reliability of our air-to-air missiles.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 63601F
DOD Mission Area: Engineering (ATD) #553

Title: Conventional Weapons Technology
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: The source of future improvements in US Air Force conventional weapons capabilities in the 1985-1995 time period lies in current technology base investigations. This program contains the total Air Force advanced development effort for demonstration of non-nuclear weapons technology and associated weapons guidance technology. New weapons concepts and new application of technology are tested to demonstrate feasiblity and effectiveness. In addition, system technology support and cost reduction efforts are also provided. A wide variety of tactical and strategic requirements for new and improved non-nuclear weapons are the sources of the developments within this program. All aspects of conventional weapons are included in the program: bombs, clusters, fuzing systems, aircraft/stores interface equipment, adverse weather day-night air-to-surface weapon guidance units, air-to-air seekers, gun mechanisms, ammunition, propellants and aircraft rockets. In addition, promising foreign technology is evaluated for possble application to US requirements.

This technology base program will serve as the basis for follow-on engineering development programs, to support ongoing engineering developments and to demonstrate advancements in the state-of-the-art. A major objective of this program is to obtain a higher return on investment, to improve early problem identification and to assure adequate focus and funding on critical, pacing and limiting technical problems.

RELATED ACTIVITIES: This program demonstrates non-nuclear technology advances initially investigated in Air Force exploratory development Conventional Munitions (PE 62602F), Aerospace Avionics (PE 62204F) and Rocket Propulsion (PE 62302F) programs. Coordination is maintained with Advanced Avionics for Aircraft (PE 63203F), Digital Avionics Information System (PE 63243F) and NAVSTAR/Global Positioning System (PE 64778F) programs. Outputs from this program are to the Advanced Missile Subsystem Demonstration (PE 63313F), Advanced Short Range Air-to-Air Missile Technology (PE 63380F), Advanced Medium Range Air-to-Air Missile (AMRAAM) (PE 63370F), Advanced Attack Weapons (PE 63609F), Armament/Ordnance Development (PE 64602F), Close Air Support Weapons System (PE 64608F), Air Delivered Land Mines (PE 64610F) and Surface Defense Suppression (PE 64733F) programs. Tri-Service coordination is accomplished through the Joint Technical Coordinating Group (JTCG) for Munitions Development, the JTCG for Munitions Effectiveness and the Joint Service Guidance and Control Committee (JSGCC) for guidance and control activities. Other joint specialized committees have been formed for specific technology subareas. Jointly funded/sponsored tasks in this program include Standard Store Interface (SSI) and the Ring Laser Gyro (RLG) programs and the demonstration of Synthetic Aperture Radar (SAR) seeker technology. International cooperation and coordination is effected under the auspices of The Technical Cooperation Program (TTCP) and various specific country-to-country data exchange agreements, such as the NATO millimeter wave target /background signature measurement program.

WORK PERFORMED BY: The Air Force Armament Laboratory, Eglin Air Force Base, FL, is the responsible technical activity for this program. Test facilities at the Armament Division, Eglin Air Force Base, FL; the Arnold Engineering Development Center, Arnold Air Force Station, TN; and the Central Inertial Guidance Test Facility, Holloman Air Force Base, NM support this program.

Major contractors on this program are: Brunswick, Costa Mesa, Ca; McDonnel Douglas, Huntington Beach, CA; General Dynamics Corporation, Pomona, CA; Texas Instruments, Dallas, TX; Honeywell Inc, Minneapolis, MN; Hughes Aircraft Company,

Canoga Park, CA; Martin Marietta, Orlando, FL; Teledyne Systems Company, Northridge, CA; and Lear Seigler, Grand Rapids, MI. Twelve other contractors and non-Air Force Government activities hold thirty-five additional contracts on this program.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Most of the new conventional ordnance in the Air Force inventory or currently in acquisition programs was initially demonstrated under this program. The list includes retarders for General Purpose (GP) bombs; the CBU-58 cluster bomb; fuel air explosive (FAE) weapons; the FMU-57 proximity fuze; the GATOR tri-service mine system; conventional bomb bay adapters for the B-52 aircraft; television and imaging infrared (IIR) guidance seekers for bombs and missiles; the SUU-16/23 20mm aircraft gun pods; the GAU-8 cannon and 30mm armor piercing ammunition; the POPEYE air-to-surface missile, which is being used as the basis for the Army HELLFIRE program; the PIRANHA underwater mine, for use against snorkeling armored vehicles and river crossing equipment; the programmable digital autopilot, successfully demonstrated and incorporated into the GBU-15 modular weapon system; three successful live firings of AIM-7 missiles against drones using PAVE BRAZO air-to-air antiradiation missile (ARM) guidance; the demonstrated feasibility of low cost 30mm target practice ammunition using plastic components and of 30mm cartridge cases fabricated from steel; and successful flight demonstration of developmental IIR guidance units using modified ACM-65 MAVERICK missiles. The Hard Structures Munitions (HSM) warhead, fuze and safing/arming subsystems has completed advanced development. Prototype flight test demonstration will follow under PE 63609F. Captive flight tests of radiometric area correlator (PAC) guidance system were successfully completed. With this system an all-weather, autonomous mid-course guidance capability has been achieved. Handover from PAC to a terminal guidance system was also demonstrated. Two basic gun designs were tested under the compact high performance gun program. A 20mm linear linkless ammunition feed system was successfully demonstrated in live fire tests involving five thousand rounds fired from an M-61 gun fed by the developmental feeder. Under the telescoped cartridge effort the required muzzle velocity was achieved with two variations of an improved round design. Two of the three design approaches for 30mm low cost non-ricochet target practice ammunition have been successful demonstrated. Demonstration of the Clustered Airfield Defeat Munition (CADM) was completed. A very successful five weapon drop test was conducted using a GBU-2 laser guidance package with the penetrators packaged inside a SUU-54 dispenser. CADM will be considered along with other submunitions during a cost effectiveness analysis of candidate airfield attack munitions. AFX-108, a plastic bonded insensitive explosive has been demonstrated and is now used as an alternate fill for the SHRIKE warhead. Demonstration of the digital Stores Management System (SMS) in an F-4 aircraft is being completed. Proportional funding and management participation in the tri-Service Fast Acquisition Search and Track (FAST) program for an active radar air-to-air seeker was completed. The results of this effort are applicable to the Advanced Medium Range Air-to-Air Missile (AMRAAM) program. Under the millimeter wave guidance demonstration (MMGD), automatic detection, acquisition and tracking of an armored target was accomplished using a brassboard millimeter wave seeker. Under the Tactical Global Positioning System Program (TGPSP), brassboard missile receivers successfully tracked and processed NAVSTAR GPS satellite signals. Under the Low Cost Inertial Guidance Subsysten (LCIGS) program, brassboard fabrication of a unit with modular gyros and accelerometer has completed laboratory testing. The resulting non-proprietary design is being used to develop industrial LCIGS units for use in a Midcourse Guidance Demonstration. The Antiarmor Cluster Munition (ACM) and the Extended Range Antitank Mine (ERAM) were transitioned to the Wide Area Antiarmor Munition (WAAM) program for validation.

Program Element: #63601F
Title: Conventional Weapons Technology
OSD Mission Area: Engineering Technology (ATL) #553
Budget Activity: Advanced Technology Development #2

2. FY 1980 Program: The FY 1980 program will continue the emphasis initiated in prior years to provide the technology for weapons developments geared to the needs defined for a non-nuclear European conflict. Efforts involve interdiction, close air support, air superiority and defense suppression munitions compatible with adverse weather delivery against large numbers of the hostile forces. This includes cluster weapons, anti-armor submunitions, low cost precision midcourse and terminal guidance seekers for air-to-surface use, countermeasures resistant air-to-air seekers and air-to-air/ air-to-surface gun system components. Specific efforts that will be accomplished include development of a standard store interface that will describe the electrical and mechanical interface between future aircraft and developmental stores. The resultant specification will be applicable to the Air Force, the Navy and NATO. Development of an advanced "30" ejector rack as a direct replacement for the MAU 12/40 will continue. A clustered air target warhead program will be initiated to demonstrate an effective warhead for modern aerial combat. Low altitude dispenser technology development for the delivery of clustered submunitions will continue. A modular fuze program will be initiated to provide greater reliability and flexibility for advanced air-to-surface weapon systems. A projected antiarmor warhead program will be initiated to demonstrate effectiveness against advanced armor. An anti-materiel incendiary (AMI) submunition program will be initiated to provide a kill capability against diesel fueled trucks, light armored vehicles, artillery, and mobile air defense elements. Upon successful completion of Phase I (captive flight tests), free flight demonstration of the tactical global positioning system guidance will be initiated. The industrial low cost inertial guidance subsystem (LCIGS) ground and captive flight testing will be completed. Development will continue on the digital integrating subsystem (DIS) structured to accommodate the LCIGS as an inertial reference system, a midcourse update capability and terminal guidance. The millimeter wave guidance demonstration program will continue with the design and development of demonstration units for free flight testing on a suitable airframe. Development and demonstration of infrared terminal guidance for air-to-surface weapons will continue with tower and captive flight tests. The midcourse guidance demonstration will continue with ground and captive flight tests involving LCIGS, DIS and one or more of the midcourse position update systems such as radiometric area correlation (RAC). The millimeter wave and infrared target acquisition and recognition technology task will continue. The results of this effort will reduce risks in developing sensor/signal processors for sensor fuzed submunitions and extended range anti-tank mines. A program will be initiated to design and demonstrate the technical feasibility of improved anti-radiation missile guidance. In the area of short range air-to-air missile technology the active laser seeker program will continue in FY 1980 with the design and fabrication of seeker brassboards and demonstration of these units through captive flight tests. Under the focal plane array infrared seeker technology program, infrared arrays and associated signal processing technology will be evaluated for short range missile. Development will continue on the 30mm linear linkless feed and drive system for advanced aerial gun application. Evaluation of monocoque and fuzeless ammunition and spinning tubular projectiles will be accomplished to provide improved rounds for use with current gun systems. Under future gun technology, development of the telescoped ammunition concept and of an optimized air-to-air projectile for the telescoped round will continue. Studies of advanced technology gun configurations will be initiated.

Program Element: #63601F
DoD Mission Area: Engineering Technology (ATD), #553

Title: Conventional Weapons Technology
Budget Activity: Advanced Technology Development #2

3. FY 1981 Planned Program: The 1981 program will emphasize the development of technology to support a capability to deliver standoff guided weapons at night and in adverse weather and to improve the performance and reliability of our air-to-air missiles. Resources will be provided to increase counterair effectiveness and to improve our weapon carriage and release capability. A number of efforts will complete the feasibility demonstration phase during FY 1981. These include the development of an advanced ejector rack which operates with a clean energy source thereby reducing costly maintenance manhours, completion of the millimeter wave guidance demonstration for aplication to mini-missile and other all weather guidance projects, completion of the 30mm linear linkless ammunition feed system demonstration, the completion of captive flight test validation of unaided inertial guidance for tactical standoff missiles, the demonstration of the digital integrating system structured to provide internal weapon system communications between subsystems, demonstration of the industry low cost inertial guidance for integration into the midcourse guidance demonstration and demonstration of the active laser seeker for all-aspect body tracking of aerial targets. Continuing efforts include the infrared guidance demonstration for application as a lock-on-after-launch alternate guidance scheme for the mini-missile, the tubular projectile, optimized air-to-air ammunition and the development of telescope rounds in conjunction with advanced aerial gun technology, the modular fuze which incorporates digital processing for multiple weapon use, and the anti-material incendiary cluster munition. The projected antiarmor warhead for use against advanced armor; the low altitude dispenser for new cluster munition systems; the standard store interface for Air Force, Navy and NATO use; the clustered air target warhead for modern aerial combat, the midcourse guidance evaluation for integration of low cost inertial components with an internal digital weapon bus and position update sensor; free flight testing of tactical global positioning system guidance, demonstation of advanced anti-radiation missile technology, the focal plane array IR seeker for short range air-to-air missiles, aerial subsystem integration technology to optimize design parameters involving the warhead, propulsion, electronics and guidance, near-term gun technology to establish gun mechanisms for firing cased telescoped ammunition; 30mm high explosive ammunition for aerial combat; and 30mm armor piercing incendiary projectiles for high speed aircraft at extended short ranges will be continued. Specific new efforts that will be initiated include guidance technology including second generation millimeter wave and infrared seekers, and advanced correlation technology for real time target acquisition.

4. FY 1982 Planned Program: The FY 1982 program will continue the emphasis begun in prior years to exploit technology advances developed in the exploratory development program for worldwide application. The emphasis will remain on anti-armor and airfield attack weapons and will be characterized by wide area effectiveness, accuracy, low level high speed delivery, functioning in adverse weather, low cost and high reliability. The standard store interface will be completed with specifications and standards written for future aircraft systems. The low altitude dispenser for delivery of advanced cluster munitions will be completed. Continuing programs include the projected anti-armor warhead for use against advanced armor, the clustered air target warhead for use during modern aerial combat, and the anti-material incendiary submunition for use against diesel fueled vehicles including light armor. In the guided weapon technology area the infrared guidance demonstration for a lock-on-after-launch capability for terminally guided submunition will be completed. Work will continue on advanced global positioning system guidance and processing, the development of an

advanced tactical inertial measurement unit and advanced correlation technology for real time acquisition and strike of fixed and mobile targets. New efforts include second generation millimeter-wave and infrared guidance, digital integration technology, and special emphasis on all weather guidance demonstration. Air-to-air technology will include continuation of the focal plane array infrared seeker program designed to increase detection range, provide clutter rejection and resistance to countermeasures. Missile integration technology and and advanced seeker demonstration will allow timely transition of missile subsystems into engineering development. Work will continue on stabilized gun system technology and on a self defense gun for strategic aircraft. Efforts completing advanced development include the spinning tubular projectile, advanced 30mm armor piercing incendiary ammunition and telescoped ammunition. Efforts will be initiated on future gun technology.

5. Program to Completion: This is a continuing technology base program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	18,999	20,970	23,000	22,800	Continuing	N/A
670A	Ordnance Technology	3,900	5,500	5,000	5,400	Continuing	N/A
670B	Air-to-Surface Guided Weapons Technology	11,099	11,170	12,000	12,000	Continuing	N/A
670C	Air-to-Air Technology	2,000	2,200	3,000	3,000	Continuing	N/A
670F	Aircraft Gun Technology	2,000	2,100	2,100	2,400	Continuing	N/A

There was an overall increase between the FY 1980 Budget Data and the FY 1981 submission. This is attributed to the increased cost ($500 thousand) of developing sophisticated electronics for guided weapons.

Project: #670A Title: Ordnance Technology

Program Element: #63601F Title: Conventional Weapons Technology

DOD Mission Area: Engineering Technology, (AD), #553 Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: This project is designed to provide the technical basis for future development of non-nuclear weapons systems and components and stores/aircraft interface equipment. Project 670A demonstrates the technical feasibility of advanced non-nuclear general and special warheads; fuzes and fuze components; stores suspension and release equipment; aircraft stores management systems; flame, incendiary and fuel air explosives (FAE); cluster dispensers; bomblet and bomblet fuzing; airfield attack submunitions; and air delivered target activated munitions. New concepts and new technology applications are tested to demonstrate feasibility and effectiveness. Technology support for systems development and cost reduction efforts through technology innovations are also provided by this project. A prototype aircraft digital stores management system capable of being programmed in flight will be demonstrated and made available for future aircraft system developments. Advanced store suspension and release units and stores arming systems will provide controlled separation from delivery aircraft to reduce the incidence of store-aircraft and store-to-store collisions after release. New microcircuitry electronics techniques are being applied to weapons fuze timing circuits, counters, proximity sensors and remote sensors for influence burst, increasing effectiveness, reliability and providing low production costs in volume. Advanced blast, fragmentation, penetration and special purpose warheads providing increased effectiveness and flexibility are demonstrated. Low altitude dispenser techniques, advanced cluster munitions and mine sensor technology is being demonstrated to counter the armor threat in Europe.

RELATED ACTIVITIES: This project demonstrates non-nuclear weapons technology initially investigated in the Air Force Conventional Munitions Program PE 62602F. Technology from this project is applied to other projects within the Conventional Weapons Program PE 63601F and in the following Air Force programs: Advanced Attack Weapons PE 63609F, Armament/Ordnance Development PE 64602F, Air Delivered Land Mines PE 64610F and Surface Defense Suppression PE 64733F. Tri-Service coordination is maintained through the Joint Technical Coordinating Groups for Munitions Development (JTCG/MD) and Munitions Effectiveness (JTCG/ME). The digital stores management system is coordinated with the Navy through JTCG/MD and also with the Air Force Digital Avionics Information System program, PE 63243F. International cooperation and coordination is effected under the auspices of the Technical Cooperation Program (TTCP) and various specific country-to-country data exchange agreements negotiated separately.

WORK PERFORMED BY: The Air Force Armament Laboratory (AFATL), Eglin AFB, FL, is the technical activity responsible for this project. Test facilities of AFATL, the Armament Division, Eglin AFB, FL and the Arnold Engineering Development Center, Arnold AFS, TN, support this project. Major contractors on project work units are: Brunswick, Costa Mesa, CA; Lockheed Missiles and Space Company, Sunnyvale, CA; Edo Corporation, College Point, NY; and Booze Allen, Bethesda, MD. Three other contractors hold three additional contracts under this project.

Project: #672A
Program Element: #63601F
DOD Mission Area: Engineering Technology, (ATD), #553

Title: Ordnance Technology
Title: Conventional Weapon Technology
Budget Activity: Advanced Technology Development #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Most of the new conventional ordnance and related equipment introduced into the Air Force inventory or placed into development for acquisition is a result of technology demonstrated under this project. Retarder fins; ballutes; fuel air explosives (FAE); cluster bomb units (CBU); mechanical, electronic and proximity bomb and rocket fuzes; incendiary weapons; flares and markers; bomb racks; B-52 bomb bay adaptors for convention bombs; anti-armor and anti-personnel mines; and aircraft stores management systems have all been demonstrated under Project 672A and later produced for inventory. The FY 1976 program saw the completion of the PIRANHA shallow water mine advanced development demonstration. During FY 1977, the hard structures munition (HSM) warhead and fuze technology was demonstrated. The HSM will be weaponized under PE 63605F. During FY 1978 the clustered airfield defeat munition (CADM) free flight demonstration was completed. The CADM will now be considered along with other submunitions during a cost and effectiveness analysis on candidate airfield attack munitions. The results of preliminary technological investigations of the sensor fuzed submunition (Cyclops) and the mini-missile (Wasp) have been provided for future development work under PE 63609F. During FY 1979, the Anti-Armor Cluster Munition (ACM) and the Extended Range Anti-tank Mine (ERAM) projects were transitioned into the Wide Area Anti-armor Munitions (WAAM) program.

2. FY 1980 Program: The FY 1980 program will emphasize requirements in warhead and fuzing technology, the development of anti-material incendiary (AMI) submunitions, and the continuation of projects initiated during FY 1979 and prior. Specifically, development on the advanced "30" ejector rack and the low altitude dispensers will continue. An effort will be initiated to develop a standard store interface that will be usable by the Air Force, Navy and members of NATO. A modular fuze program will be initiated to complement the development of a new family of unitary warheads. These two efforts together with the standard store interface program will result in a new set of munitions for NATO use. An anti-armor incendiary cluster munition program will be initiated to provide a kill capability against diesel fueled vehicles. A clustered air target warhead program will be initiated to demonstrate an effective warhead against evasive, maneuvering targets encountered during modern aerial combat. The projected anti-armor warhead effort will develop and demonstrate effectiveness of a small projected shape charge against advanced armor.

3. FY 1981 Planned Program: The FY 1981 planned program will be structured to continue development of the new modular fuze for standoff weapons. Development of the anti-material incendiary cluster munition will continue. Development will be completed on the advanced "30" ejector rack. Ejector rack technology will transition into full scale engineering development under PE 64602F. Work will continue on the low altitude dispenser and the standard store interface for NATO interoperability. Low altitude dispenser technology will be utilized for the development of the wide area anti-armor munitions. The clustered air target warhead and projected anti-armor warhead programs will continue.

4. FY 1982 Planned Program: The 1982 program will include completion of the standard store interface modular fuze, the low altitude dispenser and the anti-material incendiary submunition programs. Continuing will be the projected anti-armor warhead and the clustered air target warhead programs. Completed programs will transition into engineering development under appropriate munitions development program elements.

Project: #670A — Title: Ordnance Technology

Program Element: #63601 — Title: Conventional Weapons Technology

DOD Mission Area: Engineering Technology, (AD), #553 — Budget Activity: Advanced Technology Development #2

5. Program to Completion: This is a continuing technology base project.

6. Milestones: Not Applicable.

7. Resources: ($ in thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E Funds	5,500	4,015	5,400	5,600	Continuing	N/A

8. Comparison with FY 1980 Budget Data: Not applicable, no change.

Project: 670A — Title: Air-to-Surface Guided Weapons Technology

Program Element: #63601F — Title: Conventional Weapons Technology

DoD Mission Area: Engineering Technology (ATD) #552 — Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DISCUSSION: This project is a continuing effort to provide the technology base necessary to support future development of improved air-to-surface guided weapons. Primary objectives are to develop promising guidance and control techniques, evaluate new technology for application to weapon guidance and control, and to develop weapon integration methodology to accommodate new warhead, airframe, and other related technologies. The effort is divided into a weapon guidance technology task focused on design studies, analyses, and initial examination of promising guidance techniques; and a force applications task. The principal area of effort includes development of all-weather midcourse and terminal guidance for tactical application based on low cost inertial measurement equipment with position and velocity determination from external means such as the Global Positioning System (GPS), Radiometric Area Correlator (RAC) or other systems. This effort will culminate in a midcourse guidance demonstration where weapon guidance and control components are integrated using digital microprocessor techniques. A second area of effort, also concerned with overcoming adverse weather limitations, is the development of millimeter wave contrast guidance. This effort includes development and flight test demonstration of a millimeter wave contrast seeker. This technology will provide the capability to attack tanks and other discrete tactical targets, fixed or roving, with hitting accuracy under adverse weather conditions. Complementing the millimeter wave effort will be an Infrared Guidance Demonstration (IRGD) for development and testing of advanced seekers to evaluate their use against armored land combat vehicles. Infrared guidance is one of the principle forms of guidance being considered for the minimissile program. A third area of activity is to develop a digital integrating subsystem (DIS) for tactical weapon guidance and control. The capability and versatility of digital processors is needed to implement advanced forms of midcourse guidance such as the RAC and GPS systems, and offers the potential to increase system performance and decrease costs in a wide variety of guidance applications. This effort will provide a common digital bus/microprocessor communication system for application to future defense suppression weapons, and tactical standoff missiles.

RELATED ACTIVITIES: This project demonstrates tactical air-to-surface guided weapons advanced technology initially investigated in Air Force exploratory development Conventional Munitions (PE 62602F) or Aerospace Avionics (PE 62204F) programs. Coordination is maintained with Air Force advanced development programs: Advanced Avionics for Aircraft (PE 63203F), NAVSTAR/GPS (PE 64771F), and with the Ordnance Technology project 670A and Air-to-Air Technology project 670E of this program element. Outputs from this project are primarily into Advanced Attack Weapons (PE 63609F); past "graduates" have also transitioned into the Close Air Support Weapon System (PE 64603F) and Surface Defense Suppression (PE 64733F) programs. Tri-Service Coordination is accomplished through the Joint Technical Coordinating Group for Munitions Development (JTCG/MD), the Joint Service Guidance and Control Committee established by DoD Instruction 5154.26, and other joint specialized committees formed in specific technology sub-areas. Task areas/work units which are funded/sponsored jointly between the Air Force Armament Laboratory and Air Force Avionics Laboratory include: Millimeter Wave guidance and supporting technology, GPS Midcourse Guidance, and Low Cost Inertial Midcourse Guidance. Joint-Service funded/sponsored efforts include digital guided weapons technology, millimeter wave guidance technology and Synthetic Aperture Radar seeker technology. International cooperation and coordination is effected under auspices of The Technical Cooperation Program (TTCP) and various specific country-to-country data exchange agreements.

Project: #6708 — Title: Air-to-Surface Guided Weapons Technology
Program Element: #63601F — Title: Conventional Weapons Technology
DoD Mission Area: Engineering Technology (ATD), #553 — Budget Activity: Advanced Technology Development #2

WORK PERFORMED BY: The Air Force Armament Laboratory, Eglin AFB, FL, is the responsible technical activity for this project. Laboratory facilities of the Air Force Armament Laboratory and the Air Force Avionics Laboratory are involved in the work. Test facilities at the Armament Division, Eglin AFB, FL; the Arnold Engineering Development Center, Arnold Air Force Station, TN; and the Central Inertial Guidance Test facility, Holloman AB, NM support this project. Major contractors on work units included in this project are: Honeywell, Inc, Hopkins, MN; Hughes Aircraft Corporation, Canoga Park and Culver City CA; Texas Instruments, Dallas, TX; Teledyne Systems Co, Northridge CA; Lear Seigler, Grand Rapids, MN; Computer Science Corporation, Huntsville, AL; Martin Marietta, Orlando, FL; McDonnell Douglas, Huntington Beach, CA; General Dynamics, Pomona, CA; and Sperry, Orlando, FL. Nine other contractors hold sixteen additional contracts under this project.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: During FY 1979 this project continued to develop experimental guidance systems and equipment and carry out laboratory, field, and captive flight measurements and feasibility demonstrations. Under the Millimeter-Wave Contrast Guidance Demonstration (MCGD) program captive flight tests were completed. Armored targets were successfully acquired and tracked at tactical ranges. This data will provide meaningful and timely inputs to the Wide Area Anti-Armor Munitions (WAAM) program and will make direct technical contributions to the Mini-Missile project. The Mini-Missile is a small, low cost tactical missile with a standoff capability against armored targets. Investigations centered on both passive and active radiometric modes to permit long range target detection and accurate terminal homing. Design trade-offs involving weather penetration, target resolution and detection range, modulation techniques to improve detection, acquisition and tracking and monopulse techniques and pulse compression techniques leading to a higher degree of target resolution were also investigated. These continuing efforts are designed to lower the risk associated with alternate MCGD approaches and to develop technical solutions for the most prominent guidance problems facing the minimissile development. Joint measurement programs in the millimeter wavelength region continued in cooperation with Army and Navy agencies and the Air Force Avionics Laboratory. The Tactical Global Positioning System (GPS) guidance development continued with captive flight testing. Satellite signals were successfully acquired by the missile grade receiver. The brassboard model Low Cost Inertial Guidance unit was completed and subjected to peformance and qualification testing. Alternative sensor modules were interchanged in the brassboard model unit, to demonstrate the modularity of the approach as well as to validate interface specifications. Successful captive flight test of the Radiometric Area Correlator Guidance (RACG) system were completed in FY 1977. This involved the demonstration of an all-weather, autonomous, midcourse guidance capability during winter and spring climatic conditions in areas of New York State considered very representative of European conditions. Additional flight tests were made demonstrating accurate handover to terminal guidance. Results of computer simulations using the GBU-15 cruciform wing weapon (CWW) indicated that radiometric area correlation guidance (RACG) has a potential terminal guidance capability against area targets. Advanced development of the Programmable Digital Autopilot (PDAP) was successfully completed in December 1975. Based on its outstanding performance and flexibility, the PDAP was adopted as the baseline weapon control unit for the Planar Wing GBU-15 Engineering Development. During FY 1977, advanced development was completed on a larger capacity, more capable multipurpose digital processor for future guided weapons applications.

Project: #6708 Title: Air-to-Surface Guided Weapons Technology
Program Element: #63601F Title: Conventional Weapons Technology
Defense Mission Area: Engineering Technology (ATD), #553 Budget Activity: Advanced Technology Development #2

Conceptual design studies were completed which assess antiradiation missile (ARM) alternatives and identify those having significant potential for improvement of ARM capabilities. Support continued for other guidance technology showing promise of satisfying known requirements or significantly improving air-to-surface capabilities.

2. FY 1980 Program: The FY 1980 program will continue the emphasis of prior years on providing guidance technology for air-to-surface guided weapons and demonstrating the feasibility of this technology. Successful accomplishment of the objectives will provide the Air Force with effective midcourse and terminal guidance systems to accommodate stand-off delivery and enhance the Air Force's adverse weather, day/night tactical delivery capabilities. Midcourse guidance systems being continued in development include the Tactical Global Positioning System Guidance Subsystem (TGPSG) and the Low Cost Inertial Guidance Subsystem (LCIGS). These efforts will be focused towards the midcourse guidance demonstration, with integration tests in FY 1980. The terminal guidance program being pursued includes the Millimeter-Wave Contrast Guidance (MWCG) feasibility demonstration for mini-missiles and the application of infrared seekers to the advanced anti-armor munition programs. Specifically, free flight testing of the TGPSG subsystem, which will commence in FY 1980, will demonstrate wide and various band tracking, high quality and low quality inertial aiding, Circular Error Probable (CEP) performance, and Anti-Jamming capability. Such a system capability will allow adverse weather, autonomous, worldwide, and day/night operation. The LCIGS program will build on brassboard model flight tests and subsystem prototype development accomplished during FY 1979. In FY 1980, each vendor will deliver several prototypes to the midcourse guidance demonstration program. In this effort, the promising midcourse candidates will be integrated with the LCIGS and Digital Integrating Subsystem (DIS) into one demonstration program. Under the MWCG program, free-flight testing of the first generation seeker will be initiated. Early in FY 1981, the integration of this technology into the mini-missile effort should occur as a follow-on to the successful completion of the free-flight test program. Also during this period, infrared guidance seekers will enter laboratory and rooftop testing. The millimeter-wave and infrared target acquisition and recognition technology for the exended range antitank mine will continue. The results will be transitioned to the TAAM program. Emitter homing technology will be investigated for application to anti-radiation missiles.

3. FY 1981 Planned Program: The FY 1981 program will continue the emphasis of prior years on providing guidance technology for air-to-surface guided weapons and to demonstrate the feasibility of this technology. This will involve the industry low cost inertial guidance subsystem and a midcourse and terminal update scheme integrated into a selected test vehicle through the digital integrating subsystem. Free flight demonstration of millimeter-wave guidance units will be completed. This technology will be transitioned to the minimissile program. Captive flight testing of infrared guidance units will be initiated. Advanced terminal seeker technology including advanced correlation techniques will be initiated. Second generation millimeter-wave seeker technology will be initiated for advanced anti-armor concepts. The incorporation of time division multiplex technology into the digital integrating subsystem (DIS) concepts will be investigated. The unaided tactical guidance program for application to area weapons and industrial low cost inertial guidance subsystem program for midcourse guidance will be completed. Millimeter

wave and infrared sensor signal processing results will transition to the wide area anti-armor munition (WAAM) program. Emitter homing technology will proceed into the captive flight test phase. An effort will be initiated to develop an advanced tactical inertial measurement unit for application to conventional medium range missiles.

4. FY 1982 Planned Program: The FY 1982 program will continue the emphasis of prior years on all-weather guidance, stand-off delivery and low cost digital subsystems for tactical guided weapons. This will include continuing work on the advanced tactical inertial measurement unit, advanced global positioning system guidance/processing, advanced correlation technology and second generation millimeter wave and infrared guidance for terminally guided submunitions. The midcourse guidance demonstration program will enter the flight test phase. Emitter homing technology will be complete with captive flight test demonstration. Digital integration technology will continue with the incoporation of advanced sensors and logic functions in the internal weapon structure. Efforts will begin on the application of all-weather guidance seekers to tactical missiles for close air support/interdiction missions.

5. Program to Completion: This is a continuing technology base project.

6. Milestones: Not Applicable

7. Resources: ($ in Thousands)

		FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E:	Funds	12,670	13,150	12,700	13,200	Continuing	Not Applicable
	Quantities - Not applicable						

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
670B	Air-to-Surface Guided Wpns Tech	11,099	11,170	12,900	12,000	Continuing	Not Applicable

An increase of $700K between FY 1980 and FY 1981 occurred due to the cost of developing electronics for stand-off guided weapons.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63605F Title: Advanced Radiation Technology
DOD Mission Area: Directed Energy Technology (ATD) #554 Budget Activity: Advanced Technology Development, #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	90,700	89,800	78,300	97,900	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is the Air Force program for demonstrating the technical and engineering feasibility of using high energy lasers as directed energy weapons in USAF weapons systems. The program includes broad based technology development in all aspects of laser weaponry and airborne demonstrations of technology.

BASIS FOR FY 1981 RDT&E REQUEST: These funds will support Airborne Laser Laboratory airborne testing and general laser technology development with increasing emphasis on

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #63605F Title: Advanced Radiation Technology
DOD Mission Area: Directed Energy Technology, #554 Budget Activity: Advanced Technology Development, #2

DETAILED BACKGROUND AND DESCRIPTION: The Air Force projects a continuing requirement to defend aerospace systems against attack. The demonstration of the gas dynamic laser concept in 1966 and the subsequent development of flowing gas laser systems have provided the first laser devices with sufficient energy to be effective as directed energy weapons.

This is a broad-based technology program to demonstrate the technical and engineering feasibility of using high energy lasers as directed energy weapons

Program Element: #63605F
DOD Mission Area: Directed Energy Technology, #554

Title: Advanced Radiation Technology
Budget Activity: Advanced Technology Development, #2

RELATED ACTIVITIES: This program element (PE) is part of a Department of Defense program which is coordinated by the Under Secretary of Defense for Research and Engineering, and which includes work in: Defense Advanced Research Projects Agency PE 62301E, Strategic Technology and PE 62711E, Experimental Evaluation of Major Innovative Technology; Army PE 62307A, High Energy Laser Technology; Navy PE 62735N, High Energy Laser Technology, and Air Force PE 62601F, Project 3326, Laser Applications. Coordination with Department of Energy (DOE) is effected by attendance at DOE laboratory technical program reviews, exchange of technical reports, and cooperative efforts at the working level.

WORK PERFORMED BY: The Air Force Weapons Laboratory, Kirtland Air Force Base NM is responsible for managing this program. The ten major contractors in FY 1979 were: Rocketdyne, Canoga Park CA; Hughes Aircraft, Culver City CA; Westinghouse, Baltimore MD; Dynalectron, Albuquerque NM; Ford Aerospace, Newport Beach CA: Perkin-Elmer, Norwalk CT; Univ. of Dayton Research Institute, Dayton OH; General Dynamics, Fort Worth TX; TRW, Redondo Beach CA; Pratt & Whitney Aircraft, West Palm Beach FL. The contracts totaled $54.7 million; in addition to the above, there were 35 additional contractors with contracts totaling $9.8 million. In-house test facilities involved in this work include the Advanced Radiation Technology Facility at Kirtland Air Force Base NM.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The basic technology for weapon application of gas dynamic lasers (GDLs) at 10.6 micrometers wavelength and associated pointing and tracking has been demonstrated in ground experiments; In 1973, a ground-based testbed using the Air Force Laser and Field Test Telescope tracked and destroyed drones flying at

Program Element: #63605F
DOD Mission Area: Directed Energy Technology, #554

Title: Advanced Radiation Technology
Budget Activity: Advanced Technology Development, #2

Program Element: #63605F
Title: Advanced Radiation Technology
DOD Mission Area: Directed Energy Technology, #554
Budget Activity: Advanced Technology Development, #2

2. FY 1980 Program:

3. FY 1981 Planned Program:

Program Element: 63605F
DOD Mission Area: Directed Energy Technology, #554

Title: Advanced Radiation Technology
Budget Activity: Advanced Technology Development, #2

4. FY 1982 Planned Program.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

Program Element: #63605F
DOD Mission Area: Directed Energy Technology, #554

Title: Advanced Radiation Technology
Budget Activity: Advanced Technology Development, #2

7. Comparison of FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	76,300	90,300	89,800	90,000	Continuing	Not Applicable

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63706F
DoD Mission Area: Environmental and Life Sciences (AT) #552

Title: Health Evaluation and Risk Tabulation (HEART) (Heartline Demonstration)
Budget Activity: Advanced Technology Development, #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,132	1,900	2,100	0	0	6,132

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The single most important health problem in the Air Force is cardiovascular disease which has a direct cost in excess of $45 million annually in addition to devastating effects on the careers and on family members of afflicted personnel. This program will demonstrate that identified risk factors can be used effectively and economically to predict cardiovascular disease.

BASIS FOR FY 1981 RDT&E REQUEST: The program concludes the refinement of data and technology development efforts for operating this program. Transition to a demonstration phase and system evaluation at several Air Force bases is planned in FY 1980/1981; transition to be completed in FY 1982 and proposed implementation in FY 1983 under Program 8, Training, Medical, and Other Personnel Activities, Program Element 87714, Other Health Activities.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: 63706F
DoD Mission Area: Environmental and Life Sciences (AT) #552

Title: Health Evaluation and Risk Tabulation (HEART) (Heartline Demonstration)
Budget Activity: Advanced Technology Development, #2

DETAILED BACKGROUND AND DESCRIPTION: This program will develop a total system to identify Air Force personnel with an increased risk of cardiovascular disease and to modify their risk to increase longevity and effectiveness. The prototype system will include an operations research model, information and risk modification subsystems, and training methodologies. The system will be evaluated at several Air Force bases prior to service-wide adoption.

RELATED ACTIVITIES: This program capitalizes on prior research efforts conducted by both the Air Force and the National Institutes of Health (NIH). The Air Force efforts were conducted in Program Element 62202F, Aerospace Biotechnology. Basic clinical and biochemical studies were accomplished in a large group of aviators referred for early symptomatic evidence of cardiovascular problems. The program also uses data derived from two NIH studies, the Framingham Study and the Multiple Risk Factor Intervention Trial, which involved older, more disparate populations with serious clinical problems. The program has been and will be periodically reviewed by prominent NIH consultants serving as ad hoc members of the Scientific Advisory Board which reviews this program annually. The program has been coordinated among the services through the DoD Joint Medical Research Conference.

WORK PERFORMED BY: This program is being conducted by an Advanced Development Project Office within the USAF School of Aerospace Medicine, Brooks AFB, San Antonio, TX. The program is almost entirely contractual, requiring only administrative and limited laboratory space which is available at Brooks AFB. Booz-Allen and Hamilton, Inc., Bethesda, MD, is the prime contractor and is supported by a subcontractor, American Health Foundation.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 Program: The initial phase of this program is refining data derived from both Air Force and NIH research programs concerning the etiological and epidemiological aspects of cardiovascular disease. Subsystem development of the risk reduction program and training program for administrators will be completed.

2. FY 1980 Program: The technology development phase will be completed and will be followed immediately by the demonstration phase which involves risk identification and reduction tests, model refinement and program evaluation. The effectiveness of the risk reduction effort and the logistical support necessary for successful transition to Air Force wide use will be evaluated at Pease AFB, NH; Charleston AFB, SC; Carswell AFB, TX; and Reese AFB, TX.

3. FY 1981 Planned Program: The demonstration phase started in FY 1980 will be completed in FY 1981. The final output of the contract will be an implementation plan which will detail schedules, costs, equipment, personnel and training requirements; and other factors pertinent to a decision regarding Air Force-wide implementation of the program.

Program Element: 63706F
DoD Mission Area: Environmental and Life Sciences (AT) #552

Title: Health Evaluation and Risk Tabulation (HEART) (Heartline Demonstration)
Budget Activity: Advanced Technology Development, #2

4. FY 1982 Planned Program: No Research and Development funds are programmed in FY 1982. However, the Program Office effort will be required to support Air Force review of the implementation plan as well as to assist the user in the transition of the Health Evaluation and Risk Tabulation Program to implementation. This effort will be funded under Program 8, Training, Medical, and Other Personnel Activities, Program Element 87714, Other Health Activities.

5. Program to Completion: This program will be completed in FY 1981.

6. Milestones: Not Applicable.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data: Not applicable.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63723F
Title: Civil and Environmental Engineering Technology
DOD Mission Area: Engineering Technology (ATD) #553
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2500	2700	3900	4600	Continuing	Not Applicable
2103	Environmental Quality/ Facilities Energy Technology	555	300	800	1000		
2104	Civil Engineering Technology	1945	2400	2900	3100		
2672	Special Terrestrial Power	-	-	200	500		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the Air Force civil and bioenvironmental engineers and provides the advanced technology base to ensure air base survivability and enhance tactical and strategic force readiness. The program includes efforts to: develop an improved Rapid Runway Repair (RRR) capability for contingent aircraft operational use; optimize aircraft operational surfaces maintenance, repair, and new construction techniques for the Air Force (AF) Civil Engineer; support operational needs for tactical deployment, air mobility, and base survivability; ensure AF systems and operational compatibility with Federal, Department of Defense, and local environmental policies and regulations during peace time; and adapt Department of Energy technology to meet specific AF facilities and special terrestrial power energy goals of reduce energy consumption and petroleum-fuel dependence.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for: the continued development of a rapid runway repair capability including new/improved bomb damage repair materials, surface roughness criteria for tactical aircraft, alternate launch/recover surfaces, and post attach assessment; analysis, design, and pre-prototype development of new and continued civil engineering efforts to increase aircraft survivability and key mission facilities in a tactical threat scenario; continued study of source/quantity of Air Force generated toxic metal waste; determining the feasibility of applying co-generation systems to Air Force installations; and the initiation of a new special terrestrial power project which will study the feasibility of developing a multi-fueled, fuel cell for bare base power requirements.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: 63723F
DOD Mission Area: Engineering Technology (ATD) 553

Title: Civil and Environmental Engineering Technology
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: This program provides advances in civil and environmental engineering technology essential to meet current and planned Air Force (AF) mission requirements for enhanced readiness and survivability of tactical forces and improved air mobility. Program thrusts are consolidated within two major technology development area (TDA): Civil Engineering (CE), including Rapid Runway Repair (RRR); and Environmental Engineering, including Environmental Quality (EQ), Facilities Energy (FE), and Special Terrestrial Power (STP). Program goals and objectives for the CE TDA include development of: new and improved geotechnical engineering materials, procedures, methods, and techniques; hardened aerospace structures which will render AF fixed and mobile facilities less vulnerable to attack and more survivable for retaliation; and an RRR system which will significantly improve current capability, allow expeditious damage assessment and runway repair, and subsequently allow expeditious aircraft launch and recovery from repaired and/or alternate launch surfaces in a sustained conventional conflict. Program goals and objectives for the Environmental Engineering TDA include: development of technology, methodology, and procedures for the characterization, monitoring, assessment, control, and abatement of pollutants generated by AF systems and operations; and the development of technology and pre-prototype hardware for improved methods and procedures to satisfy specific AF facilities and special terrestrial power energy requirements by augmenting or substituting alternate or more efficient energy sources/systems for petroleum-derived fuels.

RELATED ACTIVITIES: The efforts within this program are of significant interest to the other services and are specifically coordinated through the Joint Services Civil Engineering R&D Coordinating Group, which is responsive to DOD. This group ensures efforts are not duplicated across the services and that maximum technology transfer is obtained. Efforts of civilian or national interest are coordinated as appropriate with Federal Aviation Agency (FAA), National Aeronautics and Space Administration (NASA), Environmental Protection Agency (EPA), and Department of Energy (DOE); and joint programs have been established with those agencies. Other agency research programs in energy and environment are periodically assessed by the AF to take advantage of those technologies at little or no cost. This program directly feeds related engineering development projects in Program Element (PE) 64708F, Other Operational Equipment. Additionally, exploratory development under PE 62601F, Advanced Weapons, directly feeds the EQ and CE efforts within this program.

WORK PERFORMED BY: This program is managed by the Director of Science and technology, Air Force Systems Command and is executed by the Engineering and Services Laboratory, Air Force Engineering and Services Center (formerly the Civil and Environmental Engineering Development Office), Tyndall AFB FL. Ten percent of this program's work effort is accomplished in-house while the remainder is accomplished under contract. In-house laboratory facilities include the capability for: subscale and limited full scale protective construction and pavement weapons effects testing; design and test of airfield pavement materials and construction techniques; computer facility and utility design analysis; and environmental chemistry research. In 1979, the top ten contractors were: Boeing Company, Seattle WA; Southwest Research Institute, San Antonio TX; University of California, Berkely CA; University of Texas, Austin TX; University of Tennessee, Knoxville TN; Orlando Technology, Orlando FL; Science Application, Inc., La Jolla CA; BDM Corp., McLean VA; Beattle, Columbus OH; Feecon, Westboro MA.

Program Element: 63723F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Civil and Environmental Engineering Technology
Budget Activity: Advanced Technology Development #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Accomplishments include development of hardened aircraft shelters and closures now in use in Europe and Asia; computer programs for use in the preparation of environment assessment of aircraft operations; a computer model which defines optimum energy conservation strategy for AF base facilities; weapons impact descriptive profiles for integration into an ordnance range planning methodology; a new concepts study of Rapid Runway Repair (RRR) techniques; computer simulated aircraft and repaired runway roughness interaction data for the F-4; conceptual designs for rapid assessment of bomb-damaged runways; and development of an interim repair procedure for spall damage and medium size craters using a polymer based mortar and crushed limestone respectively.

2. FY 1980 Program: Within the Civil Engineering (CE) technology area, efforts funded will primarily support the tactical air forces required operational capability for RRR: bomb damage repair (BDR) concepts will be tested and evaluated; testing of off-the-shelf materials for BDR will continue. In addition the following related CE efforts will be funded: development of a long-life corrosion-resistant protection system for air base facility use, which was originally scheduled for completion in 1979, has slipped to 1980; additional foreign weapons effects testing against selected air base structures will be conducted; development of improved Air Force (AF), tactical, air-mobile shelters will continue; and development of a pavement condition index criteria for airfield pavement maintenance and repair will continue. Within the environmental engineering technology area the following new initiatives and continued efforts will be funded: as part of the development of a methodology to determine AF land use requirements for ordnance range operations under constraints of urban encroachment and environmental legislation, work will continue on a Range Planning case study and the development of probability density functions for the AF Flight Test Center's precision impact range will be completed; and prototype development of a tactical-scale vertical axis wind turbine will be completed.

3. FY 1981 Planned Program: The majority of the planned program will continue to fund efforts which will expedite development of an enhanced RRR capability. Specific RRR efforts will focus on: the development of a polymer concrete repair system and distribution of application guidance to using commands; continuing evaluation of advanced materials application for bomb damage repair; completing the development of surface roughness criteria for the F-16, continue criteria development for the A-10 and C-130, and initiate criteria development for the F-15 and C-141 aircraft; field testing of select stabilized surfacing methods for use as alternate launch surfaces; and continuing design and testing of damage resistance runway methods. The study of electromagnetic pulse hardening techniques for air mobile tactical shelter application will be completed. In the area of airfield pavements an asphalt fatigue model will be completed and incorporated into pavement evaluation criteria. In the environmental engineering area, a study to identify and quantify industrial toxic metal sludge sources at Air Logistics Center electroplating shops will be completed and a showcase will be constructed to demonstrate sludge reduction at sources; a study to determine the feasibility of advanced co-generation systems at AF installations will be initiated; and a new project, special terrestrial power, will be initiated to evaluate the feasibility of a multifueled, fuel cell conversion system.

Program Element: 63723F
DOD Mission Area: Engineering Technology (ATD) #553

Title: Civil and Environmental Engineering Technology
Budget Activity: Advanced Technology Development #2

4. FY 1982 Planned Program: The planned program will continue to emphasize technology development of advanced materials, techniques, and procedures which will enhance RRR capability and decrease vulnerability in the North Atlantic Treaty Organization (NATO) wartime environment. Work will continue to develop computer simulated, runway roughness criteria and data for several tactical aircraft (A-10, F-15, F-111) and some cargo aircraft (C-130, C-141). Design, test, and evaluation of bomb damage repair techniques and alternate launch/recovery surfaces will continue. The design and laboratory testing of damage resistant runways (DRR) will be completed, and construction of a partial, full-scale DRR for weapons testing will begin. Work will continue in identifying post attack environment requirement for development of a post attack action plan. In addition a pilot demonstration of a pavement maintenance system will be completed and studies of advanced shelter designs and methods for improving/reducing the vulnerability of air base facilities will continue. Work will also continue in evaluating the feasibility of recycling airfield pavement materials. In the areas of environmental engineering: advanced Air Force facilities energy storage concepts will be analyzed; the feasibility and potential for AF wide application of co-generation energy systems will be studied; and work will continue on the development of a multi-fueled fuel cell for bare base application.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,601	2,500	2,700	3,500	Continuing	Not Applicable
1997	R&D Facility Criteria	376					
2101	Aerospace Structures	175					
2102	Mission Support	300					
2103	Environmental Quality Facilities Energy Technology	830	570	300	700		
2104	Civil Engineering Technology	920	1,930	2,400	2,800		

FY 81 funding increase allows initiation of project 2672, Special Terrestrial Power, and increase Facilities Energy work in Project 2103.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63728F
Title: Advanced Computer Technology
DOD Mission Area: Electronic and Physical Sciences (ATD), #551
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimate Costs
	TOTAL FOR PROGRAM ELEMENT	3,440	4,200	4,100	5,400	Continuing	Not Applicable
2527	Life Cycle Management	24	140	300	500		
2528	Software Data Collection and Analysis	412	430	500	400		
2529	Computer Architecture Applications	536	350	500	600		
2530	Distributed System Reliability and Survivability	---	550	1,200	2,200		
2531	Software Engineering Tools and Methods	811	1,330	700	300		
2532	High Order Computer Language Discipline	1,657	1,400	900	1,400		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force and DOD have experienced rapidly escalating costs for acquiring and maintaining software used on computers embedded in weapons systems. Current DOD software costs are estimated at $3.0 billion annually. The increasing complexity of military systems coupled with the availability of smaller, more powerful computer hardware has proliferated the use of digital computers and resulted in an unprecedented demand for software. Development and maintenance of software are predominantly labor intensive processes and their costs have increased with this demand. Costs can be reduced if a larger share of these processes are automated, if a prudent amount of standardization is introduced into the processes and if managers are provided with the tools and methods to control and evaluate the processes. This program is structured to develop and demonstrate technologies which will achieve these objectives. The goal is to reduce software acquisition and support costs by one third by 1985.

BASIS FOR FY 1981 RDT&E REQUEST: The FY 1981 program will continue efforts initiated in past years in the support of standard higher order programming languages, development of automated program verification aids and demonstration of the National Software Works as a user oriented programming network. Major thrusts will include expanded development efforts for (1) a distributed processing system simulator on which technologies for fault tolerance and data sharing can be evaluated; (2) a multiple microprocessor emulation system on which the most effective standard architectures can be developed and evaluated; and (3) a software reliability estimation model.

Program Element: #63728F
DOD Mission Area: Electronic and Physical Sciences (ATD), #551

Title: Advanced Computer Technology
Budget Activity: Advanced Technology Development #2

OTHER APPROPRIATION FUNDS: Not Applicable.

DETAILED BACKGROUND AND DESCRIPTION: This program was established by the Air Force as a broad based advanced development program in computer resource technology. The Air Force recognized that software development was a labor intensive process and virtually invisible to management. Software development has grown to be one of the most expensive parts of developing a weapon system and has become a pacing factor in delivery schedules. Since all services within DOD have had the same adverse experiences in software development, a DOD-wide program was established as outlined in the Defense Computer Resources Technology Plan. This plan ties the software cost reduction programs of all services together to achieve maximum benefits from invested funds by eliminating duplicative efforts. Program Element 63728F, along with related 6.2 and 6.4 efforts, implements the Air Force portion of the DOD program and has thrusts in six distinct areas: (1) Life Cycle Management - to develop automated aids to effectively transform user needs into specifications for systems with embedded computer resources, prepare basic designs meeting these specifications and, evaluate the impact of proposed changes in specifications or design on overall system capabilities, complexity, and cost; (2) Software Data Collection and Analysis - to collect and analyze software acquisition and maintenance data as a probe into high cost/high error areas of software, to develop mathematical models of the software acquisition and maintenance processes based on the collected data in order to predict software life cycle cost and support requirements; (3) Computer Architecture Applications - to evaluate Air Force computer architecture needs and assess commercially available technology to meet these needs, to develop and demonstrate effective techniques to incorporate and maintain microprocessors in weapon systems; (4) Distributed System Reliability and Survivability - to simulate distributed Command, Control, and Communications (C^3) systems configured for strategic and tactical applications, to develop techniques to design, test, and validate such configurations and to evaluate system performance under stress; (5) Software Engineering Tools and Methods - to develop and demonstrate advanced techniques which provide automated programming aids for documentation, management control, and reuse of proven software modules, to demonstrate the technology for making programming aids available to geographically separated users; (6) High Order Computer Language Discipline - to provide techniques and aids to control the configuration of the Air Force standard computer language, J-73, to support the DOD High Order Computer Language Commonality Program for evaluating and implementing the proposed DOD-wide standard language, Ada.

RELATED ACTIVITIES: This program supports the DOD Defense Computer Resources Technology Plan and the DOD High Order Computer Language Commonality Program. It is related to other programs which constitute the DOD Software Science and Technology Program: 62701A, Communications Electronics; 62725A, Computer and Information Sciences; 63723A, Automatic Data Processing Equipment Development, 62721N, Command and Control Technology; 63526N, Advanced Computer Technology; 62708E, Distributed Information Systems; 62702F, Command, Control and Communications; 62204F, Aerospace Avionics; and 64740F, Computer Resources Management Technology. Air Force thrusts are coordinated internally through technical reviews at the staff and engineering levels, and with other services through technical and apportionment reviews. Computer language efforts are coordinated through the DOD High Order Language Working Group.

Program Element: #63728F
DOD Mission Area: Electronic and Physical Sciences (ATD), #551

Title: Advanced Computer Technology
Budget Activity: Advanced Technology Development #2

WORK PERFORMED BY: Rome Air Development Center, Griffiss AFB NY has management responsibility for this program. Contractors include: Massachusetts Computer Associates, Wakefield MA; Gagliardi Systems Group, Salem NH; Stanford Research Institute, Menlo Park CA; Softech, Waltham MA; Illinois Institute of Technology Research Institute, Chicago IL; Pattern Analysis and Recognition, Rome NY; and TRW, Redondo Beach CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: The Data and Analysis Center for Software began to collect data for use in developing software cost and reliability models. The National Software Works (NSW) operations center was established to improve system documentation, user interface and network availability; this effort was a precursor to the planned joint demonstration involving Air Force Systems Command and Air Force Logistics Command. An IBM 360 compiler was developed to be used with the revised Air Force standard programming language (J-73). A tailored software development standard for use by Electronic Systems Division program offices was completed and distributed. Automated verification systems for the FORTRAN and JOVIAL languages were completed and supplied to a number of Air Force and DOD users.

2. FY 1980 PROGRAM: Efforts started in previous years will continue or expand. (1) Collection of software data on new systems in the design phase and selected systems being maintained in the field at Air Logistics Centers (ALCs) will continue. (2) The NSW demonstration will expand to include several ALCs in order to assess NSW usefulness as an aid to software maintenance in the field. (3) Support of the JOVIAL J-73 language will continue with further compiler development and demonstration of an improved set of JOVIAL programming tools on applicable programs. Specific FY 1980 starts include the following: (1) Design of a software reliability model will pick up on earlier development work. (2) Development of automated program verification tools for the COBOL language. (3) Development of a simulation capability to improve and demonstrate reliability, survivability, expandability and security technologies for distributed Command, Control and Communications (C^3) systems. (4) Development of a multiple microprocessor emulation system on which tradeoffs between hardware, software and firmware as they apply to modular computer systems can be evaluated. Programming and verification tools for the J-73 and COBOL languages will be developed so as to allow maximum compatibility with or translation to the Ada language.

3. FY 1981 PLANNED PROGRAM: (1) Complete language support work on JOVIAL J-73 and transition the Language Control Facility to the Aeronautical Systems Division. (2) Continue collecting software data to provide a basis for development of empirical models and to assess the effectiveness of new techniques in the software development process. (3) Continue joint demonstration of the NSW with the Air Force Logistics Command ALCs. (4) Continue development of the simulation capability to develop and demonstrate technologies for distributed C^3 systems. (5) Continue development of the multiple microprocessor emulation system. (6) Begin development of a software cost estimation model to assist program managers during the acquisition process. (7) Begin development of a computer based technology for the generation and validation of system and software specifications.

Program Element: #63728F
DOD Mission Area: Electronic and Physical Sciences (ATD), #551

Title: Advanced Computer Technology
Budget Activity: Advanced Technology Development #2

4. FY 1982 PLANNED PROGRAM: The National Software Works demonstration will terminate with transition to the using community. The Software reliability model development will be completed and a functional demonstration will be conducted. Development of the COBOL automated program verification system will be completed. Work will continue on distributed processing simulation with initiation of a demonstration on a candidate C^3 acquisition program. Development efforts will continue on the multiple microprocessor emulation facility, on the automated testing capability for software specifications and on the software cost estimation model; these efforts will proceed toward completion in FY 1983. The Ada root compiler and programming support aids will be completed and follow-on rehosting of the compiler to additional computer systems will begin. A demonstration of software aids will begin which will allow field commanders interactive access to distributed tactical data for force management.

5. PROGRAM TO COMPLETION: This is a continuing program.

6. MILESTONES: Not Applicable.

7. RESOURCES: Not Applicable.

8. COMPARISON WITH FY 1980 BUDGET DATA:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional Estimate	Total Estimate Costs
	TOTAL FOR PROGRAM ELEMENT	2,700	3,440	2,700	5,200	Continuing	Not Applicable
2527	Life Cycle Management	220	40	---	300		
2528	Software Data Collection and Analysis	260	400	300	500		
2529	Computer Architecture Applications	380	520	300	1,000		
2530	Computer System Reliability and Survivability	---	---	100	1,100		
2531	Software Engineering Tools and Methods	1,240	830	800	1,000		
2532	High Order Computer Language Discipline	600	1,650	1,200	1,300		

$1.5M added by the Congress in FY 1980 will allow early starts in areas such as the distributed processing system simulator and the multiple microprocessor emulation facility. The decrease in FY 1981 from last years descriptive summary will limit new starts in the area of automated software design techniques.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63743F
Title: Electro-Optical Warfare
DOD Mission Area: Electronic & Physical Sciences (ATD), #551
Budget Activity: Advanced Technology Development, #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7,370	8,600	11,800	19,700	Continuing	Not Applicable
4316	Electro-Optical Warfare	5,470	6,900	10,100	19,700	Continuing	Not Applicable
2222	Advanced Electro-Optical Countermeasures	1,900	1,700	1,700			16,300

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element develops countermeasures against visually, electro-optically or infrared aimed or guided surface-to-air and air-to-air weapons. Current Soviet antiaircraft artillery (AAA) and radar directed surface-to-air missile (SAM) systems use some form of optics as a backup to the radar when the radar is jammed or ineffective. In addition, shoulder fired SAMs and air launched missiles have been developed to home on engine radiation. Both strategic and tactical aircraft that operate over or near hostile territory may be exposed to these weapons.

BASIS FOR FY 1981 RDT&E REQUEST: This is a technology base program providing risk reduction and feasibility/military worth demonstrations of a broad spectrum of electro-optical (EO) warfare techniques, components, and systems. Both generic applications and support to specific weapon systems are provided. Continued changes in enemy air defense doctrine and expanding use of EO equipment dictate maintenance of a strong technology base in the electro-optical countermeasures (EOCM) field. Major efforts to be completed include the COMPASS HAMMER EOCM Pod, and missile warning for Close Air Support Aircraft. New starts are planned for flare improvements, infrared signature suppression, EOCM risk/cost reduction and weapon countermeasures.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #63743F
DOD Mission Area: Electronic & Physical Sciences (ATD), #551

Title: Electro-Optical Warfare
Budget Activity: Advanced Technology Development, #2

DETAILED BACKGROUND AND DESCRIPTION: Modern air warfare is dominated by the presence of a myriad of electronic and electro-optical (EO) devices that locate, monitor, guide, and control the offensive and defensive elements. Denial of enemy use of EO devices while retaining combat capability for our own systems is the function of EO Warfare. The survivability of our aircrews and the number of weapons delivered to the target are directly relatable to the efficiency of our EO warfare systems. It is axiomatic that an enemy faced with a strong EO warfare capability will attempt to enhance his capability through changes in tactics and improved equipment. To gain and maintain an advantage requires a strong EO warfare technology program to provide demonstrated alternatives that counter any initiative made by the enemy defense.

Hardware and techniques developed under this program are structured into four generic classes with a supporting analysis and simulation effort that guides the allocation of funding through the evaluation of new concepts and techniques. The four hardware areas are: (1) camouflage to prevent or delay detection of US Air Force aircraft; (2) receiver systems on aircraft to warn crew members and activate countermeasures; (3) decoys and jammers to counter enemy air defense weapons; and (4) optical intelligence (OPTINT) collection devices to gain information about enemy weapons.

RELATED ACTIVITIES: The efforts in this program are closely coordinated with other Air Force EO, electronic warfare, and reconnaissance and target acquisition programs, as well as the advanced development work in these areas conducted by the Army and the Navy. Maximum utilization of common optical hardware and techniques is stressed; equipment developed under other programs is modified only enough to perform those functions peculiar to the countermeasures problem. New developments are undertaken only when the technology base does not exist to satisfy the specific function required. Exploratory development efforts are phased into this program from Program Element (PE) 62204F, Aerospace Avionics. Completed EO efforts are transitioned into engineering development under PE 64710F, Reconnaissance Equipment; PE 64738F, Protective Systems; and PE 64739F, Tactical Protective Systems. Joint Air Force/Navy efforts include the Advanced EO countermeasure pod, COMPASS HAMMER; a low cost tail warning receiver development; and aircraft infrared signature reduction. Joint Air Force/Army efforts include optical target discrimination and visual countermeasure effects. Tri-service efforts include warning receivers.

WORK PERFORMED BY: Testing is performed at the Air Force Armament Division, Eglin AFB, FL and China Lake, CA. The Air Force Avionics Laboratory, Wright-Patterson AFB, OH, manages the program. The major contractors are: Raytheon Corporation, Bedford, MA - analysis and simulation; AVCO Corporation, Wilmington, MA - flare material and dispensers; HYCOR Corporation, Woburn, MA - flares; MB Associates, San Ramon, CA - flare research and testing; Quest Research, Nash, DC - EO countermeasure technique analysis; Perkin-Elmer Corporation, Wilton, CT - optical receivers; Hughes Aircraft Corporation, Culver City, CA - infrared jammers; Honeywell Inc., Lexington, MA - missile warning system; Martin-Marietta Corporation, Orlando, FL - optical countermeasures; Westinghouse Corporation, Baltimore, MD - optical countermeasures; SCIPAR, Buffalo, NY - camouflage techniques; and SAI, Albuquerque, NM - EOCM effectiveness evaluation.

Program Element: #63743F
DOD Mission Area: Electronic & Physical Sciences (ATD), #551

Title: Electro-Optical Warfare
Budget Activity: Advanced Technology Development, #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Prior year accomplishments include flight test of aircraft camouflage techniques, development of an improved flare for the and F-4 using flare materials, ground and flight demonstration of an airborne for use against infrared (IR) guided missiles, system integration and evaluation of the advanced electro-optical (EO) countermeasure (CM) pod, and flight test of an improved pyrotechnic flare for the F-111, flight test of a more efficient flare for the A-10 to double the flare carrying capacity, an aircraft camouflage handbook, and a radar tail warning system for strategic and tactical aircraft.

2. FY 1980 Program: The FY 1980 efforts consist of the continuation and completion of development efforts began in previous years as well as new starts. Tasks that will continue in FY 1980 include: simulation of new visual and infrared countermeasure (IRCM) techniques; electro-optical signature reduction for advanced fighter aircraft; fabrication of a missile warning system for close air support aircraft; flight test demonstration of the advanced electro-optical CM pod; development of a search system for the electro-optical CM pod and missile optical target detection and tracking systems. The new starts for FY 1980 include: a countermeasure source for electro-optical CM systems; passive optical and IR signature reduction for advanced aircraft; a chemical pump to be used in the Infrared Demonstration System to significantly reduce the size and improve performance; flight test of warning receiver; and EO cued weapon delivery system definition. Scheduled for completion are: analysis of IRCM requirements, flight test of metered flare containers for the and F-4, flight test of low cost optical intelligence receiver, countermeasure demonstraion, and low cost tail warning system flight test.

3. FY 1981 Planned Program: The FY 1981 program will consist of continuation and completion of prior year starts as well as new starts. Continued efforts include: EO and IR countermeasure effectiveness evaluation, risk reduction for (EO) countermeasure sources for target search/acquisition and jamming; and design of the missile optical target detection and tracking system. New starts in FY 1981 include: a combination flare/chaff unit to increase survivability against dual mode missile seekers, multi-unit flares to increase number of flares per mission, flares for advanced aircraft or cruise missles, an aircraft IR suppression system using aerosols, EO target cueing for weapon delivery systems, weapon countermeasure requirements study, a spherical coverage missile warning demonstration system, and integrated EO/IR/Radio Frequency countermeasures systems concepts (jointly funded with Program Element 63718F). Efforts to be completed include: flight test of the dual mode (radar/IR) missile tail warning system for close air support, completion of the Navy flight testing of the COMPASS HAMMER EOCM pods, and test of a selectable frequency EO target search and detection system for COMPASS HAMMER follow on systems, and flight test of warning receivers.

Program Element: #63743F Title: Electro-Optical Warfare
DOD Mission Area: Electronic & Physical Sciences (ATD), #551 Budget Activity: Advanced Technology Development, #2

4. FY 1982 Planned Program: The FY 1982 program represents a major increase in funding to continue and accelerate development of critical electro-optical (EO), infrared (IR) and countermeasure (CM) technologies. heavy emphasis will be placed on the development of second generation EOCM sources, recievers and signal processors which are necessary to reduce the size, cost, risk and improve performance before engineering development can begin. With the completion of flight tests of the COMPASS HAMMER system in FY 1981, accelerated development of EOCM systems should be prudent. EOCM development will include non-lethal countermeasures as well as and weapon cueing. IRCM efforts include multi-spectral signature suppression, forward fired flares, spherical coverage missle warning system to warn against advanced passive multi-mode missles. CM efforts include advanced warning receiver sensors and signature reduction. New starts are planned in EOCM cost and risk reduction, a requirement study for strategic EOCM systems, improved IR detectors using focal plane arrays for higher sensitivity and CM against weapon systems.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	8,700	7,000	8,600	12,000	Continuing	Not Applicable
Project 431G	6,500	5,100	6,900	12,000	Continuing	Not Applicable
Project 2222	2,200	1,900	1,700			14,900

FY 1979: FY 1979 funding was increased by $370 thousand. This was a result of reprogramming action to fund a special in-house computer facility at the Air Force Avionics Laboratory which performs electro-optical warfare simulation support.

FY 1980: No change.

FY 1981: FY 1981 funding represents a $200 thousand decrease recommended during the budget formulation process. In addition a shift of funds from Project 431G to Project 2222 was necessary in order to fund additional flight test costs and completion of Project 2222 activity.

Project: 4310 Title: Electro-Optical Warfare
Program Element: #63743F Title: Electro-Optical Warfare
DOD Mission Area: Electronic & Physical Sciences (ATD), #551 Budget Activity: Advanced Technology Development, #2

DETAILED BACKGROUND AND DESCRIPTION: Modern air warfare is dominated by the presence of a myriad of electronic and electro-optical (EO) devices that locate, monitor, guide, and control the offensive and defensive elements. Denial of enemy use of EO devices while retaining combat capability for our own systems is the function of EO Warfare. The survivability of our aircrews and the number of weapons delivered to the target are directly relatable to the efficiency of our EO warfare systems. It is axiomatic that an enemy faced with a strong EO warfare capability will attempt to enhance his capability through changes in tactics and improved equipment. To gain and maintain an advantage requires a strong EO warfare technology program to provide demonstrated alternatives that counter any initiative made by the enemy defense.

Hardware and techniques developed under this program are structured into four generic classes with a supporting analysis and simulation effort that guides the allocation of funding through the evaluation of new concepts and techniques. The four hardware areas are: (1) camouflage to prevent or delay detection of US Air Force aircraft; (2) receiver systems on aircraft to warn crew members and activate countermeasures; (3) decoys and jammers to counter enemy air defense weapons; and (4) optical intelligence (OPTINT) collection devices to gain information about enemy weapons.

RELATED ACTIVITIES: The efforts in this program are closely coordinated with other Air Force EO, electronic warfare, and reconnaissance target acquisition programs, as well as the advanced development work in these areas conducted by the Army and Navy. Maximum utilization of common optical hardware and techniques is stressed; equipment developed under other programs is modified only enough to perform those functions peculiar to the countermeasures problem. New developments are undertaken only when the technology base does not exist to satisfy the specific function required. Exploratory development efforts are phased into this program from Program Element (PE) 62204F, Aerospace Avionics. Completed EO efforts are transitioned into engineering development under PE 64710F, Reconnaissance Equipment; PE 64738F, Protective Systems; and PE 64739F, Tactical Protective Systems. Joint Air Force/Navy efforts include the Advanced EO countermeasure pod, COMPASS HAMMER; a low cost tail warning receiver development; and aircraft infrared signature reduction. Joint Air Force/Army efforts include optical target discrimination and visual countermeasure effects. Tri-service efforts include warning receivers.

WORK PERFORMED BY: Testing is performed at the Air Force Armament Division, Eglin AFB, FL and China Lake, CA. The Air Force Avionics Laboratory, Wright-Patterson AFB, OH, manages the program. The major contractors are: Raytheon Corporation, Bedford, MA - analysis and simulation; AVCO Corporation, Wilmington, MA - flare material and dispensers; HYCOR Corporation, Woburn, MA - flares; MB Assocates, San Ramon, CA - flare research and testing; Quest Research, Wash, DC - EO countermeasure technique analysis; Perkin-Elmer Corporation, Wilton, CT - optical receivers; Hughes Aircraft Corporation, Culver City, CA - infrared jammers; Honeywell Inc., Lexington, MA - missile warning system; Martin-Marietta Corporation, Orlando, FL - optical countermeasures; Westinghouse Corporation, Baltimore, MD - optical countermeasures; SCIPAR, Buffalo, NY - camouflage techniques; and SAI, Albuquerque, NM - EOCM effectiveness evaluation.

Project: 431G
Program Element: #63743F
DOD Mission Area: Electronic & Physical Sciences (ATD), #551

Title: Electro-Optical Warfare
Title: Electro-Optical Warfare
Budget Activity: Advanced Technology Development, #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Prior year accomplishments include flight test of aircraft camouflage technique; paint colors and patterns for various tactical aircraft; development of an improved flare for the high intensity flare materials; ground and flight demonstration of an airborne for use against infrared (IR) guided missiles; flight testing of improved flare for the F-4; and flight test of an improved pyrotechnic flare for the F-111, flight test of a more efficient pyrotechnic flare for the A-10 to double the flare carrying capacity; and an aircraft camouflage handbook.

2. FY 1980 Program: The FY 1980 efforts consist of the continuation and completion of development efforts began in previous years as well as new starts. Tasks that will continue in FY 1980 include: simulation of new visual and infrared countermeasure (IRCM) techniques; electro-optical (EO) signature reduction for advanced fighter aircraft; fabrication of a dual mode low false alarm, missile warning system for close air support aircraft; and missile optical target detection and tracking systems. The new starts for FY 1980 include: passive optical and IR signature reduction for advanced aircraft; a chemical pump to be used in the Infrared Demonstration System to significantly reduce the size and improve performance; flight test of warning receivers testing of improved system; and EO cued weapon delivery system definition. Scheduled for completion are: analysis of IRCM requirements; flight test of metered flare containers for the and F-4; flight test of low cost optical intelligence receiver; high energy countermeasure demonstration; and low cost tail warning system flight test.

3. FY 1981 Planned Program: The FY 1981 program will consist of continuation and completion of prior year starts as well as new starts. Continued efforts include: electro-optical and infrared countermeasure effectiveness evaluation, risk reduction for EO countermeasure sources for target search/acquisition and jamming, fabrication of the chemical pump for the to be used in the Infrared Demonstration system; and design of the missile optical target detection and tracking system. New starts in FY 1981 include: a combination flare/chaff unit to increase survivability against dual mode missile seekers, multi-unit flares to increase number of flares per mission, flares for advanced aircraft or cruise missles, an aircraft IR suppression system using aerosols, EO target cueing for weapon delivery systems,
weapon countermeasure requirements study, a spherical coverage missile warning demonstration system, and integrated EO/IR/Radio Frequency countermeasures systems concepts (jointly funded with Program Element 63718F). Efforts to be completed include: flight test of the dual mode (radar/IR) missile tail warning system for close air support , test of a selectable frequency EO target search and detection system for COMPASS HAMMER follow on systems, and flight test of warning receivers.

Project: 431G
Program Element: #63743F
DOD Mission Area: Electronic & Physical Sciences (ATD), #551

Title: Electro-Optical Warfare
Title: Electro-Optical Warfare
Budget Activity: Advanced Technology Development, #2

4. FY 1982 Planned Program: The FY 1982 program represents a major increase in funding to continue and accelerate development of critical electro-optical (EO), infrared (IR) and countermeasure (CM) technologies. heavy emphasis will be placed on the development of second generation EOCM sources, recievers and signal processors which are necessary to reduce the size, cost, risk and improve performance before engineering development can begin. With the completion of flight tests of the COMPASS HAMMER system in FY 1981, accelerated development of EOCM systems should be prudent. EOCM development will include non-lethal countermeasures as well as and weapon cueing. IRCM efforts include multi-spectral signature suppression, forward fired flares, spherical coverage missle warning system to warn against advanced passive multi-mode missles. CM efforts include advanced warning receiver sensors and signature reduction. New starts are planned in EOCM cost and risk reduction, a requirement study for strategic EOCM systems, improved IR detectors using focal plane arrays for higher sensitivity and CM against weapon systems.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to completion	Total Estimated Costs
431G	Electro-Optical Warfare	5,470	6,900	10,100	19,700	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Project 431G	6,500	5,100	6,900	12,000	Continuing	Not Applicable

FY 1979: FY 1979 funding was increased by $370 thousand. This was a result of reprogramming action to fund a special in-house computer facility at the Air Force Avionics Laboratory which performs electronic warfare simulator support.

FY 1980: No change.

FY 1981: FY 1981 funding represents a $1,900 thousand decrease. This is a result of transfer of $1,700 thousand to Project 2222 to complete funding of the COMPASS HAMMER flight tests which have been delayed by technical problems. There is a net decrease of $200 thousand to Project 431G which will delay electro-optical countermeasure risk reduction efforts.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63750F
Title: Counter-Countermeasures (CCM) Advanced Development
DoD Mission Area: Electronic & Physical Sciences (ATD), #551
Budget Activity: Advanced Technology Development, #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 ACTUAL	FY 1980 Estimated	FY 1981 Estimated	FY 1982 Estimated	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4,250	5,200	5,760	6,300		
2333	Ground Radar Electronic Counter-Countermeasures	1,300	800	1,060	1,300	Continuing	Not Applicable
2334	Airborne Radar Electronic Counter-Countermeasures	1,400	2,300	2,500	2,300	Continuing	Not Applicable
2335	Communication & Navigation Electronic Counter-Countermeasures	550	1,050	1,000	1,300	Continuing	Not Applicable
2347	Optical Counter-Countermeasures	1,000	1,050	1,200	1,400	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program will develop advanced counter-countermeasures (CCM) capabilities to enhance the performance of aerospace equipments in operational conditions degraded by electronic countermeasures (ECM) and optical countermeasures (OCM). This program will capitalize on demonstrated technology, and systematically develop low cost capabilities to address the increasing ECM/OCM threat. CCM features will be developed for wide application to new or existing radar, communication, and optical equipments.

BASIS FOR FY 1981 RDT&E REQUEST: Advanced development of promising CCM techniques is continued to bridge the gap between exploratory and engineering development. A phased array antenna and signal processor for troposcatter communications will complete test and evaluation and transition to engineering development. Development of a low cost anti-radiation missile decoy for tactical surveillance radars will continue. Development of anti-jam features for very low frequency communication systems will be completed. Development will begin for a low cost data link for transmission/distribution of command and control messages in an ECM environment. Work will continue on development of an air-to-air radar CCM technology baseline and a wide range of developmental tasks associated with reducing the vulnerability of electro-optical/infrared receivers and weapons.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63750F
DoD Mission Area: Electronic & Physical Sciences (ATD), #551

Title: Counter-Countermeasures (CCM) Advanced Development
Budget Activity: Advanced Technology Developments #2

DETAILED BACKGROUND AND DESCRIPTION: This program element (PE) was established to counter an increasing countermeasure (CM) threat as documented by requirements arising from Southeast Asia, the Middle East, and threat projections for Central Europe. Some current US electronic equipments require discrete counter-countermeasures (CCM) modifications to keep pace with the threat and to extend their useful operational life in jamming, deception, chaff, clutter or suppression environments: thereby avoiding more expensive system replacement programs. Future radar, radio, and optical equipments will benefit from early, systematic, and economical incorporation of state-of-the-art CCM capabilities during their design state. Programmable processing that will allow changes via software will allow future systems to more readily keep pace with the threat. However, a continuing program to develop new software and in some cases, hardware, will be required if the Air Force is to operate effectively in a hostile electromagnetic combat environment.

Program Element #63750F contains four projects: #2333, Ground Radar Electronic Counter-Countermeasures; #2334, Airborne Radar Electronic Counter-Countermeasures; #2335, Communications & Navigation Electronic Counter-Countermeasures; and #2347, Optical Counter-Countermeasures. Tasks scheduled under these projects will cross-apply appropriate, demonstrated technologies to develop wide application of CCM techniques for existing and developmental systems. The following general task areas will be used: simulation and analysis, waveform generation, signal radiation and reception, signal discrimination and enhancement, survivability enhancement technology, electro-optical (E-O), laser, and infrared vulnerability assessments.

RELATED ACTIVITIES: This program will affect strategic offense and defense and general purpose force activities, and responds to a wide range of requirements. Technical coordination will be effected with laboratories and commands of the Navy and Army, as well as in-house Air Force technical agencies and facilities and the operational commands. PE 64201, Aircraft Avionics Equipment Development is developing advanced software for aircraft radars with programmable signal processors (e.g., F-15). PE 63750F, Project 2334 will feed that effort. PE 63727F, Advanced Communication Technology contains advanced development in CCM for E-O glide bomb (GBU-15) guidance and imaging sensor data link.

WORKED/PERFORMED BY: Rome Air Development Center, Rome NY has program management responsibility and project responsibility for ground radar and communication/navigation CCM; the Air Force Avionics Laboratory, Wright-Patterson AFB, OH has project responsibility for airborne radar CCM and optical CCM. Specific tasks will be performed by Air Force computer simulation facilities or other agencies possessing necessary expertise or resources. Some tasks will be performed under contract. The low cost decoy effort is on contract to Brunswick Corp., Costa Mesa, CA; the Tropo Communication Antenna and Porcessor is on contract to CNR Incorporated, Needham, MA. The very low frequency antenna receive system is on contract to AIL division of Eaton Corp., and the Air-to-Air Radar Baseline Technology contract is with Hughes Aircraft Corp., Los Angeles, CA. Optical CCM contracts are to Mead Technology Laboratories Dayton, OH; Science Applications Corp., La Jolla, CA; Hughes Aircraft, Cluver City, CA; Honeywell Corp., Boston, MA; and Systems Research Laboratory, Dayton, OH.

Program Element: #63750F
DOD Mission Area: Electronic & Physical Sciences (ATD), #551

Title: Counter-Countermeasures (CCM) Advanced Development
Budget Activity: Advanced Technology Development, #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments:

Project #2333: A signal processor (using spread spectrum technology) for a Digitally Coded Radar was developed in conjunction with Program Element (PE) 63789F, command, control, and communications advanced development. Development was completed on an Ultra Low Sidelobe Antenna for

Anti-Radiation

Missile (ARM) Alarm sensor development was completed.

Project #2334: Development began on the air-to-air counter-measures (CCM) technology baseline to determine electronic CCM techniques applicable to modern pulse doppler digital radars and to establish quantitative engineering baseline data. Radar test units were instrumented. Enemy electronic countermeasures threat scenarios have been developed.

Project #2335: Development was initiated on a Phased Array Receive Antenna and Adaptive Signal Processor for Tropo-scatter Communications.

Design of a very

low frequency/high frequency adaptive antenna receiver system for was begun.

Project #2347: (Previously Project 405C, PE 63743F). Tasks were initiated to reduce the vulnerability of imaging electro-optical (E-O) receivers to flares and spoofers; develop a mathematical model of the acquisition/tracking system for laser guided weapons and develop new techniques for modulation and coding, use of reduction; conduct a vulnerability assessment of E-O receivers and illuminators; compare optical target and decoy signatures; reduce to defeat laser counter-measures; and develop second generation coding schemes for laser signal discrimination and rejection of jammers.

2. FY 1980 Program:

Project #2333: Development will continue on a low cost ARM Decoy for type radars.

Development will begin on a main beam noise cancellation capability for the type radars. Ultra Low Sidelobe Antenna and ARM alarm have been transferred to PE 27412F, Tactical Air Control System Improvements for Engineering Development.

Project #2344: Continue development of a quantitative air-to-air radar CCM technology baseline which will be used to reduce the electronic countermeasures susceptibility of current/future airborne radar systems. The instrumented F-15 radar will complete system checkout and commence ground testing.

Program Element: #63750F
DOD Mission Area: Electronic & Physical Sciences (ATD), #551

Title: Counter-Countermeasures (CCM) Advanced Development
Budget Activity: Advanced Technology Development, #2

Project #2335: Complete the design of Troposcatter Communications Adaptive Antenna and compelentary Adaptive Signal Processor. Start fabrication of Adaptive Antenna Procesor for Tactical Troposcatter Communications System. Start development of a sidelobe canceller as near term fix for Complete very low frequency/high frequency (VLF/HF) adaptive antenna for design and start development of prototype system.

Project #2347: Initiate target discriminating receiver demonstration and wide dynamic range receiver processor development.

3. FY 1981 Planned Program:

Project #2333: Continue development of the low cost Anti-Radiation Missile (ARM) Decoy. Continue development of main beam noise cancellation capability.

Project #2334: Commence roofhouse and flight testing of instrumented F-15 radar in electronic countermeasures environment.

Project #2335: Complete test and evaluation of the troposcatter communication antenna and signal processor and tranеition to Full Scale Engineering Development (FSED). Complete development of sidelobe canceller and start field testing. Continue development of VLF/HF adaptive antenna. Start development of an advanced low cost jam resistant multi-function tactical command, control, and communications data link family. Start development of a new Troposcatter Communications System with a full duplex capability.

Project $2347: Complete laser guided weapon counter-countermeasures alternatives development. Continue target discriminating receiver demonstration and development. Initiate imaging receiver susceptibility reduction.

4. FY 1982 Planned Program:

Project #2333: Complete testing of the low cost ARM Decoy. Continue development of the main beam noise canceller. Initiate development of passive correlation techniques for improved electronic counter-countermeasures.

Project #2334: Complete air-to-air baseline program and commence air-to-surface program.

Project #2335: Complete testing of VLF/HF terminal and antenna, transition to full scale engineering development. Continue development of low cost tactical data link family. Complete Troposcatter Communication System development and transition to FSED. Start airborne communication development.

Program Element: #63750F Title: Counter-Countermeasures (CCM) Advanced Development
DOD Mission Area: Electronic & Physical Sciences (ATD), Budget Activity: Advanced Technology Development, #2

Project #2347: Complete target discriminating receiver demonstration and laser signature reduction development.

5. Program to Completion: This is a continuing program. Project #2333 will complete development of main beam noise cancellers for ground radars and initiate development of a programmable multiple threat generator to simulate a variety of threat systems. Project #2334 will identify electronic countermeasures (ECCM) vulnerabilities and techniques for airborne surveillance, fire control, and air-to-air missile radars and will apply spread-spectrum waveform processing and radar beam quality enhancements to coherent (Pulse Doppler) airborne radars. Air-to-Surface radar ECCM will be developed. Project #2335 will complete development of a Very Low Frequency (VLF) Adaptive Antenna Processor by fabricating and testing a 100 Kilowatt frequency agility system for demonstrating the feasibility of high power and high speed frequency switching across the 27-60 kilohertz band. The goal is to achieve switching times on the order of between two frequencies at extreme ends of the band. Also, work will start on developing ECCM capabilities for high frequency communications, Tactical Air Navigation, and the MARK XII Identification-Friend or Foe system. Project #2347 will complete vulnerabilities testing of optical systems to all countermeasure threats and initiate development of counter-countermeasure technology in 17 task areas currently identified.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 80 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	Total for Program Element	3,150	4,250	5,200	5,600		
2333	Ground Radar Electronic Counter-Countermeasures	1,300	1,400	800	600	Continuing	Not Applicable
2334	Airborne Electronic Counter-Countermeasures	550	1,315	2,300	2,000	Continuing	Not Applicable
2335	Communications & Navigation Electronic Counter-Countermeasures	400	590	1,050	800	Continuing	Not Applicable
2347	Optical Counter-Countermeasures	650	945	1,050	1,200	Continuing	Not Applicable
2435	Joint Service E-O Guided Weapons Countermeasures/Optical Countermeasures Test Program	250			1,000	Continuing	Not Applicable

Program Element: #63750F Title: Counter-countermeasures (CCM) Advanced Development
DOD Mission Area: Electronic and Physical Sciences (ATD), #551 Budget Activity: Advanced Technology Development #2

One hundred thousand dollars of increased FY 1981 estimate is to cover costs associated with the development of Low Cost Jam Resistant Data Links. The remainder of the cost increase for the FY 1981 estimate is due to inflation. FY 1981 funds for Project 2435 were moved to support Project 2333, 2334, and 2335. Funding for the Joint Services Electro-Optical (E-O) Guided Weapons Countermeasures/Optical Countermeasures Test Program will be funded by Director of Defense Test and Evaluation Appropriation 65804D and, therefore, Project 2435 has been dropped from this Program Element.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63751F Title: Innovation in Education and Training

DoD Mission Area: Environmental and Life Sciences (ATD) #552 Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,700	1,600	1,700	2,700	Continuing	Not Applicable
1959	Advanced Systems for Human Resources Support of Weapon System Development	500	200	100	200		1,900
2359	Pilot Performance Measurement	300	300	300	500	1,200	2,700
2361	Maintenance Training Simulation	600	800	800	700	1,500	5,500
2362	Computer-Based Maintenance Aids	300	300	300	400	1,100	2,500
2557	Integrated Training Management System			200	900	7,000	8,100

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program consists of efforts grouped under the following three categories: HUMAN FACTORS, EDUCATION AND TRAINING, and TRAINING DEVICES AND SIMULATORS. The Air Force must develop innovative ways of lowering training costs while actually improving training and the skill level of Air Force personnel. Similarly, rapidly increasing operation and support costs of weapon systems make it imperative for the Air Force, during the acquisition cycle, to build characteristics into the weapon system that should lower these costs. This program is designed to develop technology and procedures needed to improve the value of flight simulators in pilot training through application of automated measurement of pilot performance; increase technical training productivity through the use of training simulators rather than operational equipment; reduce student school house time; improve on-the-job training methods and improve the quality of technical school graduates; reduce operation and support costs of weapon systems by impacting design decisions at early stages of system development; and increase the productivity of maintenance technicians through the development and application of a computer-based technical documentation system.

Program Element: #63751F
Dod Mission Area: Environmental and Life Sciences (ATD) #552

Title: Innovations in Education and Training
Budget Activity: Advanced Technology Development #2

BASIS FOR FY 1981 RDT&E REQUEST: The major emphasis will be on (a) in project 1959, demonstration on an avionics system of all the separate technologies and the decision model required for applying manpower, personnel, training and logistics data in design decision alternatives; (b) in project 2362, development of a prototype computer-based maintenance aid to increase the productivity of Air Force maintenance personnel; (c) in project 2361, determination of the utility, reliability, and cost effectiveness of maintenance training simulation for aircraft, missile and flight simulators; (d) in project 2359, development and evaluation of an automated aircrew performance measurement system to be used both in the C-5 aircraft and C-5 simulator; and (e) in project 2557, development of an integrated training system for on-the-job training which will include delivery systems, evaluation methods, management systems and techniques.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #63751F
DoD Mission Area: Environmental and Life Sciences (ATD) #552

Title: Innovations in Education and Training
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: The current program contains three basic categories of research and development: (1) HUMAN FACTORS - Project 1959 demonstrates techniques for predicting and controlling manpwer, personnel and training costs of weapon system ownership as a function of weapon system design characteristics. The techniques, when applied early in the system acquisition process, provide human resource support cost predictions for each design alternative which can be applied in trade-off analysis; (2) EDUCATION AND TRAINING - Project 2362 provides a prototype computer-based maintenance aid which includes a portable, interactive computer terminal located at the aircraft that interfaces with a reorganized, computer-based tech data system. The system will substantially reduce technical data search and retrieval time and improve repair quality and time to completion. Project 2557 will develop computer-based systems for administration, management, and delivery of instruction in new technical training applications with emphasis on identification of low cost approaches for the delivery and management of individualized instruction in On-The-Job Training and Field Training Detachments ; and (3) TRAINING DEVICES AND SIMULATORS - Project 2359 develops automated performance measurement techniques to optimize effectiveness of flight simulators. A capability for training managers to assess the effectiveness of their flight simulation training program will be developed. Project 2361 demonstrates applications of computer-based simulation technology for training Air Force maintenance personnel. Demonstration of the F-111 avionics test station simulator will continue and alternate devices will be evaluated to provide a comprehensive assessment of simulator fidelity requirements. User handbooks (guides) and model specifications for application in acquisition of new simulators will be developed. A strategic missile maintenance simulator and flight simulator troubleshooting trainer will also be developed.

RELATED ACTIVITIES: Related Air Force program elements are 61102F, Defense Research Sciences; 62205F, Training and Simulation Technology; and 63227F, Advanced Simulator Development. Navy and Army Program Elements are 62757N, Training and Human Engineering Technology; 63701N, Human Factors Engineering Technology; 63702N, Education and Training Development; 62722A, Army Training Technology; and 63743A, Training and Utilization in Military Systems. There is a Memorandum of Agreement with the Military Airlift Command that outlines responsibilities for development of the Pilot Performance Measurement System. The Air Force Human Resources Laboratory (AFHRL) is working directly with Air Training Command (ATC) in the demonstration and evaluation of the simulators for maintenance training. There is a tri-service working group presently assessing the total DoD effort in technology development of simulation for maintenance training. The Naval Personnel Research and Development Center (NPRDC) is conducting an effort titled: HARDMAN

Program Element: #63751F Title: Innovations in Education and Training
DoD Mission Area: Environmental and Life Sciences (ATD) #552 Budget Activity: Advanced Technology Development #2

The Air Force Human Resources Laboratory (AFHRL) manager for Project 1959 has coordinated efforts with the Navy HARDMAN manager. The Army Research Institute is planning a related effort. AFHRL has a Memorandum of Agreement with the Deputy for Avionics Control Board, Aeronautical Systems Division for evaluation of the Project 1959. The Navy Training and Equipment Center (NTEC) is conducting an effort to develop computer-based aids for maintenance training. A tri-service coordination meeting, hosted by NTEC, was held in March 1979.

WORK PERFORMED BY: The program is managed by AFHRL, headquartered at Brooks AFB TX, through the Advanced Systems Division, Wright-Patterson Air Force Base OH; Flying Training Division, Williams Air Force Base Az; and Technical Training Division, Lowry Air Force Base CO. These divisions are collocated with their primary Air Force customer so as to provide maximum technology transfer. The major contractors in FY 79 were: Logicon, Incorporated, San Deigo CA; Behavioral Technology Corporation, Silver Spring MD; Dynamics Research Corporation, Wilmington MA; Kinton, Incorporated, Alexandria VA; Honeywell, Incorporated, Minneapolis MN; and Denver Research Institute, Denver CO.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In the category of TRAINING DEVICES AND SIMULATION, modification of the Advanced Simulator for Pilot Training (ASPT) to an A-10 configuration for limited surface attack research demonstrated significant improvements in training and Research and Development (R&D) capability. In bombing practice in the actual aircraft, student pilots who received the simulator training often outscored their instructors who had not received the simulator training. All ASPT related efforts were transferred to Program Element (PE) 62205F in FY 1979. An assessment of the potential for application of simulators in technical training and an analysis of the Air Force maintenance training device acquisition system was completed, delivery of a prototype simulator for maintenance training devices was completed. In the category of HUMAN FACTORS, historical human resources data was collected on the C-130E aircraft, a consolidated data base was established, and a maintenance personnel availability analysis was conducted. This analysis resulted in a model for predicting required maintenance manpower as a function of rank, experience and skill level, and will be utilized in system design trade-off studies.

2. FY 1980 Program: In the category of TRAINING DEVICES AND SIMULATION, an automated pilot performance measurements system is being developed for C-5 aircraft simulators. Funds have also been allocated for development of a field training simulator for flight simulator maintenance, maintenance and training effectiveness evaluation of the F-111 Test Station Simulator, assess a reduced-fidelity simulator, development of a strategic missile maintenance simulator, and a study of the applicability of graphic presentation as a lower level fidelity alternative for maintenance simulators. Preliminary (introductory) handbooks, model specifications and user guides for maintenance training equipment are being developed. In the category of HUMAN FACTORS, the test and evaluation phase will be continued for the integration and application of the methodology for utilizing human resources data in weapon system design. In the category of EDUCATION AND TRAINING, format and display requirements of the computer-based maintenance aid system are being completed and work is being initiated on the development and demonstration of the system.

Program Element: #63751F
DoD Mission Area: Environmental and Life Sciences (ATD) #552

Title: Innovation in Education and Training
Budget Activity: Advanced Technology Development #2

3. FY 1981 Planned Program: In the category of TRAINING DEVICES AND SIMULATION, the development of an automated pilot performance measurement system for the C-5 Simulator will be completed. An evaluation program to determine the utility of the system for the Military Airlift Command will be initiated, and the specifications for an in-flight C-5 aircrew measurement system will be defined. The development of a strategic missile maintenance simulator and a flight simulator maintenance simulator will continue. Evaluation of the F-111 Test Station Simulator will continue. The development of introductory user handbooks and maintenance training equipment model specifications for acquisition of new simulators will be completed. In the category of HUMAN FACTORS, the extensive test and evaluation of the methodology for utilizing human resources in weapon system design and development will be continued on an avionics system selected by the Aeronautical Systems Division. In the category of EDUCATION AND TRAINING, hardware and software development of the computer-based maintenance aid system will continue through FY 1983. Work will be initiated on the development of an integrated training system for the management, delivery, and evaluation systems of On-The-Job Training (OJT)

4. FY 1982 Planned Program: In the category of TRAINING DEVICES AND SIMULATION, an in-flight C-5 aircrew performance measurement system will be developed and the evaluation of the utility of the ground-based C-5 Simulator automated performance measurement system will continue. Other efforts will include continuation of the two-dimensional simulation studies, continued development of flight simulation and strategic missile maintenance training devices, studies on fidelity requirements for intermediate level maintenance training simulators, development of an electro-mechanical maintenance training simulator for missile maintenance personnel, and evaluation of these simulators. Work in the category of EDUCATION AND TRAINING will continue with an analysis of the field training environment to describe and assess the requirements for on-the-job training, its interface with resident training, and procedures used to design field training, leading to the development of a computer-based instructional delivery and management system for OJT. Development of computer-based maintenance aids system will continue.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

Program Element: #63751F Title: Innovation in Education and Training
DoD Mission Area: Environmental and Life Sciences (ATD) #552 Budget Activity: Advanced Technology Development #2

8. Comparison with FY 1980 Budget Data:

RESOURCES (Project Listing): ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	* 2,264	1,600	1,600	2,400	Continuing	Not Applicable
1193	Advanced Instructional System (AIS)	920					14,100
1959	Advanced Systems for Human Resources Support of Weapon System Development	461	460	200	100		1,700
2359	Pilot Performance Measurement	80	250	300	500	1,800	2,900
2361	Maintenance Training Simulation	698	600	800	1,100	2,600	6,400
2362	Computer-Based Maintenance Aids	105	290	300	500	1,700	2,900
2557	Applied Training Systems				200	4,850	5,100

* Does not include Project 1192 ($3,911K), reported in PE 62205.

The FY 1981 reduction of $0.7M results in a reduced level of effort in Projects 2359, 2361, and 2362.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63789F
DOD Mission Area: Electronic & Physical Sciences (ATD) #551

Title: Command, Control & Communications Advanced Development
Budget Activity: Advanced Technology Development #2

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	6,350	6,400	9,136	17,100	Continuing	Not Applicable
2314	Tactical Air Surveillance	2,250	2,000	2,900	4,700		
2315	Automated Tactical Intelligence	3,250	3,000	3,600	4,200		
2317	Tactical Info Proc & Distribution	350	400	1,100	3,300		
2321	Advanced Systems Concepts		100	436	3,100		
2478	Tactical C^3I Architecture	500	900	1,100	1,800		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This advanced development program provides solutions to selected command, control and communications operational needs and validated operational requirements. This involves the evaluation of technology, requirements analyses, conceptual system design, system engineering and fabrication of advanced development models for test and demonstration. In addition, this program provides for the transition from exploratory development to engineering development for those emergent projects that have demonstrated the potential to satisfy Air Force requirements. These requirements include a jam-resistant tactical air surveillance radar with an aircraft identification capability, the handling of intelligence data more efficiently and effectively, a near-real-time ground target location display, new techniques to distribute information, and the development of a tactical command, control, communications and intelligence architecture.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds to continue the advanced development of a jam-resistant tactical air surveillance radar and positive aircraft identification techniques for the Tactical Air Forces (TAF), project 2314; demonstration of a near-real-time ground target location display and the automation and integration of multi-source intelligence data for tactical fusion operations including the Combat Operations Intelligence Center (COIC) in Europe, project 2315; advanced development and demonstration of a high-capacity, processor-controlled communications subsystem to distribute information within tactical command and control centers of the Tactical Air Control System (TACS), project 2317; the analysis of new technology, techniques, procedures and equipments which have the potential to satisfy Air Force requirements, project 2321; and time-phased implementation planning and architecture for future tactical command, control, communications and intelligence systems, project 2478.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63789F
DOD Mission Area: Electronic & Physical Sciences (ATD) #551
Title: Command, Control & Communications Advanced Development
Budget Activity: Advanced Technology Development #2

DETAILED BACKGROUND AND DESCRIPTION: The objective of this advanced development program is to demonstrate solutions to tactical command, control and communications operational needs and validated requirements. This objective will be accomplished by the evaluation of technology, requirements analyses, conceptual system design, system engineering, demonstration and test of procedures and equipment needed to correct operational deficiencies and satisfy requirements. This program includes five projects. Three of these projects apply new technology in the tactical air surveillance, intelligence and information processing and distribution areas. These projects provide for the development of a tactical air surveillance ground radar including the development of positive aircraft identification techniques; the automation and integration of multi-source intelligence information for the combat operations intelligence centers and tactical fusion operations; and the development of tactical information processing and distribution equipment for the Tactical Air Control System (TACS). The Advanced Systems Concepts Project analyzes the applicability of new systems, techniques, procedures, technologies, and equipments which have a high potential for increasing Air Force capabilities. A tactical architectural project provides the time-phased implementation planning required for future tactical command, control, communications and intelligence systems.

RELATED ACTIVITIES: Related Program Elements include: 62702F, Command Control and Communications, for emergent technology; 27412F, Tactical Air Control System, and 27422F, Tactical Air Control System Communications, for engineering development of demonstrated solutions to operational requirements. Applicable technology developed by other sources is utilized to satisfy requirements for future engineering development and acquisition activities. Projects within this program element are coordinated with the Army, Navy and Marine Corps.

WORKED PERFORMED BY: The program will be managed by Air Force Systems Command, Andrews AFB, MD, with project effort being conducted by the Electronic Systems Division, Hanscom AFB, MA, and Rome Air Development Center, Griffiss AFB, NY. Current contracts are with the MITRE Corporation, Bedford, MA; Sanders Associates, Nashua, NH; RCA, Burlington, MA; TRW, Redondo Beach, CA; Martin-Marietta, Orlando, FL; Hughes Aircraft, Fullerton, CA; RCA Moorestown, NJ; ITT Gilfillian, Van Nuys, CA; Syracuse Research Corporation, Syracuse, NY; Calspan, Buffalo, NY; TRW, McLean, VA; and Operating Systems, Incorporated, Woodland Hills, CA.

Program Element: #63789F
DOD Mission Area: Electronic & Physical Sciences (ATD) #551

Title: Command, Control & Communications Advanced Development
Budget Activity: Advanced Technology Development #2

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: An assessment and demonstration of high frequency swept spectrum communications techniques to determine the capability for providing survivable communications during trans/post attack was completed in FY 1977. Development of an experimental model of a tactical air surveillance radar was initiated in FY 1977 and initial tests were conducted in FY 1980 with a two-dimensional antenna, project 2314. Technology development for a near-real-time positive identification of hostile, friendly and neutral aircraft was initiated in FY 1978, project 2314. Automated integration of tactical intelligence information was initiated in FY 1977, project 2315. Development and demonstration of an experimental penetration analysis support system to assist fighter aircraft mission planning was initiated in FY 1979, project 2315. Development and demonstration of a near-real-time ground target location display was initiated in FY 1979, project 2315. Initial engineering designs for a tactical information processing and distribution system were completed in FY 1979, project 2317. An architectural effort for future tactical command, control, communications and intelligence systems was initiated in FY 1978, project 2478.

2. FY 1980 Program: Development of a jam-resistant tactical air surveillance radar is being continued with initial tests on an experimental model with a two-dimensional antenna and continuation of the three-dimensional antenna development, project 2314. The positive aircraft identification task is being continued with the selection of radar data processing techniques and further definition of identification system concepts, project 2314. Automated integration of tactical multi-source intelligence data to improve reaction time capabilities is being continued, project 2315. Development and demonstration of an experimental penetration analysis support system will be completed. Results of this two year effort will form the basis for a follow-on engineering development program to provide an operational fighter aircraft mission planning capability, project 2315. Development of a near-real-time ground target location display is being continued as one of the tasks in project 2315. Development of a high-capacity, processor-controlled communications subsystem to distribute information within tactical command and control centers of the Tactical Air Control System is being continued, project 2317. The analyses of new technology, procedures, and equipments which have the potential to satisfy Air Force requirements are being continued, project 2321.

3. FY 1981 Planned Program: The development of a tactical air surveillance radar will continue with delivery of a three-dimensional antenna for functional test with the experimental signal processor and transmitter, project 2314. Positive aircraft identification will concentrate on developing automated recognition techniques, project 2314. The automation and integration of multi-source intelligence data for tactical fusion operations will be continued, project 2315. Development of the capability to provide a near-real-time ground target location display will be continued, project 2315. High-capacity information distribution equipment will be fabricated for test and demonstration, project 2317. The analyses of new technology, techniques, procedures, and equipments which have the potential to satisfy Air Force requirements will be continued, project 2321. Time-phased implementation planning and architecture analysis for future tactical command, control, communications and intelligence systems will be continued, project 2478.

Program Element: #63789F Title: Command, Control & Communications Advanced Development

DOD Mission Area: Electronics & Physical Sciences (ATD) #551 Budget Activity: Advanced Technology Development #2

4. FY 1982 Planned Program: Based on the tactical air surveillance radar experimental model data, a performance specification for an advanced development model of the radar will be completed, project 2314. Efforts to provide accurate and timely classification and identification of aircraft will be continued, project 2314. The automation and integration of multi-source intelligence data for tactical fusion operations will continue, project 2315. The capability to identify, track and display mobile ground targets based on the simulated operation of advanced sensor systems will be demonstrated, project 2315. The design, fabrication and initial test of a high-capacity, processor-controlled communications subsystem for the Tactical Air Control System will be completed, project 2317. The analyses of new technology, techniques, procedures and equipments which have the potential to satisfy Air Force requirements will be continued, project 2321. The time-phased implementation planning and architecture analysis for tactical command, control communications and intelligence systems will be continued, project 2478.

5. Program to Completion: This is a continuing program to provide for the transition of selected command, control, and communications technology projects to engineering development.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,900	5,700	6,400	9,000	Continuing	Not Applicable
2314	Tactical Air Surveillance	1,800	2,100	1,700	2,800		
2315	Automated Tactical Intelligence	1,400	2,400	2,800	2,800		
2317	Tactical Info Proc & Distribution	200	300	400	1,100		
2321	Advanced Systems Concepts	300	400	600	1,200		
2478	Tactical C^3I Architecture	200	500	900	1,100		

FY 1979 funding was increased by $650,000 to satisfy an unfunded requirement for an experimental penetration analysis support system. FY 1979, FY 1980 and FY 1981 project funding was reprogrammed to take care of fact-of-life changes. FY 1981 funding was increased by $136,000 in recognition of expected inflation.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63238F
DOD Mission Area: Strategic Offensive, #113

Title Cruise Missile Carrier Aircraft
Budget Activity Strategic Programs #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	13,200	30,000	30,300	50,600	TBD	TBD

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Cruise Missile Carrier Aircraft (CMCA) program provides a technology hedge against the threat or age induced failure of the B-52 force, as well as the need for a larger force of Air Launched Cruise Missile (ALCM) than can be carried on the B-52G/H force. With reasonable efforts, the B-52 should remain an effective and economical cruise missile carrier into the 1990s; however, because of the importance of ALCM, we should allow for the possibility that subsequent events may cause us to reverse our judgment. The program is structured to provide high confidence in the selected design with the capability to move into production quickly; if the need arises. As a result of the CMCA studies completed in FY 1979, the program is focused on the evaluation of the Strategic ALCM Launcher.

BASIS FOR FY 1981 RDT&E REQUEST: Conducts an aircraft modification, flight evaluation, and advanced design of a Strategic ALCM Launcher (SAL). B-1 aircraft number 3 is a test bed for the evaluation. The SAL is an attractive CMCA candidate because of excellent base escape, hardening (blast, electromagnetic pulse, and thermal) characteristics, and enroute survivability. In addition, the SAL is capable of carrying up to 30 of the current ALCMs to ranges in excess of 5000 nautical miles unrefueled.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 63238F
DOD Mission Area: Strategic Offense, #113

Title: Cruise Missile Carrier Aircraft
Budget Activity Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: The Cruise Missile Carrier Aircraft (CMCA) program was initiated in response to the cancellation of the B-1 production program in July 1977. Original concept evolved from studies that postulated the economic and schedule advantages of commercial, wide-body aircraft as stand-off cruise missile launch platforms. In the fiscal year (FY) 1978 budget supplemental, $15M was approved for the study of wide-bodied aircraft as cruise missile carriers. For FY 1979, $20.6M was approved and the scope of studies was expanded to include other than wide-bodied aircraft such as the C-141, B-1, Boeing 707, and Advanced Medium STOL Transport (AMST). Last year, Congress approved $30M for the program and directed the Department of Defense (DOD) to conduct a competitive hardware demonstration of the Strategic Weapons Launcher (SAL) and derivative of a military or commercial aircraft to establish their utility as cruise missile carriers not later than 30 September 1981.

RELATED ACTIVITIES: This Program is related to the Air Launched Cruise Missile (ALCM) Program, Program Element 64361F and the Advanced Cruise Missile Technology (ACMT) Program Element 63319F, since the ALCM and follow-on cruise missiles would be deployed on the CMCA, if it is produced. The Advanced Strategic Air Launched Missile (ASALM), Program Element 63318F could be used as an offensive and/or defensive system for use with the CMCA. The Strategic Bomber Enhancement Program, Program Element 63314F, demonstrates the technologies critical to next generation strategic systems. Ongoing activities under the Bomber Penetration Evaluation (B-1), Program Element 63252F will provide technical and flight test support to the CMCA program and result in some cost avoidance.

WORK PERFORMED BY: Responsibility for the program was assigned to the Aeronautical Systems Division (ASD), Air Force Systems Command, Wright-Patterson AFB, OH. Contractors on the Concept/Systems Requirements study effort included: the Boeing Company, Seattle, WA; McDonnell-Douglas Corporation, Long Beach, CA; Lockheed-California Company, Burbank, CA; Lockheed-Georgia Company, Marietta, Georgia; and Rockwell International, Los Angeles, CA. For the flight demonstration and advanced design of the SAL, Rockwell International of Los Angeles, CA is the expected bidder.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Efforts began to evaluate the cost and mission effectiveness of a wide variety of military and commercial aircraft as potential CMCA. The original studies were completed in June 1979; however, additional studies were directed to evaluate various threat excursions, commonality and basing considerations. The studies have shown that the B-1 technology derivatives and scaled-up AMST/CX aircraft represent the most cost and mission effective CMCA candidates. Derivatives of existing commercial or military transports were found unsatisfactory because the hardening and fast base escape modifications required to convert these aircraft to CMCA resulted in substantial increases in costs at increased threat levels - particularly Sea Launched Ballistic Missile (SLBM) threats.

2. FY 1980 Program: Modification of B-1 aircraft number 3 will begin for carriage and launch of cruise missiles from both internal and external locations. Specific work will include modification of the internal weapons bays, integration of B-1 avionics with ALCM interface equipment, and fabrication of internal launching hardware.

Program Element: 63238F
DOD Mission Area: Strategic Offense, #113

Title: Cruise Missile Carrier Aircraft
Budget Activity: Strategic Program #3

3. FY 1981 Planned Program: Modification efforts will continue and the initial work will begin on advanced design to provide a legacy for potential production downstream. Planning will begin for a flight demonstration in FY 1982.

4. FY 1982 Planned Program: Aircraft modification will be completed and the actual flight demonstration will begin late in the year. Advanced development work will continue so as to provide a viable production hedge.

5. Program to Completion: Flight demonstration and advanced development efforts will be completed and an evaluation of utility completed to provide the base for a decision to proceed into full scale engineering development (FSED) and production. With a potential FSED decision in fiscal year (FY) 1983, reasonable Initial Operating Capabilities (IOCs) are possible in the range from FY1986 through FY1989.

6. Milestones:

		Date:
A.	Program Initiation	Feb 78
B.	Concept/Requirements Analysis began	Apr 78
C.	Initial Studies Complete	Jun 79
D.	Additional studies directed/completed	Jul-Aug/Nov 79
E.	Strategic ALCM Launcher effort initiated	Nov 79
F.	Modification of B-1 aircraft #3 begins	Aug 80
G.	Flight Demonstration	Early Spring 1982
H.	FSED decision	Spring 1983

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

FY 1978 Actual	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
15,000	20,600	30,000	60,000	1,007,000	1,133,400

The reduction in FY 1979 is the result of reprogramming because of the delay in program decision. The decrease in FY 1981 is due to focusing the program on the evaluation of the Strategic ALCM Launcher only, rather than the advanced design of two aircraft candidates. Since the program is for the preservation of a viable production hedge, "to completion" and "total" costs are not yet defined.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63252F
DOD Mission Area: Strategic Offense, #113

Title: Bomber Penetration Evaluation (B-1)
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	50,308 1/	54,900	30,700	0	0	3,814,500

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The B-1 was being developed for modernization of the bomber leg of the strategic TRIAD. Since the decision has been made not to deploy this weapon system, development is now limited to that necessary to complete the test program in an orderly manner to extract useful technology from the large investment already made. The program will provide valuable data applicable to existing and future bomber aircraft through testing of the full-up B-1 system in an operational environment.

BASIS FOR FY 1981 RDT&E REQUEST: Includes funds to support orderly completion of the B-1 penetrativity evaluation which will provide empirical data on the B-1's and future bomber's capability to penetrate projected Soviet air defenses. Aircraft #4 flight test will complete evaluation of the defensive avionics system capability against updated threats. The new defensive suite incorporates major advances in electronic countermeasures technology. The technologies advanced during this year will have application to future strategic and tactical aircraft development programs.

OTHER APPROPRIATION FUNDS:

Procurement (FY 1977 and Prior)	469,000
(Quantity)	

1/ Funded under Program Element 64215F

Program Element: #63252F
DOD Mission Area: Strategic Offense, #113

Title: Bomber Penetration Evaluation (B-1)
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The B-1 development program was initiated to provide modernization of the strategic bomber force. The aircraft is designed to penetrate projected Soviet defenses at high subsonic speed at very low altitude with a low radar cross section utilizing high quality electronic countermeasures. The aircraft design reduces vulnerability to Soviet submarine launched ballistic missile attack by incorporating short takeoff distance, fast escape from its base, and resistance to nuclear effects. Its short takeoff distance also allows dispersal to many airfields in the United States which also contributes to prelaunch survivability. However, in 1977, the Administration decided not to produce the B-1, electing instead to add emphasis in the development and production of cruise missiles.

The B-1 RDT&E program has been very successful to date and represents a major investment in modern bomber technology. In order to obtain the maximum return on this investment, orderly completion of the developmment program is planned which will provide actual rather than theoretical evaluation of the B-1's capability to penetrate current and projected Soviet air defenses. Penetrativity testing in a simulated operational environment provides needed data on the effectiveness of a modern, large, high speed, low altitude, automated electronic countermeasures aided penetrating bomber. Technologies advanced during B-1 RDT&E will have application to present and future strategic and tactical aircraft and the benefits derived from this program will be transferable to new development programs.

RELATED ACTIVITIES: B-1 Aircraft #3 will undergo modifications and flight evaluation as a Strategic ALCM Launcher (SAL) under Program Element 63238F Cruise Missile Carrier Aircraft (CMCA) to evaluate the capabilitiy of a B-1 variant to launch cruise missiles. Advanced development of the Strategic ALCM Launcher is included under this effort. The ongoing Bomber Penetration Evaluation program activities will lend technical and flight test support to the CMCA program which will result in a cost avoidance to the CMCA program.

WORK PERFORMED BY: This program is managed by the Strategic Systems Program Office, Aeronautical Systems Division, Wright-Patterson AFB OH. Aircraft flight testing is accomplished by the Air Force Flight Test Center, Edwards AFB CA, and wind tunnel testing is accomplished at Arnold Engineering Development Center, Arnold AFS TN. During the flight testing the Space and Missile Test Center, headquartered at Vandenberg AFB CA provides the primary test range. The program is also supported by the White Sands Missile Range, headquartered at Fort Bliss TX.

The following are the prime contractors:

Rockwell International, Los Angeles Aircraft Division, Los Angeles CA. Rockwell, as the Aircraft/System Integrating Contractor, is responsible for achieving design integrity and has total system integration responsibility for the development of the B-1.

General Electric Company (GE), Aircraft Engine Group, Cincinnati OH. GE is an associated contractor with Rockwell and is responsible for the design and development of the propulsion system.

Boeing Aerospace Company (BAC), Seattle WA. BAC is an associated contractor with Rockwell and is the Avionics Subsystem Interface Contractor (ASIC). The ASIC is responsible for integrating the B-1 avionics systems and for providing that avionics equipment which is not government furnished.

AIL Division of Cutler Hammer, Deer Park, NY. AIL is an associated contractor with BAC and is developing defensive avionics equipment. AIL is responsible for developing and building selected electronic countermeasures and for assisting Rockwell and BAC in the flight test of this equipment.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Engineering development contracts were awarded in June 1970 to Rockwell International and General Electric for the system and engine respectively. The Avionics Subsystems Interface contract was awarded in April 1972 to the Boeing Company. After a year long competitive risk evaluation, the Defensive Avionics system development contract was awarded to AIL Division of Cutler Hammer in January 1974.

The Mock-up Review for the B-1 was completed in October 1971 and the Critical Design Review for the airframe was completed in May 1973. The engine Critical Design Review was completed in July 1972, the Design Assurance Review in May 1973, and the engine Preliminary Flight Rating Test in April 1974. The Offensive Avionics Critical Design Review was completed in August 1974.

Aircraft #1 completed its manufacturing phase in February 1974. After an extensive ground test program, it made its first flight on 23 December 1974. It has demonstrated high altitude supersonic flight and low altitude high speed subsonic flight. Compatibility with the KC-135 in aerial refueling has been shown. Extensive tests were conducted to assure good flying qualities and flutter-free characteristics. The aircraft is currently in temporary storage at Edwards AFB CA.

Aircraft #2 completed major assembly and began static proof load testing in December 1974. This testing, which was completed in June 1975, demonstrated the ability of the design to withstand operational loads. After installation and checkout of the aircraft electrical systems, Aircraft #2 started its flight test program on 14 June 1976. This testing has demonstrated correlation of the aerodynamic loading environment actually experienced in the air with that predicted by engineering analyses. Engine development and testing has been highly successful, including flight testing of the production engines at speeds above Mach 2.0. The aircraft is currently in temporary storage at Edwards AFB CA.

Aircraft #3 completed its manufacturing process and began flight testing on 1 April 1976. The aircraft is equipped with offensive avionics and has demonstrated that the aircraft/avionics are compatible and can fulfill the strategic mission requirements. Prior to the production contract award on 2 December 1976, the test activities required to assure that the program was ready to enter production were completed. They included engine product verification, static testing of major aircraft assemblies, fatigue testing, and performance validation with Aircraft #1, flight loads with Aircraft #3, and avionics demonstrations with Aircraft #3. Aircraft #3 has flown in support of the defensive avionics and penetrativity testing of Aircraft #4 as the baseline non-electronic countermeasures aircraft for comparison against Aircraft #4.

Aircraft #4 was completed in FY 1978 and began flight test in February 1979 after extensive ground testing of the defensive avionics. This aircraft is a preproduction prototype and is the first B-1 development aircraft to have the defensive avionics installed. During the period, shakedown of the basic ALQ-161 defensive avionics system was initiated along with preliminary penetration demonstration testing. Emphasis has been on evaluation of defensive system performance and effectiveness. Evaluations have confirmed integration and compatibility of the ALQ-161 with the B-1 and have assessed the key features and basic performance of the system. This included receiving and jamming in multiple bands to counter first generation ground and air threats. The majority of the basic system shakedown has been completed and effectiveness testing will continue. Radar cross section measurements and evaluation of expendable countermeasures were also accomplished during this period. Modifications to the defensive avionics to provide capability against updated threats and incorporate advances in electronic countermeasures technology were initiated during FY 1979.

2. FY 1980 Program: During this period, flight testing of Aircraft #4 will be continued including developmental test and evaluation of the electronic countermeasures modifications followed by the beginning of operational penetrativity testing. Further evaluations of the defensive avionics system will be accomplished to evaluate performance and determine overall system effectiveness against multiple threats. The modifications to the defensive avionics system will be tested and evaluated to assess capability against updated second generation threats. Full operational penetrativity testing, starting in late FY 1980, will provide realistic, credible and complete answers about the future capabilities of a manned penetrating bomber. This last phase will emphasize evaluation of bomber penetrativity in an operational environment against current and projected threats.

Program Element: #63252F
DOD Mission Area: Strategic Offense, #113

Title: Bomber Penetration Evaluation (B-1)
Budget Activity: Strategic Programs, #3

3. FY1981 Planned Program: During this final year of B-1 RDT&E, emphasis will be on completion of operational penetrativity testing of B-1 Aircraft #4. The penetration testing is scheduled for completion in January 1981. Completion of the operational penetrativity testing is required to bring the B-1 program to orderly completion and maximize technology gained from over ten years of strategic bomber development for use in future strategic aircraft. The full-up operational scenario testing will provide needed empirical data on B-1 penetration capability for use in current and future strategic aircraft.

4. FY 1982 Planned Program: None.

5. Program to Completion: None.

6. Milestones:

			Date
A.	Delivery of First Test Engine		Jan 74
B.	Engine Preliminary Flight Rating Test Complete		Mar 74
C.	First Flight		Dec 74
D.	Engine Verification Complete		Sep 76
E.	Production Contract Award		Dec 76
F.	Decision not to deploy B-1 System		Jun 77
G.	First Flight Aircraft #4	*(Dec 82)	Feb 79
H.	R&D Program Complete		Sep 81

* Date presented in FY 1979 Descriptive Summary

EXPLANATION OF MILESTONE CHANGES

The B-1 program was originally planned for final termination in FY 1982.

7. Resources: Not applicable.

Program Element #63252F
DOD Mission Area: Strategic Offense, #113

Title: Bomber Penetration Evaluation (B-1)
Budget Activity: Strategic Programs, #3

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	443,438	55,000	54,900	30,400	13,300	3,832,282

Budget Activity: Strategic Programs, #3

Program Element: 63252F, Bomber Penetration Evaluation (B-1)

Test and Evaluation Data

1. Development Test and Evaluation: Rockwell International, Los Angeles, California, as the aircraft/system integrating contractor, is responsible for achieving design integrity and has total system integration responsibility for the development of the B-1 weapon system. General Electric, Cincinnati, Ohio, is an associate contractor responsible for the design and development of the propulsion system. Boeing Aerospace Company, Seattle, Washington, is an associate contractor responsible for integrating the B-1 avionics subsystems and for providing avionics equipment which is not government furnished. AIL Division of Cutler-Hammer, Deer Park, New York, is an associate contractor responsible for developing and building electronic countermeasures equipment and for assisting Rockwell and Boeing in the test of this equipment.

Testing of the B-1 consists of ground and flight test. Currently, B-1 aircraft number 3 and 4 are undergoing test and evaluation of the defensive avionics system including modifications to enhance capability against advanced threats. Tests run from February 1979 to January 1981 and include a total of 432 test hours and 72 test sorties. Ground testing has been in progress since the start of development in June 1970. In the structural area some 1800 fracture mechanics tests and some 680 design development static and fatigue tests have been conducted on aircraft elements. Static loads testing has been conducted on major structural sections of the aircraft. Aircraft number 2, the airloads aircraft, completed an extensive static proof load test and detailed vibration investigation. Four B-1 structural assemblies completed four lifetimes of fatigue testing. Two more have undergone damage tolerance investigations. The aft fuselage has completed three lifetimes of test and residual strength tests, while the wing carrythrough section has completed three lifetimes. These tests have demonstrated the B-1's structural integrity.

About 24,500 hours of wind tunnel testing have been accomplished to investigate performance, engine/inlet compatibility, structural mode control system, flutter, drag, stability and control, weapon separation and crew safety. Flight controls and other subsystems have been tested in simulators to insure correct mechanical interfaces, establish performance values and evaluate failure mode characteristics. Ejection seat testing was completed at Holloman AFB to check the sequencing, divergence and safety implications of the seats installed in aircraft 4. As mentioned, defensive avionics are being evaluated on aircraft 4. Flight testing will continue on aircraft 4 to demonstrate key features of the innovative system, and functional compatibility with the aircraft and aircraft equipment. The engine has completed over 21,000 hours of engine operation.

Budget Activity: Strategic Programs, #3

Program Element: 63252F, Bomber Penetration Evaluation (B-1)

Test and Evaluation Data

Flight testing has been conducted as a joint development test and Initial Operational test and Evaluation (IOT&E) with participation by the Air Force Flight Test Center, the Air Force Test and Evaluation Center, the System Program Office and the contractors. It has been in progress since 23 December 1974 when aircraft number 1 flew for the first time. It was joined in the flight test program by aircraft number 3 in April 1976, aircraft 2 in June 1976, and aircraft 4 in February 1979. The aircraft was found to be flutter free throughout the explored flight envelope and to possess satisfactory flying qualities and handling characteristics. It has been flown at speeds over Mach 2.1 at an altitude of 50,000 feet and at Mach 0.85 at 200 feet in the terrain following mode. Heavy weight takeoffs, landings, and aerial refueling have been demonstrated. Weapons bay door operation, assisted and unassisted engine airstarts, acoustic information and complete subsystem investigation has been completed. The offensive avionics system has performed well. Live SRAM, inert gravity nuclear and conventional weapon drops have been accomplished. The airloads aircraft has demonstrated that the actual loads encountered in various flight configurations correlate with the predicted loads.

Further testing of aircraft 3 and 4 will evaluate the effectiveness of a large, modern, high speed low altitude, automated electronic countermeasures aided penetrating bomber. Evaluation of the defensive avionics will provide actual rather than theoretical data on penetration effectiveness. Additionally, the operational effectiveness testing of aircraft 4 will allow Air Force evaluation of advanced aircraft.

2. Operational Test and Evaluation: The B-1 test was combined development test and evaluation/operational test and evaluation (DT&E/OT&E) and was conducted primarily at Edwards AFB, CA utilizing the Pacific Missile Range, Edwards Test Range and low-level training routes. An Air Force Test and Evaluation Center (AFTEC) test team composed of AFTEC, Strategic Air Command, Air Force Logistics Command, and Air Training Command personnel conducted the initial operational test and evaluation (IOT&E) portion of the test.

Budget Activity: Strategic Programs, #3

Program Element: 63252F, Bomber Penetration Evaluation (B-1)

Test and Evaluation Data

The purpose of the IOT&E was to provide an estimate of the military utility, operational suitability, and effectiveness of the B-1 weapon system in support of the Defense Acquisition Review Council (DSARC) III production decision. The IOT&E of the B-1 weapon system was conducted on three research and development test and evaluation aircraft. A total of 122 flights and 355 flying hours were flown by these aircraft. It was AFTEC's conclusion that the production B-1 would have been operationally effective considering ongoing efforts to identify and implement corrective action on those deficiencies identified by AFTEC in the IOT&E final report.

Follow-on tests are being planned to assess the capability of the manned bomber to penetrate current and projected enemy defenses. US inventory weapon systems will be used as surrogates for the projected enemy defenses. Test will include both air controlled intercepts using the E-3A, and ground controlled intercepts using available enemy defense simulations. The F-15 and F-4 aircraft will be used as surrogate interceptors. The I-HAWK and NIKE systems will be tested to demonstrate capability against these generic radar systems.

B-1 aircraft 3 has been modified with a prototype Cross-Eye system This prototype Cross-Eye will be tested against the F-15, F-4J, and NIKE type radars to provide DT&E data on the feasibility and effectiveness of Cross-Eye. B-1 aircraft 4 will be updated with an advanced version of the prototype Cross-Eye for penetrativity testing against the F-15 as well as the NIKE system. In addition, the basic ALQ-161 defensive avionics will be updated to provide advanced countermeasures techniques against systems such as the E-3A and CW tracking systems such as the I-HAWK. The modifications to the ALQ-161 will undergo engineering checkout to ensure functional performance.

Operational penetrativity testing of the defensive avionics is scheduled to start in April 1980 and should be completed by January 1981. The Air Force Systems Command has the management responsibility for the ongoing B-1 research and development. AFTEC has test responsibility for the manned bomber penetrativity evaluation. Strategic Air Command actively monitors the test program.

Budget Activity: Strategic Programs, #3

Program Element: 63252F, Bomber Penetration Evaluation (B-1)

Test and Evaluation Data

3. Systems Characteristics	Objectives	Demonstrated
Subsonic Design Mission (refueled)		
Total Distance (NM)		1/
Low Level Penetration Portion (NM)		1/
Penetration Altitude (ft)	200	200
Penetration Speed (Mach)	.85	.85
Max Takeoff Weight (lbs)	395,000	360,000
Payload (max internal weapons)	24	24
Navigation Accuracy (NM/hr)		
Sustained Speed (Max Mach)		
Altitude	1.6	2.1
Sea Level		
Engine Thrust (uninstalled SLS)(lbs)		
Maximum		
Military		

1/ Extrapolations of test data to production configuration aircraft indicate that the low level mission range will be achieved.

2/ Restorable to 2.2 upon installation of inlet actuators.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63311F
DOD Mission Area: Land Based Strike, #111

Title: Advanced Ballistic Reentry System (ABRES)
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	TITLE	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	105,000	95,300	110,900	128,700	Continuing	Not Applicable
	System Technology	39,500	36,300	62,100	67,600	Continuing	Not Applicable
	Ballistic Reentry Vehicle Preprototype	19,000	12,200	1,300	3,000	Continuing	Not Applicable
	Maneuvering Reentry Vehicle Preprototype	31,700	29,100	12,900	29,500	Continuing	Not Applicable
	Penetration Aids	10,300	13,000	29,700	23,700	Continuing	Not Applicable
	Analysis and Test Support	4,500	4,700	4,900	4,900	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: ABRES develops and applies reentry technology in the advanced development of reentry systems, subsystems, and penetration aids, making those products available for timely full scale development and deployment on existing and future Intercontinental Ballistic Missiles and Sea-Launched Ballistic Missiles. Soviet throw-weight advantages, their capability and their on-going program to upgrade strategic offensive effectiveness create a need for offsetting United States (U.S.) technology which can be quickly fielded if needed, or for relatively low cost, can serve to steer Soviet strategic systems spending toward costly countermeasures least threatening to the U.S. This national program supports all three Services, providing most of the U.S. reentry technology and related test launch support. ABRES priorities, scope and funding requirements are determined by the Under Secretary of Defense for Research and Engineering, with management and funds being provided by the Air Force.

BASIS FOR FY 1981 RDT&E REQUEST: This program will complete key flight tests of advanced development preprototype reentry vehicles for the M-X and Trident ballistic missiles. Improved technologies will be demonstrated on flight tests of the Advanced Ballistic Reentry Vehicle and Advanced Maneuvering Reentry Vehicle and incorporated into refined designs. Preprototype penetration aid, countermeasure resistant fuzing, and guidance subsystems will be developed for M-X and Trident reentry vehicles. Through technology flights, advanced technology will continue to be developed for penetration, fuzing, guidance, and airframe components including heatshields, nosetips, control surfaces, substructures, and antenna windows for both ballistic and maneuvering reentry vehicles. Studies and analysis will be continued which address future potential defensive threats, mission requirements, and offensive reentry system responses.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #63311F
DOD Mission Area: Land Based Strike, #111

Title: Advanced Ballistic Reentry Systems (ABRES)
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Advanced Ballistic Reentry Systems (ABRES) program is the single Department of Defense program for advanced development of reentry vehicle and penetration aid technology in support of the three Services. The program is managed and funded by the Air Force. ABRES also provides priority support for upgrading operational reentry systems as well as technology support for intelligence assessments and strategic defensive programs. Technology and systems are being developed which will allow the United States (U.S.) to maintain or improve the effectiveness and penetration of existing operational forces currently limited in numbers by existing Strategic Arms Limitation agreements. The following technology and development efforts are presently being pursued in the ABRES program: ballistic reentry vehicles; maneuvering reentry vehicles; arming, fuzing, and guidance subsystems; penetration aids and their deployment systems; materials development; ablation, erosion, aerodymanic and thermodynamic studies and tests of heatshields, nosetips, control surfaces, antenna windows, and other vehicle airframe components; testing via laboratory, underground nuclear; ballistic missile, air launched rocket, and sounding rocket flight tests. Conceptual studies and tests are performed for more advanced and novel missile systems which may be required to sustain future force survivability and effectiveness.

For descriptive purposes, the ABRES program can be separated into the following areas: System Technology, Ballistic Reentry Vehicle Preprototypes, Maneuvering Reentry Vehicle Preprototypes, Penetration Aids, and Analysis and Test Support. These divisions are inexact, however, since the various aspects of reentry vehicle and penetration aid technology are quite highly interrelated, and since, for purposes of economy, the maximum number of technologies are addressed in each experimental missile launch. The major areas are described in detail in the accompanying summaries.

RELATED ACTIVITIES: The program is closely coordinated with the Army's Systems Technology Program and Ballistic Missile Defense Advanced Technology Center; Navy's Strategic Systems Program Office; Defense Advanced Research Projects Agency; Defense Nuclear Agency; Department of Energy, Military Applications; Government laboratories and testing facilities; and other agencies allied with reentry technology. Within the Air Force, ABRES coordinates with and is closely associated with the Theater Ballistic Missile Program (PE63317F), Advanced ICBM Technology Program (PE 63305F), and M-X (PE 64312F) in development of advanced reentry vehicle preprototypes and the Minuteman Program (PE 11213F) for system modifications and demonstration launches. Coordination and information exchange is achieved through briefings to the various agencies and frequent communications at the working level. Army and Navy personnel are assigned to the ABRES program office and are integrated into the management structure.

WORKED PERFORMED BY: The responsible Air Force agency is the Ballistic Missile Office, Norton Air Force Base, CA. ABRES contracts with over 50 contractors and makes extensive use of Government laboratories. The major contractors are: Aerospace Corporation, El Segundo, CA - systems engineering support. AVCO Corporation, Wilmington and Everett, MA - flight test vehicles, penetration aids, and supporting technology. Boeing Aerospace Company, Seattle, WA - Minuteman I booster launch services. McDonnel Douglas Astronautics Company, Huntington Beach, CA - flight test vehicles and support technology. MIT, Lincoln Laboratory, Lexington, MA - systems engineering and penetration aids.

Raytheon Company, Bedford MA - guidance update systems. TRW Systems Group, Redondo Beach, CA - targeting and trajectory software, systems engineering support. Honeywell, Inc., St Petersburg, FL - inertial navigation systems. Singer-Kearfott, Wayne, New Jersey inertial navigation systems. Major supporting government laboratories and test centers are: Air Force Materials Laboratory and Air Force Avionics Laboratory, Wright-Patterson AFB, OH; Air Force Rocket Propulsion Laboratory, Edwards AFB, CA; Air Force Geophysics Laboratory, L. G. Hanscom Field, MA; Harry Diamond Laboratory, Washington, DC; Arnold Engineering Development Center, Arnold AFS, TN; Air Force Special Weapons Center, Kirtland AFB, NM: Naval Surface Weapons Center, White Oak, MD; and Department of Energy, Sandia Laboratories, Albuquerque, NM.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The ABRES program has produced virtually the entire technology base from which past reentry systems have been derived and from which future ones will emanate. Accomplishments with major effect on existing and future systems include: development of slender bodies for high performance reentry vehicles; development of the penetration aids technology base for Minuteman II and III penetration aids systems; development of small ballistic reentry vehicle technology for use as Multiple Independently Targetable Reentry Vehicles (MIRV); development and engineering feasibility demonstration of Maneuvering Reentry Vehicles (MaRV); development of development and underground demonstration of materials hardened to nuclear effects; development of techniques for denying reentry vehicle discrimination by defenses; accomplishment of comprehensive defensive threat technical analyses which have been a primary national source of data in this area; the PAVE PEPPER program which demonstrated the capability of the Minuteman III missile to deliver up to reentry vehicles; and development of carbon-carbon nosetip concepts now used on M-X candidate reentry vehicles -- the MK12A, and the Advanced Ballistic Reentry Vehicle (ABRV) preprototype. In 1979, the first two ABRV vehicles were successfully flight tested, and hardware fabrication for the third and fourth flight vehicles continued. The development and final fabrication of the Advanced MaRV preprototype flight test hardware continued. penetration aids options were developed and tested for the and M-X ballistic reentry vehicles. Multiple experiments for heatshields, nosetips, aerodynamics, vehicle radar transmission, arming and fuzing, and penetration aids were flight tested via the Technology Development Vehicle and Advanced Nosetip Test Vehicles. Aircraft flight tests of a guidance update system were accomplished. Fabrication was completed for a full-scale reentry vehicle configured for post-reentry recovery; the vehicle was successfully flight tested and recovered for analysis.

Program Element: #63311F
DOD Mission Area: Land Based Strike, #111

Title: Advanced Ballistic Reentry System (ABRES)
Budget Activity: Strategic Programs, #3

2. FY 1980 Planned Program: The Advanced Ballistic Reentry Vehicle and Advanced Maneuvering Reentry Vehicle (AMaRV) preprototype programs will continue their flight tests this year. Flight testing will continue in support of the Army's Systems Technology Reentry Experiment Program. Reentry technology flight tests planned this year include flights of the final Technology Development Vehicle and the first Interim Recovery System (IRS), each with multiple reentry experiments. Multiple Payload Program (MPP) test-bed vehicle development will be initiated, and a second Recoverable MK12A will be fabricated. Development of decoys for the will continue. Preprototype penetration aid and deployment mechanism development for M-X ballistic reentry vehicles (RV), applicable to Trident II, will be initiated. Advanced jam resistant fuze components for M-X and Trident II reentry vehicles will continue to be developed.

3. FY 1981 Planned Program: The third AMaRV flight test, concluding the series, and the second flights of both the Recoverable MK12A and IRS will be conducted, including recovery of an IRS vehicle after reentry through weather. Development of MPP test bed vehicles will continue and an Advanced Recovery System (ARS) development will be initiated. Two Minuteman I flight tests will be conducted to evaluate the decoys and deployment devices. Development of a ballistic RV penetration aid system and advanced fuzing components will continue for M-X, applicable to Trident II, including air launched probe fuzing tests. Preparations for support to the Army's Homing Overlay Experiment flight tests will begin.

4. FY 1982 Planned Program: The first MPP and ARS (recovery) reentry technology flight tests will be conducted, including tests of advanced fuze components, ballistic RV penetration aids, and advanced RV airframe components. Development of an integrated M-X ballistic reentry system, including RVs, decoys, and deployment system will continue. MK500 decoy development will continue. AMaRV design refinement and guidance subsystem development will continue, and the Maneuvering Technology Vehicle test bed for MaRV guidance subsystems will begin.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

Program Element: #63311F
DOD Mission Area: Land Based Strike, #111

Title: Advanced Ballistic Reentry System (ABRES)
Budget Activity: Strategic Programs, #3

8. Comparison with FY 1980 Budget Data:

Project Number	TITLE	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	99,582	105,000	105,300	110,200	Continuing	Not Applicable
	System Technology	33,300	41,200	58,600	58,800	Continuing	Not Applicable
	Ballistic Reentry Vehicle Preprototype	17,800	17,300	700			
	Maneuvering Reentry Vehicle Preprototype	36,400	31,700	23,600	22,900	Continuing	Not Applicable
	Penetration Aids	9,000	10,300	17,700	23,600	Continuing	Not Applicable
	Analysis and Test Support	3,082	4,500	4,700	4,900	Continuing	Not Applicable

The FY 1980 budget estimate for ABRES was reduced by $10.0 million. This recent reduction is the result of Department of Defense funding requirements external to the ABRES program. Impacts on developments in support of the M-X program and the program are currently being assessed.

Project: N/A
Program Element: #63311F
DOD Mission Area: Land Based Strike, #111

Title: System Technology
Title: Advanced Ballistic Reentry Systems (ABRES)
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: This area includes design, analyses, development, and testing of arming and fuzing components, reentry materials, heatshields, nosetips, control surfaces, antennas and antenna windows, substructures, and other vehicle airframe components. Fuzing and antenna development is aimed at reducing volume, weight, and countermeasure susceptibility, while at the same time emphasizing increased reliability and accuracy performance of the reentry vehicle. Heatshield, nosetip, control surface, antenna window, and materials technologies are pursuing the combined characteristics of light weight, increased nuclear hardness, improved low reentry dispersion aerodymanics, and decoyable characteristics, as well as pursuing processing and design methods which could significantly reduce production costs. Emphasis is being placed on airframe components in an effort to produce high performance during normal reentry and through severe environmental conditions that statistically occur in target areas, as well as through hostile defensive environments. In addition, reentry vehicle test beds are being developed, including recoverable vehicles and small vehicles (three and four per Minuteman I booster), as well as advanced vehicle instrumentation, to achieve maximum technology benefit from each missile launch in the cheapest manner.

RELATED ACTIVITIES: Same as basic program element Descriptive Summary.

WORK PERFORMED BY: The responsible Air Force agency is the Ballistic Missile Office, Norton AFB, CA. A partial list of existing and potential contractors includes: AVCO Corporation, Wilmington and Everett, MA; Fiber Materials, Inc., Biddeford, ME; General Electric Company, Philadelphis, PA; General Dynamics, Pomona, CA; McDonnell Douglas Astronautics Corp., Huntington Beach, CA; Simulation Physics, Inc., Foxborough, MA; Aeronautics Division of Ford Aerospace & Communication Corp., Huntington Beach, CA; TRW Systems Group, Redondo Beach, CA; Kaman Science Corporation, Colorado Springs, CO; Science Applications, Inc., Santa Ana, CA; Acurex Corp., Mountain Home, CA; Calspan Corp., Buffalo, NY; Xonics Corp., Van Nuys, CA; Prototype Development Associates, Santa Ana, CA; Aerojet-General Corp., Azusa, CA; HITCO, Los Angeles, CA; Space Data Corp., Phoenix, AZ.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Previous work in this area established the feasibility of high performance reentry through the use of slender body designs. Other accomplishments include, for example: analysis and development of hardened reentry vehicle materials which provide greater natural and nuclear environmental protection; improved nosetips for reduced reentry dispersion; and major reduction in the size and weight of arming and fuzing components. These technologies have been directly applied to the design of the reentry vehicles for Trident. The development of small vehicle technology allowed the economical testing of four reentry vehicles at Intercontinental Ballistic Missile velocities on a single Minuteman I. Emphasis was placed on developing nosetips and heatshields insensitive to erosion from rain, ice, snow, and dust. Several programs

investigated surface shape change, dispersion effects, vehicle dynamics, and modeling to assess accuracy, transition, and heat transfer. Both sub-scale nosetip test vehicles, such as the Advanced Nosetip Test (ANT) vehicles and full scale vehicles were developed and flight tested to look at combinations of nosetips, heatshields, antennas, and arming and fuzing components simultaneously. Arming and fuzing developments to support the Advanced Ballistic Reentry Vehicle (ABRV), MK12A and Advanced Maneuvering Reentry Vehicle preprototypes were continued. The first ABRV flight test was successful,
that test was accomplished with extremely high accuracy -- almost no reentry dispersion. The first is currently being analyzed to improve performance modeling.

2. FY 1980 Planned Program: Development and flight testing of low dispersion nosetips, heatshields, and antenna windows, as well as arming and fuzing experiments will continue on the third and fourth ABRV flight tests the fourth Technology Development Vehicle (TDV) flight; and the first Interim Recovery System flight test. An advanced impact fuze experiment, part of the preprototype jam resistant fuze development program, will also be conducted on an aircraft launched rocket probe. Vehicle radar fuze transmission data will be obtained on several of the above flights. Laboratory and underground nuclear tests of advanced composite substructures and other ballistic and maneuvering RV components will be conducted to determine their nuclear survivability. Maneuvering vehicle aerodynamic modeling and testing including control surface design assessment will be continued. Development of test bed vehicles for future flight test experiments will be pursued, including the Multiple Payload Program vehicle development.

3. FY 1981 Planned Program: Flight data from the ABRV and TDV flight tests will be used to refine the ABRV design. Vehicle airframe components and arming and fuzing components will continue in development; these components will be flight tested on the second vehicle, and on Air Launched Probe System flights (fuzes only). Development of the Multiple Payload Program (MPP) vehicles will continue, and work will be initiated on the Advanced Recovery System, a recoverable RV specially designed to maximize simulation of normal vehicle reentry and preserve reentry induced surface features. Feasibility analysis and supporting tests will be conducted for an advanced missile system concept, the cruise ballistic missile.

4. FY 1982 Planned Program: Key Intercontinental Ballistic Missile flight tests of advanced airburst and surface proximity fuze components will be conducted on the first four vehicle MPP flight test, along with antenna window

experiments and airframe component tests. Fuzing components will be integrated into an advanced, jam-resistant design option for M-X ballistic Reentry Vehicles (RVs), applicable to Trident II. The first Advanced Recovery System recovery vehicle flight will be conducted. Development will continue for an integrated reentry system, including ballistic RV, penetration aids, and deployment system for M-X, applicable to Trident II. Design and development will be pursued for ballistic RV with advanced decoyability features. Design and early development will be initiated for the Reentry Technology Vehicle, a large experiment test bed vehicle of the Technology Development Vehicle class, required for experiments which cannot be scaled to the smaller Multiple Payload Program class vehicles. Feasibility testing for advanced missile system concepts will continue.

5. Program to Completion: This is a continuing program.

6. Resources: ($ in thousands)

	FY79	FY80	FY81	FY82	Additional To Completion	Total Estimated Costs
RDT&E Funds	39,500	36,300	62,100	67,600	Continuing	Not Applicable

7. Comparison with FY 1980 Budget Data:

Project Number	TITLE	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	System Technology	33,300	41,200	58,600	58,800	Continuing	Not Applicable

This System Technology portion of the program has not changed significantly in overall FY 1981 funding. The FY 1980 funds for System Technology efforts have been reduced to accommodate an overall program element budget reduction and to shift funds from System Technology to Advanced Ballistic Reentry Vehicle work.

Project: N/A
Program Element: #63311F
DOD Mission Area: Land Based Strike, #111

Title: System Technology
Title: Advanced Ballistic Reentry Systems (ABRES)
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: This development effort encompasses technology and subsystems for maneuvering reentry vehicles required to enable flight on non-ballistic trajectories, allowing evasion of defenses while maintaining or improving accuracy achievable by ballistic reentry vehicles. The ability to evade defenses represents a response to potential anti-ballistic missile defense upgrades Current efforts are directed toward developing a MaRV preprototype vehicle which will provide high performance evasion options needed for timely full-scale development and deployment on current and potential strategic systems such as M-X and Trident II. The objectives of the Advanced Maneuvering Reentry Vehicle (AMaRV) program are to: develop a high performance maneuverer capable of evading terminal defenses while maintaining accuracy; provide the potential for targeting flexibility and demonstrate guidance and control nosetip, and aerodynamic configuration technologies and subsystems which are critical to operational vehicle concepts. A follow on Maneuvering Technology Vehicle, a maneuvering test-bed vehicle planned for potential development in the early 1980s, would test new MaRV subsystem developments such as low cost-of-ownership inertial guidance, terminal update guidance sensors and onboard processing, MaRV shape-stable nosetips, and MaRV decoyability features and penetration aids.

RELATED ACTIVITIES: Same as basic program element Descriptive Summary.

WORK PERFORMED BY: The responsible Air Force agency is the Ballistic Missile Office, Norton AFB, CA. A partial list of existing or potential contractors includes: C. S. Draper Laboratory, Cambridge, MA: Lockheed Space and Missile Company, Sunnyvale, CA; Logicon, Inc., San Pedro, CA; Martin-Marietta Corporation, Orlando, FL; McDonnell Douglas Astronautics Company, Huntington Beach, CA; Singer-Kearfott, Wayne, NJ; General Electric Company, Philadelphia, PA; Raytheon Co., Missile Systems Division, Bedford, MA; Honeywell, Inc., St. Petersburg, FL;

Goodyear Aerospace Corp., Akron, OH.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Large maneuvering reentry vehicles (2000-3500 lbs) were flown in the mid 1960s. These flight tests established the fundamental feasibility of the maneuvering concept. More recently, MaRVs were flown, proving alternate design concepts in severe maneuvering environments. Inertial guidance subsystems design and development was begun in 1970 and has continued to the present, leading to current concepts in promise significant lowering of operations and maintenance costs. The Precision Guided Reentry Vehicle System Design Study, completed in FY 1976, provided system configuration definition, established MaRV system and subsystem requirements, and accomplished preliminary flight test definition and ground test planning for the AMaRV program which was initiated

in 1976. The Advanced Maneuvering Reentry Vehicle (AMaRV) program, which includes three flight test vehicles, has transitioned into the hardware fabrication phase and the first vehicle demonstrated maneuvering for the AMaRV design in a flight test in December of last year. The AMaRV flight program includes further MaRV guidance experiments and performance evaluation to be accomplished on the second and third AMaRV vehicles. Operational MaRV performance simulation have been conducted for postulated defenses of varying capability, to aid in vehicle evaluation and design. As an integral part of advanced MaRV development, parallel development of the most promising inertial guidance and terminal update guidance subsystems and technologies continues. Aircraft tests of terminal update sensor candidates were conducted in FY 1979 (and are ongoing), to complement planned reentry testing.

2. FY 1980 Planned Program: The second AMaRV flight test will be conducted and will include an experimental version of the Dormant Inertial Navigation System (DINS) Fabrication of the third AMaRV vehicle for flight test in FY 1981 will continue. Development of MaRV inertial guidance, terminal update guidance sensors, onboard processors, and nuclear hardened electronics designs will continue. Aircraft flight tests of a radar terminal update guidance sensor will be conducted.

3. FY 1981 Planned Program: The third AMaRV vehicle will be tested in the first half of FY 1981, and will include a second DINS experiment. This final AMaRV flight test will complete the complementary three-flight series designed to Development of improved inertial guidance and terminal update guidance will continue, emphasizing preparation of preprototype subsystems for reentry flight testing. Assessment of MaRV operational capability versus postulated Soviet defensive threats will continue. AMaRV vehicle decoyability will be investigated.

4. FY 1982 Planned Program: AMaRV flight test data analysis will be completed and will be used to update and refine the operational AMaRV design. Design and early development of the Maneuvering Technology Vehicle (MTV) test bed will be initiated to prepare for advanced MaRV guidance subsystem reentry tests. Preprototype guidance and navigation subsystems will be continued in development and ground tested in preparation for incorporation into the MTV. A post-flight design update will be conducted for the DINS navigation system, making it available for full-scale development if desired. AMaRV operational capability, decoyability, and defense penetration assessment will continue.

5. Program to Completion: This is a continuing program.

Project: N/A
Program Element: #63311F
DOD Mission Area: Land Based Strike, #111

Title: Maneuvering Reentry Vehicles (MaRV)
Title: Advanced Ballistic Reentry Systems (ABRES)
Budget Activity: Strategic Programs, #3

6. Resources: ($ in thousands)

	FY79	FY80	FY81	FY82	Additional to Completion	Total Estimated Costs
RDT&E Funds	31,700	29,100	12,900	29,500	Continuing	Not Applicable

7. Comparison with FY 1980 Budget Data:

Project Number	TITLE	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	Maneuvering Reentry Vehicle Preprototype	36,400	31,700	23,600	22,900	Continuing	Not Applicable

This portion of the program has been increased in FY 1980, reflecting increased and decreased in FY 1981, reflecting a delay of the Maneuvering Technology Vehicle program

Project: N/A
Program Element: #63311F
DOD Mission Area: Land Based Strike, #111

Title: Penetration Aids
Title: Advanced Ballistic Reentry Systems (ABRES)
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DISCRIPTION: Effort in this area includes analysis, design, development and flight test of penetration aids and countermeasures to nullify defensive attempts to target incoming reentry vehicles. are being developed to defeat defensive discrimination via sensors. These devices are being developed to enhance penetration of ballistic and maneuvering reentry vehicles both in the exoatmosphere and during reentry. Preprototype decoys and associated deployment devices are being developed for M-X ballistic reentry vehicles, the and the ABRES Advanced Maneuvering Reentry Vehicle (AMaRV). Technology efforts include materials development; nuclear survivability and vulnerability tests, including underground nuclear testing; signature modification through vehicle and decoy design,

RELATED ACTIVITIES: Same as basic program element Descriptive Summary.

WORK PERFORMED BY: The responsible Air Force agency is the Ballistic Missile Office, Norton AFB, CA. A partial list of existing and potential contractors includes: AVCO Corporation, Wilmington and Everett, MA; Boeing Aerospace Company, Seattle, WA; General Electric Company, Philadelphia, PA; Honeywell, Inc., Minneapolis, MN; Prototype Development Associates, Inc., Santa Ana, CA; L'Garde, Inc., Newport Beach, CA; MIT, Lincoln Laboratory, Lexington, MA; McDonnell Douglas Astronautics Company, Huntington Beach, CA; Ford-Aerospace and Communications Corporation, Huntington Beach, CA; and Stanford Research Institute, Menlo Park, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The technology base for penetration aids options and systems in use by the Minuteman II and III and Navy Submarine-Launched Ballistic Missile systems has been developed. Technical feasibility of using, on the Minuteman II reentry system against potential Basic technology and techniques for evaluating reentry vehicle discrimination by defenses have been developed and continue to be udpated, A high altitude penetration aid experiment using an decoy for the Minuteman III MK12 reentry vehicle was successfully conducted via ground tests. Flight test models of two traffic decoys and a Thrusted Replica decoy were developed and flight tested. Work continued on replica and traffic decoys to provide the technology needed for an assured penetration capability for the AMaRV and Advanced Ballistic Reentry Vehicle preprototypes, and the MK12A.

Project: N/A
Program Element: #63311F
DOD Mission Area: Land Based Strike, #111

Title: Penetration Aids
Title: Advanced Ballistic Reentry Systems (ABRES)
Budget Activity: Strategic Programs, #3

2. FY 1980 Planned Program: Candidate radar and optical decoys and devices for ballistic and maneuvering reentry vehicles will be flight tested on sounding rockets and Minuteman I boosters. Development and hardware fabrication will continue for preprototype decoys. A reentry flight test will be conducted to test the Continuously Dispensed Masker, Development will be initiated for an M-X ballistic reentry vehicle testing will be conducted for penetration aid survivability.

3. FY 1981 Planned Program: _ preprototype penetration aids will be fabricated and flight tested on several sounding rocket flights, two Minuteman I and one Trident I flight test. Development of M-X ballistic reentry vehicle (RV) penetration aids and deployment devices will continue. Advanced thrusted replica and shroud technology will be developed and eventually integrated into an advanced preprototype design. Decoy test data will be analyzed and decoy performance will be predicted for a defensive environment. Analytical simulation methods for assessment of defense penetration performance will be continued in development.

4. FY 1982 Planned Program: Development of penetration aid options will continue including a flight test on Trident I. M-X ballistic RV penetration aids development will continue, Development of M-X penetration aid deployment devices will continue. Components of the advanced thrusted replica and vehicle shroud will be flight tested and development will be initiated for an Advanced Maneuvering Reentry Vehicle preprototype penetration aid system.

5. Program to Completion: This is a continuing program.

6. Resources: ($ in thousands)

	FY79	FY80	FY81	FY82	Additional to Completion	Total Estimated Costs
RDT&E Funds	10,300	13,000	29,700	23,700	Continuing	Not Applicable

7. Comparison with FY 1980 Budget Data:

Project Number	TITLE	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	Penetration Aids	9,000	10,300	17,700	23,600	Continuing	Not Applicable

This profile of the ABRES program was increased in FY 1981 due to decoy development and flight test program, and as a result of effort deferred from FY 1980 due to an overall Department of Defense reduction in ABRES FY 1980 funds.

FY 1981 RDT&E Descriptive Summary

Program Element: 63314F
DoD Mission Area: Strategic Offense, #113

Title: Strategic Bomber Enhancement
Budget Activity: Strategic Program #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additonal to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	58,500	0	15,100	20,300	Continuing	Not Applicable
1993	Studies and Analysis	4,900					
1994	Lethal Defense Tech.	2,300					
1995	Advanced Strategic Air Launched Missile (ASALM)	48,700	1/				
2353	Bomber Avionics Tech.	2,600					
2558	Strat. Vehicle Prop. Tech.			4,100	5,300	Continuing	Not Applicable
2559	Strat. Vehicle Airframe Tech.			11,000	15,000	Continuing	Not Applicable
2566	Conventional Employment Techniques						

1/ Transferred in FY 80 to Program Element 63318F, Advanced Strategic Air Launched Missile (ASALM).

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides a technology base to support decisions for the acquisition of future strategic air breathing weapon systems. In anticipation of an increasing Soviet defensive threat and obsolescence of the current strategic bomber force, the program will develop technology and program options for new offensive air breathing strategic systems in the 1990s. The program will include the demonstration of technologies identified in prior studies as critical for the development of the next generation of strategic aircraft and associated weapons systems.

BASIS FOR FY 1981 REQUEST: Includes funds for the "breadboarding" and hardware demonstration of critical technologies needed for existing and future components of our strategic air breathing force. These efforts will include development of new propulsion/fuel systems, avionics architecture, low observable primary structures, and aerodynamic innovations for enhanced survivability and performance. Studies and analyses performed to date in this and other programs will form the basis for the planned effort.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: 63314F
DoD Mission Area: Strategic Offense, #113

Title: Strategic Bomber Enhancement
Budget Activity: Strategic Program #3

DETAILED BACKGROUND AND DESCRIPTION: Strategic Bomber Enhancement was inititated in 1969 as a program to translate and focus technology efforts toward applications with manned bombers. Projects were active in the development of technology in bomber avionics, lethal defense concepts, conventional applications, and the formulation of bomber strategy and future bomber production options. The program has spawned both the Advanced Strategic Air Launched Missile (ASALM) and the Advanced Cruise Missile Technology (ACMT) programs. Because of the program cancellation in FY 1980, the effort was restructured around the goal of demonstrating the critical technologies needed for our current and future generation of penetrating bombers and advanced weapon systems. Specific work will now focus on hardware/"breadboard" demonstration of those technologies the prior studies have shown to be the critical areas involved in driving the development pace, scope, costs, schedule, and risk of future acquisition programs for advanced strategic air-breathing vehicles. Overall, the program will provide a technology base for the key elements of the strategic air-breathing force.

RELATED ACTIVITIES: This program element provides a technology base for the Advanced Cruise Missile Technology (63319F), the Air Launched Cruise Missile (64361F), and the Advanced Strategic Air Launched Missile (63318F) programs. Outputs of the program may have application to the Cruise Missile Carrier Aircraft (63238F), B-52 Squadrons (11113F), and the Ground Launched Cruise Missile (64362F) programs.

WORK PERFORMED BY: Program responsibility has been assigned to the Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, OH. Within the Wright-Patterson complex, specific laboratories that participate include the Aerospace Propulsion Lab, the Flight Dynamics Lab, and the Avionics Laboratory. Potential bidders for the FY 1981 efforts include Boeing Aircraft Co, McDonnell Douglas Corp, Lockheed Aircraft Corp, Rockwell International, General Electric Co, Williams Research Corp, the Garrett Corp, Teledyne CAE, and General Dynamics Corp.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Major studies completed include the Innovative Strategic Aircraft Design Study (ISADS), the Advanced Technology Cruise Missile (ATCM) study, the Strategic Bomber Study, the B-52 Defensive Requirements Study, the Advanced Conventional Standoff Missile study and the Advanced Gun/Fire Control System Trade-Off study. Efforts were also completed on the initial design evaluation of a high density weapons launcher for the B-52 and future bombers, the application of fiber optics technology for bomber avionics, integration feasibility of the high-speed anti-radiation missile (HARM) into the bomber force, subsystem analysis of critical components for a Bomber Defense Missile (BDM), and the determination of error sources in cruise missile/bomber navigation systems.

2. FY 1980 Program: Not Applicable.

3. FY 1981 Planned Program: Funds will be used to initiate demonstration efforts on radar absorbing materials as primary structure material to reduce radar detectability, aerodynamic and flight control systems for low observable vehicles, variable camber airfoils, and high density weapons launchers. Funds will also be used to explore advanced turbine engine concepts for several air vehicles. Several high risk, innovative concepts involving compound engine cycles and off-axis engine spools are planned for future demonstration.

4. FY 1982 Planned Program: Work will continue on the specific efforts initiated in FY 1981 with the addition of a new effort on the evaluation of concepts for stealthy terrain following/avoidance systems.

5. Program to Completion: As specific technologies are demonstrated, they will provide the foundation for the definition of a new manned penetrating bomber. Based upon the designs developed during the configuration studies completed in FY 1978/1979, system integration of the critical technologies will be well under way by the mid 1980s so that a new bomber can be developed with an Initial Operating Capability (IOC) by the early to mid 1990s. The program will continue to provide technical evaluation and hardware demonstration critical subsystems needed for existing and planned elements of the bomber leg of the TRIAD.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FTY 1981 Estimate	Additonal to Completion	Total Estimated Cost
47,100	58,500	12,800	17,400	Continuing	Not Applicable

The deletion of funding in FY 1980 is the result of Congressional cancellation; the decrease in FY 1981 is due to program restructuring.

Project: #2559
Program Element: #63314F
DOD Mission Area: Strategic Offense, #113

Title: Strategic Vehicle Airframe Technology
Title: Strategic Bomber Enhancement
Budget Activity: Strategic Program #3

DETAILED BACKGROUND AND DESCRIPTION: This project provides the technical base for the technologies, design, and development of a new strategic air-breathing aircraft. This aircraft is needed because of the increasing Soviet defensive threat to air-breathing systems as well as the growing obsolescence of the current strategic bomber force. Moreover, a mixed force of a large number of cruise missiles and a lesser, but still consequential, number of manned penetrators is the most mission and cost effective solution for maintaining the viability of the air-breathing leg of the TRIAD. A consequential force of manned penetrators precludes the Soviets from narrowly tailoring their air defenses to cope with only the ALCM. In addition, a long range combat aircraft is capable of performing in a host of varied roles including force projection, conventional missions, sea surveillance, etc. Such an aircraft provides the flexibility and responsiveness not available in any other strategic system and is invaluable across the entire spectrum of conflict. This project is to evaluate existing technologies and assess the prospects of new technologies to help us understand how such an aircraft can be optimally designed.

RELATED ACTIVITIES: The continuing B-1 RDT&E program has direct application to this effort since planned activities under the Bomber Penetration Evaluation program (PE 63252F) will provide data on bomber effectiveness including the assessment of modern, automated electronic countermeasures. Many of the technological advances garnered from this program will have direct application on the course of development activities in this project.

WORK PERFORMED BY: Project responsibility has been assigned to the Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, OH. Potential bidders for the FY 1981 efforts include the Boeing Aircraft Co., McDonnell Douglas Corp., Lockheed Aircraft Company, Rockwell International, and General Dynamics Corp.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Major studies completed in prior years that compromise the technical basis for this project include the Innovative Strategic Aircraft Design study, the Strategic Air-Breathing Technology Alternatives study, the Strategic Bomber Study, and several others with a focus on elements of the technologies involved. Some of these include the High Density Weapons Launcher study, the Lethal Defensive Requirements Analysis, and Air Slew Technology for Bomber Defense Missiles.

2. FY 1980 Program: Not applicable.

3. FY 1981 Planned Program: Funds will be used to initiate "breadboard" fabrication and demonstration of the low observable materials for critical components of strategic aircraft. Materials will be evaluated for both aircraft primary and secondary structure. Several advanced aerodynamic concepts such as variable camber airfoils, digital flight control systems, and flush/reduced aperture inlets will also be evaluated and demonstrated for feasibility. Work will also begin on demonstrating the application of high density weapons launchers for bomber aircraft.

Project: #2559
Program Element: #63314F
DOD Mission Area: Strategic Offense, #113

Title: Strategic Vehicle Airframe Technology
Title: Strategic Bomber Enhancement
Budget Activity: Strategic Program #3

4. FY 1982 Planned Program: Work will continue on the efforts initiated in FY 1981 as well as the initiation of work on stealthy terrain following/avoidance systems to determine their specific capabilities and potential for future penetrating bombers. The evaluation of low radar cross section antennas and apertures will be an important element of this evaluation. The initial work on the development of conceptual designs will also begin.

5. Program to Completion: As subsystem technologies are evaluated, demonstrated, and defined, specific system architectures will be developed and merged into specific aircraft designs. These designs will be further refined to detail the needed interfaces, propulsion, and weapon carriage. A demonstration validation phase, full scale development, and production are planned downstream. Initial operational capability and specific milestone dates will be determined at a later date.

6. Milestones:

	Date:
a. Development of technology roadmaps	1978-1979
b. MENS approval	Sep 80
c. Project Start	Oct 80

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data:

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
0	0	2,000	2,000	Continuing	Not Applicable

The deletion of funding in FY 1980 is the result of Congressional cancellation; the increase in FY 1981 is due to program restructuring due to cancellation in FY 1980 of the Penetrating Manned bomber program and its inclusion as this project in FY 1981.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63318F
DOD Mission Area: Airborne Strike, #113

Title: Advanced Strategic Air Launched Missile (ASALM)
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979[1/] Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	48,500	25,000	25,700	50,500	TBD	TBD

BRIEF DESCRIIPTION OF ELEMENT AND MISSION NEED: This program element supports the Strategic Air Command Required Operational Capability (ROC) 13-73, and provides for the development of the Advanced Strategic Air Launched Missile (ASALM) system. It continues the work started in 1971 under Project 1995 of Program Element 63314F, Strategic Bomber Enhancement. The ASALM requirement, as defined, is to improve survivability of the air breathing leg of the Triad by suppressing enemy defenses - the projected Soviet Airborne Warning and Control System, airfields, and surface-to-air missile sites - and by attacking terminally defended targets that are beyond the range capabilities of the B-52/ Short Range Attack Missile combination.

BASIS FOR FY 1981 RDT&E REQUEST: This request continues the competitive subsystem development program and design integration effort programmed to start in FY 1980 upon approval of a Defense System Acquisition Review Council I scheduled to convene in early 1980. Major system design/development work to be accomplished under this effort includes air-to-air guidance; radar cross section reduction; propulsion system refinement; and system design integration.

OTHER APPROPRIATION FUNDS: None

1/ Funded under Program Element (PE) 63314F, Strategic Bomber Enhancement

Program Element: #63318F
DOD Mission Area: Airborne Strike, #113

Title: Advanced Strategic Air Launched
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The program objective is to develop an Advanced Strategic Air Launched Missile (ASALM) as a supersonic attack missile designed for air-to-air and air-to-ground employment. The ASALM will enhance the survivability and effectiveness of the bomber leg of the Triad against improving Soviet defenses and increased hardening of objective targets. ASALM will fill this role through active defense suppression of the projected Soviet Airborne Warning and Control System, surface-to-air missile defenses and interceptor airfields, and by striking defended targets. Neither the Short Range Attack Missile (SRAM) nor the Air Launched Cruise Missile (ALCM) have an air-to-air capability and SRAM, because of its limited range, provides insufficient bomber standoff range, routing flexibility, and mission capability to overcome the projected threat environment. ASALM will provide the bomber force with its first long range air-to-air missile capability. Through FY 1979 the program was a project under Program Element (PE) 63314F, Strategic Bomber Enhancement. It consisted of two major efforts: Technology Integration Program (TIP) and Propulsion Technology Validation (PTV). The TIP was a competitive effort by eight contractors (two airframe) which included wind tunnel tests of scale model missiles, integral rocket-ramjet engine development and testing, and other subsystem component development. The on-going PTV program is intended to demonstrate existing integrated rocket-ramjet technology maturity through flight tests. Upon approval of a Defense Systems Acquisition Review Council I early in 1980, the program will enter a competitive subsystem validation phase of development. The competitive subsystem validation phase will include four major tasks: air-to-air guidance development; radar cross section reduction; propulsion system refinement, and system design integration.

RELATED ACTIVITIES: PE 11113F, B-52 Programs; PE 64361F, Air Launched Cruise Missile; PE 63228F, Cruise Missile Carrier Aircraft; are related to the ASALM effort.

WORK PERFORMED BY: The overall project manager is the Aeronautical System Division, Strategic Systems Program Director, Wright-Patterson AFB, OH. Technical assistance is provided by the following Air Force Laboratories: Aerospace Propulsion Laboratory; Avionics Laboratory; Flight Dynamics Laboratory; and Rocket Propulsion Laboratory. Arnold Engineering Development Center wind tunnel facilities are used for aerodynamic model testing and ramjet propulsion testing. Contractors are: Martin Marietta, Orlando, FL, and McDonnell Douglas, St Louis, MO (ASALM airframe); United Technology Corporation; Sunnyvale, CA (Ramjet Propulsion); and Marquardt, Van Nuys, CA (Ramjet Propulsion); Thiokol, Huntsville, AL (Rocket Propulsion Technology); and Martin Marietta, Orlando, FL, is also a prime contractor for the Propulsion Technology Validation Program.

Program Element: #63318F
DOD Mission Area: Airborne Strike, #113

Title: Advanced Strategic Air Launched Missile (ASALM)
Budget Activity: Strategic Programs #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Technology development and integration on the Advanced Strategic Air Launched Missile (ASALM) has been underway since 1974. Under the ASALM Technology Integration Program (TIP), competing contractors prepared preliminary designs, conducted wind tunnel tests on scale models, and ran ground tests on competing integral rocket-ramjet engines. TIP development efforts also included tests of critical flight control system components, the firing of a heavy-weight solid rocket booster, and additional work on reduction of radar cross section. Concurrent with this program a Propulsion Technology Validation (PTV) program was initiated to demonstrate integrated rocket-ramjet technology maturity. Under the PTV effort ground testing was completed as well as several preliminary flight separation tests. Specifically, this effort included full scale rocket and ramjet engine tests, full scale wind tunnel tests, and airframe structural tests. Separation tests were carried out, initially using scale models of the missile and carrier aircraft, and then advancing to an actual A-7D aircraft and a dummy missile. Fabrication of initial flight test vehicles was also completed under the PTV program.

2. FY 1980 Program: The FY 1980 PTV program is devoted to completion of flight demonstration and evaluation of the data resulting from the flight demonstration tests. The flight demonstrations began during early FY 1980 with a successful first flight, a partially successful second flight, and a totally successful third flight. Four additional flights are planned during the remainder of FY 1980. Specific TIP ground tests during FY 1980 will include test firing of the flight-weight rocket booster and additonal testing of the integral rocket-ramjet engines. The TIP is scheduled to end in FY 1980, and upon approval of the Defense Systems Acquisition Review Council I (DSARC I), two prime contractors will be selected to conduct a subsystem validation phase under a Competitive Subsystem Demonstration Validation Program (SDVP). SDVP startup efforts will include initial design work on guidance subsystems and the development of techniques and the selection of materials to reduce ASALM radar cross section.

3. FY 1981 Planned Program: The FY 1981 program will continue the ASALM subsystem development begun in 1980. The competing prime contractors will continue design integration work. The initial design of the air-to-air subsystem will be completed and fabrication of captive flight test hardware begun. Development of radar cross section (RCS) reduction techniques and materials will continue. Refinement of the propulsion systems designs for improved performance and durability will be made.

4. FY 1982 Planned Program: Program plans include hardware fabrication and ground testing of guidance hardware. Radar cross section measurement of missile models will be made to evaluate RCS reduction techniques and materials. Ground testing of selected integral rocket ramjet components will be conducted. Preparations will begin for DSARC II in FY 1983.

Program Element: #63318F
DOD Mission Area: Airborne Strike, #113

Title: Advanced Strategic Air Launched Missile (ASALM)
Budget Activity: Strategic Programs #3

5. Program to Completion: Contingent on Defense System Acquisition Review Council I (DSARC I) approval, the subsystem validation phase of development will be completed in late FY 1983. The captive flight test of the air-to-air guidance systems is scheduled to occur in FY 1983. Subsequent to a successful DSARC II, a single prime contractor is to be selected for entry into full scale engineering development (FSED). As currently envisioned, the FSED program will develop and flight test the complete multimode missile system. The initial operational capability is planned for the late 1980s or early 1990s with the specific date dependent on outyear funding and future DSARC decisions.

6. Milestones:

a.	Technology Integration Program (TIP) Contract Award	Jun 1974
b.	Propulsion Technology Validation (PTV) Contract Award	Mar 1976
c.	Mission Element Need Statement (Draft)	(Feb 1979)*Jul 1979
d.	PTV First Flight	(Jun 1979)*Oct 1979
e.	DSARC I	(May 1979)*Mar 1980
f.	Subsystem Demonstration Validation Program Contract Award	(Jun 1979)*Apr 1980
g.	DSARC II (Full Scale Engineering Development Go-Ahead)	(Sep 1982)*FY 83
h.	Initial Operational Capability	TBD

* Data presented in the FY 1980 Description Summary

Explanation of Milestone Changes: The Advanced Strategic Air Launched Missile (ASALM) program was slowed during the FY 1980 budget preparation because of research and development (R&D) funding constraints and the desire by the Air Force to conduct a detailed mission analysis. As a result of the favorable outcome of the mission analysis the program has been restructured to include a subsystem development phase with emphasis on air-to-air guidance. The milestones were changed to reflect the restructured program and will be presented to the DSARC I for approval.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs	Total
TOTAL FOR PROGRAM ELEMENT	48,500	25,000	30,000	TBD	TBD	

The FY 1980 Five Year Defense Program estimate for FY 1981 was for $30,000.

BUDGET ACTIVITY: Strategic Program, #3

PROGRAM ELEMEMT: 63318F (ASALM)

Test and Evaluation Data

1. Development Test and Evaluation: The Advanced Strategic Air Launched Missile (ASALM) was funded under PE 63314F through FY 1979. Several contractors are involved in the program. Contingent upon a successful Defense System Acquisition Review Council I (DSARC I) in early CY 1980 two prime contractors will be selected to enter a competitive Subsystem Demonstration Validation Program (SDVP). The current development work consists of a Technology Integration Program (TIP) and a Propulsion Technology Validation (PTV) program. The TIP program, planned for completion in FY1980, is part of the Advanced Development Phase involving McDonnell Douglas, St. Louis, MO and Martin Marietta, Orlando, FL, as the primary integration contractors. United Technology Corporation, Sunnyvale, CA, and Marquardt, Van Nuys, CA, are contracted to do ramjet work while Thiokol, Huntsville, AL, is tasked to do the rocket development. The early guidance development was carried out by Rockwell International (Autonetics) and Raytheon. Testing consisted of laboratory tests of subsystem components (pumps, actuators, etc.), wind tunnel tests of scale model missiles, ground firing of the ramjet engine designs, and full scale firings of the rocket motor. Engine testing and rocket-ramjet transition tests are scheduled for FY1980. The PTV program is under contract to Martin Marietta and Marquardt. The PTV flight test missile is not an ASALM prototype, but the technology it will demonstrate is directly applicable to the ASALM program. ASALM flight profiles will be duplicated by the PTV test vehicle as closely as possible. The PTV test vehicles will be launched from an A-7D aircraft and all tests will be conducted at the White Sands Missile Range (WSMR). Seven flights are planned. The first flight was conducted in October 1979 and was successful in demonstrating all primary test objectives; including safe separation from the aircraft, rocket boost, transition from rocket to ramjet operation, and sustained ramjet operation. However, some secondary objectives were not obtained due to a fuel control malfunction which resulted in cruise at a higher speed than planned. The second flight in November 1979, although terminated early due to a secondary power source failure, extended our knowledge by providing a second in-flight demonstration of successful transition from solid rocket to ramjet propulsion and by providing additional data on drag characteristics. A third flight in January 1980 was conducted over a typical ASALM flight profile and was completely successful. The PTV flight test program is scheduled to be completed by mid 1980. The Subsystem Demonstration Validation Program (SDVP) Test and Evaluation is intended to demonstrate the functional and performance feasibility of guidance subsystems, passive location systems, and radar cross section reduction techniques. The guidance subsystems and passive location system are to be fabricated in a brassboard form and demonstrated in flight aboard a testbed aircraft against a representative target. Passive location flight testing is scheduled for FY1982 and guidance subsystems flight testing is to be conducted in the FY1982-1983 time frame.

2. Operational Test and Evaluation: During the ASALM Subsystem Demonstration Validation Program (SDVP), FY1980-1983, there will be no operational test and evaluation. However, the Air Force Test and Evaluation Center (AFTEC) will monitor Development Test and Evaluation (DT&E) testing and participate in DT&E test planning working groups. During the Full Scale Engineering Development (FSED) phase, scheduled for FY1983-1986, AFTEC will participate in the combined Development Test and Evaluation (DT&E)/Initial Operational Test and Evaluation (IOT&E) scheduled for FY1985-FY1986. A dedicated Operational Test and Evaluation (OT&E) phase is scheduled to follow the DT&E/ IOT&E. The purpose of the ASALM OT&E will be to estimate the operational effectiveness and suitability of the ASALM to accomplish its intended mission in an operational environment.

3. System Characteristic:

System Characteristic	Objective	Demonstration
Weight	2700 pounds	FSED
Length/Diameter	168/21 inches	FSED
Radar Cross Section		SDVP/FSED
Warhead Yield		FSED
Propulsion	Integral Rocket/Ramjet	SDVP/FSED
Speed Mach/Range (NM)		
High altitude		FSED
Low altitude		FSED
Air-to-air		FSED
Guidance		
Inertial		FSED
Anti Radiation Homing	SUAWACS tracking at long range	SDVP/FSED
Active	Tracking near zero doppler targets at low altitude	SDVP/FSED
B-52 Carriage	7 internal/12 external	FSED

* Also retain growth potentia.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63319F
DoD Mission Area: Strategic Offense, #113

Title: Advanced Cruise Missile Technology
Budget Activity: Strategic Program #3

RESOURCE (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		-	10,000	13,900	30,800	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Advanced Cruise Missile Technology (ACMT) program provides for the investigation of technology that could lead to a follow on cruise missile with improved propulsion, signature reduction, and avionics in the late 1980s or early 1990s. The program will insure the United States has cruise missile development options that are capable of exploiting technology opportunities as well as responding to the evolving Soviet defensive threat. The objectives of the program are to maintain the momentum of U.S. cruise missile development efforts, provide a high confidence option to develop a new cruise missile with an initial operational capability (IOC) as early as FY1987, and pursue a baseline development program for an FY 1991 IOC cruise missile. The program is based upon existing ALCM hardware, technology efforts underway in the Air Force and other agencies, and prior studies and analyses.

BASIS FOR FY 1981 REQUEST: This request would continue a multiple contractual approach in two development areas: airframe and engines/fuels. Airframe contractors will develop configurations, design and fabricate demonstration hardware, and perform ground testing. Engine contractors will develop advanced engine designs, fabricate and test critical subsystems and components, and ground test demonstration engines. Advanced slurry fuel concepts using carbon and, perhaps, boron will be evaluated for use with the later baseline effort. Airframe and engine efforts are intended to improve survivability through reduced radar cross section and infrared signatures, and enhance performance with improved "clobber" avoidance, target recognition, damage assessment, threat warning,and "stealthy" sensors. Engine efforts will be dedicated to increasing range, and improving thrust for maneuverability and performance.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #63319F
DoD Mission Area: Strategic Offense, #113

Title: Advanced Cruise Missile Technology (ACMT)
Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: This program is based upon studies and analyses completed by the Air Force and exploratory development activities underway in the Defense Advanced Research Projects Agency (DARPA). The Advanced Technology Cruise Missile (ATCM) studies were started by the Air Force in August 1977 and completed in September 1979. This major study evaluated the future threats to cruise missiles against a variety of cruise missile concepts (i.e., subsonic, subsonic with supersonic dash, supersonic,, and hypersonic), highlighted the most cost and mission effective concepts, and prepared a technology roadmap for development of a next generation missile. The work in DARPA began in 1977 and included test and evaluation of reduced radar cross section techniques, new engine concepts, autonomous terminal homing, and avionics innovations. With this work as a foundation, the program will focus on the advanced development of a new generation of cruise missile technology through successive demonstration, refinement, and upgrade with options to proceed into engineering development as conditions warrant. The program is responsive to technology innovations and breakthroughs as well as the evolving Soviet defensive threat to cruise missiles and their launch platforms.

RELATED ACTIVITIES: The Strategic Bomber Enhancement program (63314F) provides a continuing technology base for the higher risk elements involved in engine and airframe developments. The DARPA development efforts done under Strategic Technology (62301E) will be transitioned to the Air Force under a 7 November 1979 Memorandum of Agreement between DARPA and the Air Force. Technology in propulsion and guidance from the Advanced Strategic Air Launched Missile (ASALM-63318F) may have application. The development effort under the Air Launched Cruise Missile (ALCM-64361F) program is the baseline for the ACMT program.

WORK PERFORMED BY: Responsibility for the ACMT program was assigned to the Aeronautical Systems Division (ASD), Air Force Systems Command (AFSC), Wright-Patterson AFB,OH. Contractors on the study and development efforts to date include: The Boeing Company, Seattle, WA, McDonnell Douglas Corp, St Louis, MO, General Dynamics (Convair Division), San Diego, CA, Rockwell International, Columbus, OH, and Martin-Marietta Corp, Orlando, FL.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not Applicable.

2. FY 1980 Program: In FY 1980, contracts will be awarded to airframe and propulsion contractors to develop specific configurations, design and fabricate demonstration hardware, and perform ground testing and evaluation. The cruise missile design requirements for the early 1987 initial operational capability (IOC) option and the baseline 1991 IOC will be defined, so that technology roadmaps for both IOCs can be developed.

3. FY 1981 Program: The four initial engine contractors will be reduced to two based upon their development proposals for engines with reduced fuel consumption, increased performance over the current Air Launched Cruise Missile (ALCM) engine, use of high density slurry type fuels, and potential to meet cruise missile initial operational capabilities (IOCs) in FYs 1987 and 1991. The two airframe contractors will be demonstrating component technologies in the areas of materials for low radar signatures, techniques for reduced infrared emissions, and improved guidance subsystems.

4. FY 1982 Program: Work will continue on engine and airframe development. The specific efforts will be a function of the Air Force and DoD decision to proceed (or not proceed) with the FY 1987 IOC option. Efforts could focus on retrofit of the current ALCM, continue with only the baseline program for a new missile with an FY 1991 IOC, or proceed into full scale engineering development of a missile with an IOC in FY 1987.

5. Program to Completion: Develop a new cruise missile to replace or supplement the current ALCM in response to technology improvements that could significantly improve the capability of our cruise missiles or to threat-induced problems with the current ALCM due to the evolving Soviet defensive threat against cruise missiles.

6. Milestones:	Date
A. Advanced Technology Cruise Missile studies	Aug 77 - Oct 79
B. Program initiation	Apr 80
C. Engine design/component development begins	May 80
D. Narrow engine competition	Nov 80
E. Decision to pursue FY 87 IOC option	Sep 81

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
	10,000*	10,000	15,000	Continuing	Not Applicable

*FY 1979 Supplement Request; not approved by the Congress. The FY 1981 Estimate was reduced slightly due to higher budget priorities.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 63424F
DoD Mission Area: Strategic Surveillance and Warning, # 132

Title: Missile Surveillance Technology
Budget Activity: Strategic Programs, #3

Resources (Project Listing): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Total for Program Element		5,825	3,960	12,200	14,200	Continuing	Not Applicable (N/A)
2122	Advanced Sensors	1,990	0	0	0	N/A	N/A
2123	IR Data Collection	3,835	3,960	12,200	14,200	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is directed to the collection and analysis of infrared phenomenology associated with the earth (as a background), the surrounding atmosphere, and specific targets such as strategic and tactical missiles and aircraft. Data from this program will directly support design considerations for a follow-on strategic missile warning and attack assessment system that will support National Command Authorities response option selection during a nuclear missile attack.

BASIS FOR FY 1981 RDT&E REQUEST: The FY 1981 program will contribute infrared phenomenology data to support system design and technology development considerations associated with a proposed improvement in performance of the existing space based missile warning system. Data will be collected with high altitude balloon flights, rocket probes, aircraft, and laboratory experiments. These projects will be coordinated with other government agencies (i.e. Defense Advance Research Projects Agency (DARPA), Navy, Army) to assure maximum utilization of resources in support of infrared data requirements. As a result of the Advanced Warning System Defense Systems Acquisition Review Council I Secretary of Defense Decision Memorandum, funding in this line may be used in a joint USAF/DARPA program to support additional technology development.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 63424F
DoD Mission Area: Strategic Surveillance and Warning, # 132

Title: Missile Surveillance Technology
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: Projected threat level increases in the Soviet Intercontinental Ballistic Missile (ICBM) and Sea Launched Ballistic Missile (SLBM) technology will potentially stress the capability of current surveillance systems which provide tactical warning and very limited attack assessment. New ICBM and SLBM deployment and
could reduce the effectiveness of our existing missile surveillance systems. The requirement to provide missile attack characterization beyond an inference that the U.S. ICBM force may be threatened demands that the space sensor have the sensitivity to detect the foreign missiles when launched and
The impact footprint will be predicted to
This will provide the National Command Authorities the data necessary to select appropriate response options, and the opportunity to conduct effective strategic force management and enhance United States deterrent posture. Additionally, the need for improved force effectiveness dictates a survivable system capable of providing data during trans and post attack phases of a nuclear war.

The efforts funded under this program element should support design and development of an improved capability missile warning system which will
The spectra of primary interest are Short Wavelength Infrared and Medium Wavelength Infrared from 2 to 7 microns. The technical objective is to support development of a follow-on
surveillance system with greatly improved and survivable warning and attack characterization.

RELATED ACTIVITIES:
is the current space-based missile early warning system.

P.E. 63211F, Project 2100, Laser Hardened Materials, provides information relative to system survivability.

WORK PERFORMED BY: Hq Space Division (SD), Los Angeles, CA is responsible for the management of this P.E. Government agencies supporting the Multi-Spectral Measurements Program task (Project 2123) include White Sands Missile Range, NM; and Air Force Materials Laboratory, Wright-Patterson AFB, OH. The Air Force Geophysics Laboratory manages the Multi-Spectral Measurements Program (MSMP) and Balloon Altitude Mosaic Measurements tasks for Hq SD. MSMP contractors include Martin Marietta Corporation, Denver CO (ultraviolet sensors), Honeywell Radiation Center, Lexington, MA (spectral radiometers), and Aeroydne Inc., Burlington, MA (computer data analysis). Visidyne Inc., Burlington, MA provides balloon payload and field services support to the Balloon Altitude Mosaic Measurements task.

Program Element: # 63424F Title: Missile Surveillance Technology

DoD Mission Area: Strategic Surveillance and Warning, # 132 Budget Activity: Strategic Programs, # 3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Development of the optics and focal planes for two sensor configurations were completed. Advanced sensor system concepts for improved surveillance capabilities were studied. Sensor system concept studies were concluded. Aircraft, probe and satellite measurements were performed under Project 2123. Potential sensor and reporting network configurations were defined for nuclear detonation reporting system using current and future sensors and communications. Contract work demonstrating the capability to fabricate hardened high performance optical devices for use in missile detection systems was completed. Technology efforts were continued in the use of mercury cadmium telluride detectors, charge coupled devices and design of mosaic staring sensor arrays for increased infrared sensor capability. The RM-20 satellite experiment, incorporating multispectral infrared scanning and staring sensors was launched in FY 1975, but failed to achieve orbit because of a failure in the Atlas launch vehicle. A Mission Analysis for Missile and Nuclear Detonations Surveillance was performed in FY 1975. The Mission Analysis revealed that engineering modifications to the would provide an improved interim capability until a well focused technology program could provide the survivability and performance required of a missile surveillance system by the mid 1980's. Goals and requirements for a follow-on were then identified. Under Project 2122 efforts for the development of a mosaic staring sensor and advanced technology for the use of charge coupled devices in missile detection systems were pursued. In Project 2123, spectral background and scintillation collection efforts, applicable to missile surveillance, were initiated using balloons and rocket probes. Aircraft were completed in FY 1978 with Army funding. Mosaic staring sensor validation efforts initiated in FYTQ led to two unique approaches in staring sensor design and fabrication. These efforts continued during FY 1979, with $1.9 million RDT&E funding approved by Congress at a reprogramming hearing in March 1979. Infrared measurements of earth background scintillation continued, using balloons. Measurements of background and engine plumes in space were to be collected using ARIES rockets for launch vehicles. An unsuccessful launch attempt in September 1978 delayed the next MultiSpectral Measurements Program launch until February 1979. This was further delayed until May 1980 due to launch vehicle malfunctions.

2. FY 1980 Program: This program supported preparation of a Defense Systems Acquisition Review Council I for the Mosaic Sensor Program and, after Congressional approval, subsequently will support a technology risk reduction program involving Air Force and Defense Advanced Research Projects Agency mosaic technologies. Earth background scintillation measurements and data analysis will continue to collect data in support of mosaic sensor design concepts. Infrared and ultraviolet measurements will also continue in addition to preparation for high performance target engine measurements, using excess Minuteman (Upper Stage) boosters for launch vehicles, beginning in FY 1981.

3. FY 1981 Planned Program: Collection and evaluation of background and target measurements data will continue and launch of the first high altitude Multi-Spectral Measurements Program rocket probe will occur late in the year. Some funding in this program may be used to support the joint AF/DARPA technology development and demonstration program.

Program Element: # 63424F
DoD Mission Area: Strategic Surveillance and Warning, # 132

Title: Missile Surveillance Technology
Budget Activity: Strategic Programs, # 3

4. FY 1982 Planned Program: Balloon background, rocket probe, and laboratory measurements will be continued to support system design considerations. Technology validation projects will be initiated, with the high altitude balloon and rocket probe being used as platforms.

5. Program to Completion: Infrared data collection and technology validation will continue, to provide data that could be used to support system design reviews for eventual development of an infrared mosaic sensor system as a follow-on to the existing missile warning system. The infrared data collection project may be terminated in Fiscal Year 1985 if no further data is required.

6. Milestones: Not Applicable

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimated	FY 1981 Estimated	FY 1982 Estimated	Additional to Completion	Total Estimated Costs
RDT&E Funds	5,825	3,960	12,200	14,200	Continuing	Not Applicable (N/A)
Quantities: N/A						

8. Comparison with FY 1980 Budget Data:

Missile Surveillance Technology

	FY 1978 Actual	FY 1979 Estimated	FY 1980 Estimated	FY 1981 Estimated	Additional to Completion	Total Estimated Costs
Total for P.E.	9,130	13,890	21,800	52,800	Continuing	N/A

The funding has changed since the Mosaic Sensor Program is no longer funded in this Program Element.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 63428F
DoD Mission Area: Space Defense, # 123

Title: Space Surveillance Technology
Budget Activity: Strategic Programs, # 3

RESOURCES (PROJECT LISTING) ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		35,932	42,100	44,300	57,400	Continuing	Not applicable
2698	System Development	28,032	34,000	38,500	50,600	Continuing	Not applicable
2699	Information & Network Development	7,900	8,100	5,800	6,800	Continuing	Not applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Soviets have an aggressive anti-satellite and space program. SPACETRACK has very limited detection capability above 3000 nautical miles (nm) and is a peacetime system. As a result, SPACETRACK has limited warning capability

This program pursues near-term (early 1980's) and far-term (late 1980's) SPACETRACK improvements. Near-term improvements include technology to support a ground-based electro-optics system for high altitude search, a satellite attack warning software system, new capabilities for satellite mission assessment, and existing sensor upgrades. The efforts leading to a far-term capability are to convert SPACETRACK to a near real-time, totally responsive space-based system for satellite attack warning with reduced dependence on overseas based sensors and with increased survivability. These efforts are specifically oriented toward the development of a space-based long wavelength infrared (LWIR) space object detection and tracking system. This program supports the Presidential and Secretary of Defense Directives for a Space Defense capability with balanced ASAT, surveillance and satellite survivability components.

BASIS FOR FY 1981 RDT&E REQUEST: Near-term efforts continue the integration and improvement of assets for the tactical assessment of satellite missions. Completion of an engineering test site operation which support the deployment of a 5 site ground-based electro-optical system, and continued upgrade to the initial operational capability for Satellite Attack Warning and Verification. The efforts supporting the far-term system are the continued collection of LWIR background data from probes, the development of long life cryogenic coolers for LWIR sensor operation, and the development of a Space Infrared Experiment (SIRE) for launch in FY 83 on a shuttle sortie mission. The SIRE and LWIR probe measurements are essential for the surveillance system.

OTHER APPROPRIATION FUNDS: Not applicable

Program Element: # 6342[illegible]
DoD Mission Area: Space Defense, # 123

Title: Space Surveillance Technology
Budget Activity: Strategic Programs, # 3

DETAILED BACKGROUND AND DESCRIPTION: The Soviets continue an aggressive anti-satellite program. The SPACETRACK system provides limited warning of an attack. It also has a very limited detection capability above 3000 nautical miles (nm) and

The identification of new Soviet space launches cannot support
Because of limited ground sensors, it can take

Examples of these deficiencies are:

The Soviet dependence on space as an instrument for global strategic and tactical support is increasing in significance for their military operations. Space allows them to operate globally with support systems which are free of threat from foreign land, sea, and air forces and to achieve missions that would otherwise infringe on other nations' territories. The SPACETRACK limitations cited above have created a situation where

This program is structured into near and far-term improvements. The near-term improvements are specifically oriented to satisfy critical deficiencies using off-the-shelf technology to modernize current capabilities. The remaining program provides for a far-term major upgrade. Initially, existing operational and research and development (R&D) sites were evaluated and consolidated with marginal R&D sites discarded. R&D was performed to increase the operational effectiveness of these sites and transition them to SPACETRACK. New ground-based surveillance systems are being developed where required and space-based systems are being examined to increase the SPACETRACK detection altitude to 22,000nm and beyond and provide near real-time operations to support the satellite attack warning missions. A mathematical model has been developed for the SPACETRACK network to determine the most cost effective R&D and system deployment for correcting current and projected deficiencies.

A major near-term effort has been the development of a Satellite Attack Warning and Verification system. An initial capability was completed in FY 1979 with follow-on improvements in progress. Since Soviet attack against a U.S. space system could indicate the initiation of a strategic or theater Soviet attack, it is essential that advance notification be provided to the National Command Authorities as soon as possible so that the attack can be assessed and forces can be alerted.

Program Element: # 63428F
DoD Mission Area: Space Defense, # 123

Title: Space Surveillance Techology
Budget Activity: Strategic Programs, # 3

The program for the far-term option includes developments leading to an advanced space-based long wavelength infrared surveillance system for space object tracking. Near-term efforts in this program address the basic technical, background, system feasibility and utility issues to evaluate the basic system concept. These include a measurements program that will provide indicative data on background levels and models; a major development effort on cryogenic coolers that will provide not only adequate performance, but also operate at least three years for system practicality; key sensor technology and data processing developments to evaluate the state-of-the-art; and a continuing systems evaluation including visibile alternatives, and concept development to understand the system issues such as life cycle cost, deployment, survivability, performance and assess changes in the requirements, (See Descriptive Summary on Project 0001 for details).

The space-based system can provide near real-time, detection of an attack, growth to meet more sophisticated Soviet attack modes, Furthermore, this system offers increased survivability and is not subject to the difficulties and uncertainties of foreign basing.

RELATED ACTIVITIES: This program is part of a single managed Space Defense Program involving four functional areas: anti-satellite, space surveillance, space survivability, and command and control. Program Element (P.E.) 64406F, Space Defense System, provides an' P.E. 63438F, Satellite Systems Survivability, provides on-board sensors which assist in the satellite attack verification function of this program which provides the required warning time needed for some survival aids such as maneuvering. The Defense Advanced Research Projects Agency's Space Object Identification Program and the Tactical Assessment of Satellite Mission Program under the Space Surveillance Program are integrated and have common technical management agencies. P.E. 12424F, United States Air Force SPACETRACK, incorporates the research and development efforts of this program into the operational SPACETRACK system. P.E. 12311F will provide the command and control for these programs.

WORK PERFORMED BY: Headquarters, Space Division, Los Angeles, CA, is responsible for overall management of the P.E., A.D. Little Corporation, Cambridge, MA --cryogenic cooler. Hughes, Culver City, CA --cryogenic cooler and long wavelength infrared sensor. TRW, Redondo Beach, CA --ground electro optics moving target indicator. Aerospace Corporation, El Segundo CA, Lincoln Laboratory, Lexington, MA, and MITRE, Boston, MA provide general systems engineering.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Cryogenic cooler efforts were continued with life testing for the Vuilleumeir cooler and acceptance testing for a two stage rotary reciprocating refrigerator. In FY 1976 both the tactical assessment of satellite mission efforts and the long wavelength infrared probe efforts were initiated. The experimental prototype ground-based electro-optics site at White Sands Missile Range started operation in August 1975 and has completed initial sensor and moving target indicator testing. Design studies were conducted for a ground-based radar system and a

multi-mission space-based radar. A contract was awarded in Fiscal Year (FY) 1976 for development of Satellite Attack Warning and Verification software system with initial system testing algorithms initiated in FY 1978 and transition in FY 1979 to Aeorspace Defense Command. Development testing was completed for calibrating existing SPACETRACK radars using the Navy navigation system and for extending the tracking range of several radars to 22,000 nautical miles (nm) through the use of

Contracts were awarded for the Space Infrared Experiment (SIRE) and the program has proceeded past Critical Design Review and initial sensor fabrication and testing. In FY 1979 the SIRE host spacecraft, developed by the Space Test Program, Program Element (P.E.) 63402F was terminated and the SIRE program was converted to a shuttle sortie mission. Changes to the SIRE sensor were initiated. An expanded performance and reliability program on the Vuilleumeir cryogenic cooler was initiated for SIRE. Acceptance testing of a two stage rotary reciprocating refrigerator was completed. Component development was initiated for a three stage refrigerator. The sensors and probes for the long wavelength infrared measurements were procured and are in the later stages of design, fabrication and testing. One probe was launched and failed due to rocket problems. The HAYSTACK imaging radar development and transition was initiated. The ALCOR imaging radar transitioned in FY 1978. The experimental prototype ground-based electro-optical site was developed and initiated sensor reliability and other testing to support procurement of the operational system (P.E. 12424F, SPACETRACK) (See Descriptive Summary for Project 0001). A mathematical model was developed to support the United States Satellite Attack Warning missions and will result in a surveillance architecture for upgrading the SPACETRACK system. A program was initiated to A new program office was formed integrating the surveillance, anti-satellite, survivability and command and control functions to be more responsive to Presidential and Secretary of Defense directives.

2. FY 1980 Planned Program: The Vuilleumeir cryogenic cooler performance reliability test program will continue. Fabrication of a rotary reciprocating three stage refrigerator and advanced Vuilleumeir cooler will be continued. Three Long Wavelength Infrared (LWIR) probe launches are planned. The integration and improvement of assets for the tactical analysis of satellite missions will be continued. The initial HAYSTACK imaging radar development will be completed. Testing of the ground-based electro-optical systems and the payload/spacecraft integration of the LWIR space experiment will be initated along with continued data processing development and testing (see separate Descriptive Summary for Project 0001). The SPACETRACK model will be maintained to allow for trade-offs in system performance as changes occur. Evaluation and refinements of the Satellite Attack Warning software for transition to Aerospace Defense Command will continue. Development of software/hardware for integrating missile tracking and other data into SPACETRACK will also continue with improvement to satellite attack warning.

3. FY 1981 Planned Program: The SIRE payload redesign will be completed with fabrication initiated. Several activities will be completed or in the final development phase in the FY 1981 time frame including: tactical assessment of satellite mission improvements and transition; ground-based electro-optics testing; software development for improved SPACETRACK targeting; development and transition of Satellite Attack Warning algorithms; and integration of data into SPACETRACK. The primary space efforts in this period will be the development of the redesigned SIRE payload, LWIR cryogenic cooler performance and 3 year life testing, and system concept development.

Program Element: # 63428F
DoD Mission Area: Space Defense, # 123

Title: Space Surveillance Technology
Budget Activity: Strategic Programs, # 3

4. FY 1982 Planned Program: The program will complete most of the near-term improvements including documentation and engineering design. The Space Infrared Experiment effort will continue with hardware testing and shuttle integration planning. The probe measurements launches will be completed with the data being analyzed and provided to the United States program and for the surveillance system design.

5. Program to Completion: The long wavelength infrared efforts will lead to a 1984 Defense System Acquisition Review Council II decision on the configuration and requirements for the space-based system. , Satellite Attack Warning requirements and threat growth will, coupled with the system development results provide the decision data base.

6. Milestones: Not applicable

7. Resources: Not applicable

8. Comparison with the FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	36,869	36,100	42,100	56,000	Continuing	Not applicable

- The change in FY 1981 funding is due to the delay in initiating the development of a space based system resulting from the restructing of the SIRE program with a delayed launch date.

Project: 2698
Program Element: # 63428F
DoD Mission Area: Space Defense, # 123

Title: System Development
Title: Space Surveillance Technology
Budget Activity: Strategic Programs, # 3

DETAILED BACKGROUND AND DESCRIPTION: The efforts under this project are those system oriented tasks that are specifically designed to increase the reaction time of SPACETRACK to support the time constrained requirements of Space Defense and for increasing the detection range of SPACETRACK from the current limit of 3,000 nautical miles (nm) to 22,000nm). Currently,

This project is divided into two basic efforts. First is the testing of an experimental ground electro-optical site that is used as the prototype for development of a near-term, low risk, five site global Ground Electro-Optical Deep Space Surveillance System under Program Element (P.E.) 12424F, SPACETRACK. This system will immediately increase the detection altitude to 22,000nm and will cover the geosynchronous belt; however, with limited response time due to weather limitations and night time background requirements. The experimental site, located at White Sands Missile Range, NM, has been operating since August 1975 and will terminate operations in Fiscal Year (FY) 1981 to be replaced by a full global Ground Electro-Optical Deep Space Surveillance site.

The second effort is the development of a 1980's solution to reduce the need for overseas and vulnerable remote bases, improve high altitude coverage and range for the whole celestial sphere, and to reduce the detection time to near real-time so that high confidence warning of an attack on United States (U.S.) satellites can be provided in sufficient time to exercise a political or military response. This program will also provide more responsive Current technology and background data are not available to develop or evaluate this system in the near-term. Technology is being pursued for the experimental development of a space-based Long Wavelength Infrared (LWIR) system. Several systems were compared for performance, coverage and cost with the space-based LWIR sytem. The LWIR sytem was selected as the primary approach for satisfying the needs.

Preliminary LWIR surveillance system concepts were developed during FY 1975. These preliminary studies provided a conceptual basis for the program and identified the specific technological and background issues and areas of concern, along with a preliminary development roadmap. The infrared background probe measurements program, cryogenic cooler and sensor developments, space infrared experiment and a surveillance architecture program were formed to specifically address the critical path areas, provide for a system level demonstration experiment and evaluate the system utility. Design concepts may be investigated at a low level under this project for advanced microwave, visible and alternate infrared systems as potential backups to support this mission and assure the program is current.

Project: 2698
Program Element: # 63428F
DoD Mission Area: Space Defense, # 123

Title: Systems Development
Title: Space Surveillance Technology
Budget Activity: Strategic Programs, # 3

RELATED ACTIVITIES: Provides
In P.E. 63438F, Satellite Systems Survivability, the "On-Board Sensors" effort, when integrated with this program, provides an integrated capability to warn of or verify an attack on a satellite. Defense Advanced Research Projects Agency's (DARPA) Space Surveillance Program is integrated with these efforts. P.E. 12424F, United States Air Force SPACETRACK, will deploy a five site ground electro-optics system and other improvements based on technology from this project. The Space Infrared Experiment will be flown by the Space Test Program (P.E. 63402F).

WORK PERFORMED BY: Hq Space Division, Los Angeles, CA, manages this project. The Electronic Systems Division and Air Force Geophysical Laboratory, Hanscom AFB, MA, and Rome Air Development Center, Rome NY manage selected tasks within the individual projects. The contractors for ground and space-based system development include Westinghouse Electric Corporation, Baltimore, MD; TRW, Redondo Beach, CA; Hughes, Culver City, CA; MIT, Lincoln Laboratory, Lexington, MA; Lockheed Missiles and Space Company, Incorporated Sunnyvale, CA; Rockwell International Corportation, Seal Beach, CA; MITRE Corporation, Bedford, MA; Aerospace Corporation, Bedford, MA; Aerospace Corporation, El Segundo, CA, and Science Applications Incorporated, La Jolla, CA;
provide general systems engineering.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The ground-based electro-optics site at White Sands Missile Range started operation on 30 August 1975. An advanced electro-optical tube was developed and tested. Four competing moving target indicator techniques were developed and tested. A 31 inch telescope and a 14 inch telescope were used in the prototype configuration. The development of the procurement package and specifications for the five site operational system was conducted in Fiscal Year (FY) 1977 and a contract was awarded in May 1978 under P.E. 12424F SPACETRACK. During this period through FY 1981 the ground-based electro-optical test site at White Sands Missile Range were dedicated to supporting the operational system procurement and developing improvements in software and sensors (some developed by DARPA) as potential block changes to the operational system. The test site will suppport the operational site development in areas such as sensor reliability testing and system maintenance. This site will also serve as the primary high altitude detection sensor for SPACETRACK until the first site becomes operational in

Several space-based system concepts employing a Long Wavelength Infrared (LWIR) sensor were analyzed to determine background, target and technology data required to evaluate the concept. To meet these requirements and because adequate LWIR data cannot be gathered on the ground, a three part technology and measurement program was initiated. The first effort had a background measurements program initiated in 1976. Three types of background data are needed including infrared data on stars (celestial data), the earth's atmosphere (Earthlimb data) and the solar plane (Zodiacal data). Seven probes were initially planned, later expanding to ten. Three different sensors were required and were developed starting about FY 1977 using two modified sensors and one new sensor. This program was to provide early indicative data to bound system technology development and provide critical background data for the United States
. The second effort was a space experiment to be flown as the primary experiment on a Space Test Program (P.E. 63402F) shuttle sortie flight scheduled for FY 1983. The title of the effort is Space Infrared Experiment.

Project: 2698 Title: System Development
Program Element: # 63428F Title: Space Surveillance Technology
DoD Mission Area: Space Defense, # 123 Budget Activity: Strategic Programs, # 3

The payload was initially scheduled as a one year satellite mission to be la ched in Fiscal Year (FY) 1981, however, the satellite was terminated in FY 1979 and Space Infrared Experiment (SIRE) was restructured to the satellite sortie mission including the additional probe flights.

The primary payload elements are a modification of a state-of-the-art sensor, a high sensitivity experimental focal plane, a cryogenic cooler, a gimbal and heat rejection system. A detailed System Design Review was accomplished to establish experimental goals consistent with hardware realities. The design and fabrication was completed at the time of the satellite termination. The completed sensor was successfully tested but will require extensive redesign to fly captive on the shuttle.

This experiment will provide detailed systems background and extensive : data for both the Long Wavelength Infrared (LWIR) surveillance system and

The third program was the LWIR satellite surveillance systems technology, primarily cryogenic coolers, although some other work is included. These surveillance systems are dependent upon detection sensors of high sensitivity which requires cooling as low as ten degrees above absolute zero. To obtain the requisite cooling, cryogenic coolers must be developed which provide adequate performance and are sufficiently long-lived to make an LWIR operational system cost effective. The objective of this effort is to develop and demonstrate the cryogenic cooler technology and reliability for the surveillance system. Cryogenic coolers for this application represent a significant departure from other Air Force cryogenic cooler work because they operate near absolute zero (versus 50 degrees Kelvin), they must operate in space, and they must operate for at least three years without maintenance. This program also supports a near term requirement for a space qualified cooler for the SIRE (1 year life goal) and the development of cooling techniques for the system three to five year requirement.

2. FY 1980 Planned Program: The ground-based electro-optical developments will continue with reliability and maintainability improvements testing. Preparation will begin in FY 1980 to replace this site with a full Ground Electro-Optical Deep Space System for operational transition to the Aerospace Defense Command. This site will continue to provide a high altitude detection capability for SPACETRACK.

The SIRE payload will be redesigned for the shuttle. Special design requirements must be accommodated, such as contamination control, along with detailed interface definition for the planned Space Test Program standard test pallet. Detailed mission planning will be accomplished along with changes to the data reduction program.

The prototype technology development activitites will continue limited long lead sensor developments using the results of the probe measurements. The cooler reliability testing and development will continue. Three probe launches are planned. System concept studies will continue.

Project: 2698
Program Element: # 63428F
DoD Mission Area: Space Defense, # 123

Title: Systems Development
Title: Space Surveillance Technology
Budget Activity: Strategic Programs, # 3

3. FY 1981 Planned Program: All ground-based electro-optical developments will be completed in Fiscal Year (FY) 1981 and the site will be replaced with a full Ground-based Electro-Optical Deep Space Surveillance for use by the Aerospace Defense Command. The Space Infrared Experiment (SIRE) redesign will be completed in [illegible] 1981 with hardware fabrication initiated. The data processing/reduction program will be redesigned to process the SIRE data. The technology programs to support the operational system decision will continue including cooler development and testing probe measurements and component technology investigations. Preparation of a procurement package will be initiated for a major system/concept development starting in FY 1982. All these efforts are focused to provide the basis for a Defense Review Council (DSARC) II milestone in FY 1984.

4. Program to Completion: The near-term improvements to SPACETRACK will be completed in the early 1980's. These results coupled with the results of the SIRE flight, [illegible]ong Wave-Length Infrared (LWIR) concept, technology and design results, and updated threat projections will be the basis on which the far-term system surveillance concept will be selected for full up prototype development. This DSARC II review and decision will occur in late FY 1984 for a prototype launch in FY 1988.

5. Milestones: Not applicable

6. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	28,032	34,000	38,500	50,600	Continuing	Not applicable

8. Comparison with the F

RDT&E Funds	28,069	28,200	30,900	47,100	C

- There was a major funding change in the FY 1981 budget estimate from the 1980 Descriptive Summary estimate. Minor fluctuations in FY 1979 have occurred as estimates become actuals. The major change was due to the Space Test Program restructuring of the SIRE from a free flying spacecraft to a shuttle sortie. This necessitated major redesign of the near completed payload for a significantly different host environment with about an eighteen month delay. The additional cost to accomplish the change was taken from within this program, specifically the operational development, resulting in a program and operational system delay of about two years. FY 1981 funds were deleted consistent with this delay.

1/ Different project breakout in these years

Project: 2699 Title: Information & Network Development
Program Element: #63428F Title: Space Surveillance Technology
DoD Mission Area: Strategic Defense, # 123 Budget Activity: Strategic Programs, # 3

DETAILED PROGRAM AND BACKGROUND: This project consolidated several previous projects and tasks that are developing new techniques and hardware to gather, process, analyze and report data to support the SPACETRACK surveillance system missions. Included are: target signature techniques for collection of Space Object Identification (SOI) data to help determine a satellite mission and threat potential; software for assesing, tasking and reporting if there isan attack on a United States satellite, (U.S. system under development and; modeling of the current SPACETRACK system evaluate requirements and propsed solutions to evaluate those solutions and develop an architecture for improvements.

To support the SOI requirements, a Target Signatures Planninng Group was formed in FY 1975. This group reviewed all RDT& operational facilities. A program was established to (a) perform the RDT&E at existing sites to extract the most cost effective image data and to convert the output of the equipment to near real-time tactical data for transmission to North American Air Defense Command; (b) eliminate sites not required; (c) examine new techniques, and a central processing capa bility. These efforts are scheduled to be completed by FY 1982. These efforts will provide a high altitude radar imagin capability, low altitude optical imaging, high altitude visible photometry and a thermal remote sensing capability.

The Satellite Attack Warning/Verification (SAW/V) software feasibility was demonstrated at the Aerospace Defense Command (ADCOM) FY 1975. During FY 1976 a three year design and development effort for implementation of an operational SAW/V system at the ADCOM Space Defense Center was initiated. This included procurement of software, modification of existing display equipment, procurement of program-peculiar displays, use of existing computers, procurement of program computer interface hardware, and software/sensor interface.

This capability was demonstrated in FY 1979 and transitioned to ADCOM in FY 1979 as an initial capabilities. Improvements were initiated, and SAW/V systems, therefore, preliminary studies were initiated to identify potential improvement.

An initial SPACETRACK system model was used to assess the operational requirements and evaluate the proposed system in the FY 1975 SPACETRACK Augmentation Studies discussed in Project 0001. This model was extremely useful and was expanded to help analyze the requriements and quantitatively evaluate the proposed solultions.

Project: 2699 Title: Information & Network Development
Program Element: # 63428F Title: Space Surveillance Technology
DoD Mission Area: Strategic Defense, # 123 Budget Activity: Strategic Programs, #3

RELATED ACTIVITES: This project is coordinated with Air Force and Defense Research Projects Agency (DARPA) programs. Future space-based space surveillance concepts and other options developed under Project 0001 of this program will be evaluated using the SPACETRACK model. The United States

Several DARPA Space Object Identification efforts are being transitioned for operational use. P.E. 12424F, SPACETRACK, will provide the support for incorporating these developments into the operational inventory.

WORK PERFORMED BY: HQ Space Division, Los Angeles, CA, manages this project with support by Romc Air Development Center, Rome, NY, on specific tasks. Major contractors include Grumman Aerospace Corporation, Bethpage, NY; Lincoln Laboratories, Lexington, MA; Aerospace Corportion, El Segundo CA, and Science Application Incorporated, La Jolla, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Target Signature Group reviewed all Department of Defense space object identification facilities and made recommendations on their use, termination, and necessary Research and Development to integrate selected facilities into a single capability. Those recommendations were implemented under this project. Several sensor developments and modifications were initiated on the selected capabilities. Modifications of existing Lincoln Laboratory wideband radar software and data analysis procedures were initiated for use at North American Air Defense Command and to provide near real-time transmission of selected parameters collected on satellies by the HAYSTACK radar and DARPA - Lincoln coherent radar. Efforts to develop tactical software and data processing at the ARPA MOTIF facility at Maui, Hawaii, were initiated in 1975 and are completed and were transitioned to Aerospace Defense Command in FY 1979.

The Satellite Attack Warning/Verification development program was initiated and transioned resulting in an initial operational capability in FY 1979.

The proposed improvements were assessed and an initial study conducted to determine the technical alternatives. In FY 1979 a development program was initiated.

The SPACETRACK model was developed by assessing the technical and mission requirements and evaluating the proposed solutions. This model was used to evaluate and tailor several SPACETRACK improvements such as the Ground Electro Optical Deep Space Surveillance sytems, use of the ARPA-Lincoln Tracking and Identification Radar (ALTAIR) at Kwajalein, Hawaii and GPS-10 relocated to the the use of the HAYSTACK, ALTAIR and Dyarbakin radars and development of a preliminary SPACETRACK Surveillance architecture roadmap to satisfy the surveillance requirements.

Project: 2699 — Title: Information & Network Development
Program Element: # 63428F — Title: Space Surveillance Technology
DoD Mission Area: Strategic Defense, # 123 — Budget Activity: Strategic Programs, # 3

2. FY 1980 Proposed Program: Continuation of these efforts and the use of the SPACETRACK model to support a major Air Force review of the requirements and proposed space based surveillance system concepts for the late 1980's.

3. FY 1981 Proposed Program: FY 1981 is especially important as the program to improve the Space Object Identification and Satellite Attack Warning /Verification (SAW/V) capabilities will near completion for transition in FY 1982. Major system demonstrations are planned in FY 1981. The HAYSTACK sensor development will be completed and the SAW/V improvements will be demonstrated for transition to Program Element 12311F, North American Air Defense Command Combat Operations Center for incorporation into the Space Defense Operations Center. The SPACETRACK network architectural studies will continue.

4. FY 1982 Proposed Program: Completion of the efforts except the SPACECTRACK network model which will be used for the FY 1984 Defense System Acquisition Review Council (DSARC) on the space based surveillance system decision.

5. Program to Completion: The program will be completed after a Defense System Acquisition Review Council Milestone II decision is made on the space based surveillance system.

6. Milestones: Not Applicable

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	7,900	8,100	5,800	6,800	Continuing	Not Applicable
Quantiity	2			2		

8. Comparison With The FY 1980 Budget:

FY 1981 RDT&E Descriptive Summary

Program Element: #63429F
DoD Mission Area: Strategic Information Systems, #134

Title: Warning Information Correlation (WIC)
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,348	3,600	3,000	6,600	Continuing	Not Applicable
2490	Sensor Interface	2,000	1,600	1,100	1,500	Continuing	Not Applicable
2491	System Development	1,348	2,000	1,900	5,100	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Warning Information Correlation (WIC) evaluates and supports efforts developing higher levels of confidence in assessing the size, timing, and targets of missile attacks. It provides basic studies evaluating and defining the scope of improved warning, attack assessment, communications, processing systems, and displays for tactical warning and attack assessment information. The information is required by the National Command Authorities (NCA) and the primary nuclear Commanders-in-Chief (CINCs) for strategic force management during crisis and conflict to initiate survival actions, control escalation, terminate hostilities, and manage the strategic reserve force in support of our flexible response policy. To reduce duplication, WIC requirements and efforts are coordinated with the sensor system programs, the World Wide Military Command and Control System, and the Command Center Processing and Display System. WIC evaluates and develops general design specifications for coherent, integrated use of warning data from a variety of sensors (both space based and ground based); evaluates the survivability and transmission of this data from sensor to command; and considers processing and display techniques which assure reliable and useable information is available at the command centers and commands.

BASIS FOR FY 1981 RDT&E REQUEST: The FY 1981 effort is directed to design, test, demonstrate, and deliver improved, more reliable software and display design specifications to replace obsolete equipment providing missile warning and attack assessment information. The program will also initiate competitive studies directed toward reconstitutable warning sensors to focus related efforts by other services and agencies within the total system context.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63429F
DoD Mission Area: Strategic Information Systems #134

Title: Warning Information Correlation (WIC)
Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: The United States Air Force (USAF) missile attack assessment (AA) program was low key during the 1973-1975 period. USAF concluded that correlation of reports from the with those from Ballistic Missile Early Warning System (BMEWS) was not possible with the current sensor capability. Therefore, sensor improvements were required. However, during 1975 under this program element (PE) (PE 63429F, then the Attack Assessment System), initial software was designed and tested using BMEWS detection radar data which provides an estimated count of total objects) and impact predictions (on the order of nautical miles or greater). However, this data's utility is limited to large attacks against all target classes - missiles, submarine and bomber bases, cities, command and control, and other. Although the algorithms are only marginally descriptive, it was shown statistically that the estimated object counts from large raids would be representative of the threat actually presented. This inital capability was installed at North American Air Defense (NORAD) in April 1978. In FY 1977, PE 63429F was directed to analyze current and proposed sensors (BMEWS, PAVE PAWS, Integrated Operational NUDET (Nuclear Detonation) Detection System (IONDS), Perimeter Acquisition Radar Attack Characterization System) to identify specific improvements that would contribute to improved, high confidence, integrated attack assessment. In order to understand the sensors and test concepts a simulator program was initiated and test tools developed. Recommendations for BMEWS, PAVE PAWS, and IONDS improvements were made which, together with the USAF Missile Warning Study (1978), provided the basis for the USAF sensor improvement program initiated in 1979. WIC has also initiated systems studies concerning processing and display concepts as well as requirements and operations concepts for an improved AA system. WIC is directed toward providing capabilities to meet the Office of Joint Chiefs of Staff requirements for AA and supporting valid NORAD requirements for continental United States and world-wide tactical warning and AA (TW/AA) using both pre-attack warning data and post impact nuclear detections. The extension of these capabilities for potential force management roles would also be pursued. The improvements are essential if the National Command Authorities are to have information supporting a credible and sustainable policy of flexible response.

RELATED ACTIVITIES: WIC provides RDT&E for improved missile warning and attack assessment (MW/AA) software and display in support of the Department of Defense's World-Wide Military Command and Control System (WWMCCS). The USAF program, AF/WWMCCS, PE 63735F, develops the overall architecture for all command and control functions from sensor to user, end-to-end, to include communications and survivability. Supporting this architecture, WIC provides specific TW/AA design for integration into the common user computer and display system - Command Center Processing and Display System (CCPDS), PE 12436F. CCPDS provides the computer and display hardware and implements improved software packages into the system at the National Military Command Center and its alternate, into the Strategic Air Command, and into NORAD's Cheyenne Mountain Complex. In addition to its integral coordination with AF/WWMCCS and CCPDS, WIC is closely aligned with the sensor system programs to provide common threat, simulator support, and design/evaluation interface for AA. Air Force Research, Development, and Acquisition has directed a special emphasis management project, SEEK OPTIONS, upon Headquarters, Air Force Systems Command to assure integration of several RDT&E programs toward a common goal of improved MW/AA without duplication and with commonality, cooperation, and coordination.

Program Element: #63429F
DoD Mission Area: Strategic Information Systems, #134

Title: Warning Information Correlation (WIC)
Budget Activity: Strategic Programs #3

WORK PERFORMED BY: Electronic Systems Division, Bedford, MA, is the System Program Office. Space Divison, Los Angeles Air Force Station, Los Angeles, CA, is also a participant. Contractors in FY 1980 include TRW System Group, Redondo Beach, CA; Kappa Systems, Inc., Colorado Springs, CO; General Research Corporation, Santa Barbara, CA; Teledyne-Brown Engineering, Huntsville, AL; Logicon , San Pedro, CA; Lincoln Laboratories, Bedford, MA; Aerodyne Research Inc., Bedford, MA; and MITRE Corporation, Bedford, MA. Several other contracts will be awarded under competition.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In April 1976 Warning Information Correlation (WIC) delivered the current North American Defense (NORAD) four class attack assessment (AA) algorithms and supported development of improved software. In 1977 recommendations were provided for sensor upgrades, and sensor and command center simulators for analyses, development, and test usage were developed. In 1978 initial work was completed for specification of improved missile warning (MW) and AA, on operational concepts, and on threat studies for a 1985 threat required in support of software/sensor design. Threat work was expanded in 1979 along with new efforts initiated for data processing concepts and data distribution.

2. FY 1980 Program: An updated threat will be completed and the current sensor simulators will be updated to represent proposed sensor improvements. Outstanding issues such as discrimination, data base requirements, system architecture trades between sensor processing and rearward user, system sensitivities, and data integration will be investigated. Concepts, software, data bases, algorithms, and design specifications will be pursued to support improved AA. Integration (as available) of improved azimuth and count data, more timely improved Perimeter Acquisition Radar Attack Characterization System data, and upgraded Ballistic Missile Early Warning System (BMEWS) data will be addressed; specifications and potential procedures for communicating and processing will be developed as required. Command display upgrades will be evaluated. Reconstitutable warning sensor concept studies will be initiated.

3. FY 1981 Planned Program: Initiate design and development of an improved continental United States (CONUS) MW/AA system based on BMEWS sensor improvements, improved sensor evolutionary development and improved nuclear detonation (NUDETS) data from the Advanced Atmospheric Burst Locator, and the Integrated Operational NUDETS Detection System (IONDS) Program. Provide for integrated sensor AA with association and correlation in conjunction with the and BMEWS upgrades supporting flexible response. Deliver improved software and display specifications from prior tasks. Continue reconstitutable warning sensor concept studies. Maintain necessary threat support.

4. FY 1982 Planned Program: Continue CONUS AA evaluation, design and development for improved, integrated, and more survivable AA, as a function of utility, cost, risk, and availability (including timeliness and survivability). Evaluate contributions and integration of new or improved sensors, including fully upgraded BMEWS, follow-on, and IONDS. Initiate extension of CONUS AA efforts to support worldwide theater MW/AA for crisis and force management. Continue to evaluate potential display and threat support improvements.

Program Element: #63429F
DoD Mission Area: Strategic Information Systems, #134

Title: Warning Information Correlation (WIC)
Budget Activity: Strategic Programs #3

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,100	4,100	4,600	8,000	Continuing	Not Applicable
2490	Sensor Interface	1,100	1,400	1,200	1,100	Continuing	Not Applicable
2491	System Development	1,000	2,700	3,400	6,900	Continuing	Not Applicable

The Warning Information Correlation (WIC) Program Office was transferred in October 1978 to the Electronics Systems Division of the Air Force Systems Command; however, WIC funding was not provided until February 1979. As a result of this reduced time, 752 thousand dollars of FY 1979 funds were not required. The FY 1981 program was reduced five million dollars to fund higher priority needs. The FY 1980 program was reduced by one million dollars in December, 1979 to help offset late developing critical requirements. These reductions will delay completion of improved software and display specifications and delay initiation of studies for overall warning and attack assessment system design improvements.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63431F
Title: Advanced Space Communications
DoD Mission Area: Satellite Communications, #133
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	30,600	32,900	27,000	44,200	Continuing	Not Applicable
1227	Terminal Segment Technology	8,300	9,600	7,500	8,500	Continuing	Not Applicable
2028	Space Segment Technology	15,100	13,300	11,900	14,800	Continuing	Not Applicable
2029	System Analysis/Demonstration	7,200	10,000	7,600	20,900	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element is the only Air Force program for advanced development of satellite communications system concepts, techniques, and technologies. The program identifies, develops, demonstrates, evaluates, and transitions to operational systems the satellite and terminal technology necessary to support survivable command and control communications with reliable global coverage. The technologies being developed are necessary to counter the electronic jamming threat posed to satellite communications systems.

BASIS FOR FY 1981 RDT&E REQUEST: The FY 1981 program will concentrate on the techniques, technologies, and concepts for providing a future military satellite communications system for the Department of Defense's tactical mobile forces and for improving the electronic jam resistance and capacity of DoD's high data rate users. These requirements are represented by the previously designated General Purpose Satellite Communications System and by future upgrades to the Defense Satellite Communications System. Developments will be conducted for the space segments and airborne terminal segments of these future satellite communications systems.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63431F Title: Advanced Space Communications
DoD Mission Area: Satellite Communications, #133 Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Air Force is responsible for the development of the Department of Defense's military satellite communications systems (MILSATCOM). The architecture for future MILSATCOM systems to meet DoD's evolving satellite communications requirement is developed by the Defense Communications Agency/Military Satellite Communications System Office (DCA/MSO). Near term specific satellite systems within this architecture are developed in the Air Force under separate Program Elements. This Program Element (63431F) primarily develops and demonstrates the techniques, technologies, and concepts for the next generation MILSATCOM systems. Future generation MILSATCOM systems present unique technology challenges to enable high capacity military communications to survive under the stress of sophisticated electronic jamming environments. These technology challenges are pursued in this program element under three projects. The first project (1227) concentrates on the development of the technologies required for providing airborne terminal segments with cost effective MILSATCOM capabilities. Technologies included are solid state amplifiers, conformal null steering aircraft antennas, small light weight low cost terminals, higher frequency band components, and advanced modulations. These technologies and resulting systems are field tested and simultaneous atmospheric propagation effects measurements accomplished. The second project (2028) concentrates on the development of the technologies required for future generation satellite segments. Included are systems for supporting Nuclear-Capable Forces, High Volume/High-Data-Rate Command/Control requirements and the Mobile/Tactical users. Associated technologies include solid state amplifiers, on-board processors, null steering antennas, higher frequency band components, and subsystems. The third project (2029) accomplishes preliminary MILSATCOM system analyses from which future airborne, ground, and space requisite technologies can be identified. A primary concentration at this point in time is a tactical satellite communication system for the future. This project further considers the integration of multiple technologies for orbital testing and evaluation.

RELATED ACTIVITIES: The technology and concepts developed in this program will be transitioned to operational systems for implementation. These systems are represented by the Air Force Satellite Communications Program and the Strategic Satellite System (PE 33601F), the Defense Satellite Communications System (PE 33110F) and the General Purpose Satellite Communications System (previously structured under PE 33602F - now transferred to this program element - 63431F - for technology development). MILSATCOM system planning and technology development are coordinated with Army and Navy companion efforts: Navy - Advanced Satellite Communications (PE 33109N) and HYDRUS (PE 11403N); Army - Tactical Satellite Communications Systems (PE 33142A, Project D456).

WORK PERFORMED BY: This program and Projects 2028 and 2029 are managed by Air Force Systems Command, Space Division, Los Angeles, CA. Project 1227 is managed by Electronic Systems Division , Hanscom AFB, MA. Facilities supporting these efforts include: the Air Force Avionics Laboratory, Wright-Patterson AFB, OH; the Rome Air Development Center, Griffis AFB, NY; and the Air Force Weapons Laboratory, Albuquerque, NM. This program involves approximately 20 separate contracts. Major contractors are: McDonnell Douglas Aircraft Corporation, St. Louis, MO, for the space laser communications program; TRW Systems Group, El Segundo, CA; and Hughes Aircraft Company, Culver City, CA. for solid state amplifiers; Lincoln Laboratory, Lexington, MA., for tactical technology; Linkabit Corporation, Redondo Beach, CA., on terminal modems; Raytheon, Wayland, MA., for a dual frequency terminal; and Ball Brothers, Boulder, CO., for conformal antennas. Federal Contract Research Center support is provided by: the Aerospace Corporation, Los Angeles, CA.; the MITRE Corporation, Bedford, MA; Lincoln Laboratory, Bedford, MA.

Program Element: #63431F
Dod Mission Area: Satellite Communications, #133

Title: Advanced Space Communications
Budget Activity: Strategic Programs, #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Lincoln Experimental Satellites (LES) 8 and 9 were successfully launched (March 1976) and evaluated. Technologies demonstrated included Extremely High Frequencies (EHF), advanced frequency hopping modulations, satellite-to-satellite cross-links, and nuclear prime power sources. A Dual Frequency Terminal (EHF/SHF - Extremely High and Super High Frequencies) for command post aircraft was developed and testing accomplished. This type of terminal will

A source selection was initiated on a smaller version SHF/EHF Airborne Terminal for command post applications. This terminal will weigh approximately 1,200 pounds in comparison to the existing 5,500 pound SHF Airborne Command Post Satellite Communications Terminal. A Command Post Message Processor development was initiated that will provide for command post control of multiple channel communications through different satellite systems simultaneously. A Solid State Ultra High Frequency (UHF) Airborne Amplifier was developed, delivered and tested. This terminal will increase force element aircraft transmit power from 100 watts to 1,000 watts. A demonstration Space Laser Communications System successfully completed laboratory testing and transferred to the White Sands Missile Range for ground and airborne demonstration tests. Development of a Laser Space Measurement Unit (LSMU) was initiated for launch in FY 1983 on a host vehicle to evaluate basic aspects of laser communications through the atmosphere to an orbital platform. Solid state EHF diodes for spaceborne amplifiers were developed and demonstrated.

2. FY 1980 Program: The Command Post Message Processor and the Small SHF/EHF Airborne Terminal development will continue. Planning will be initiated for FY 1981 flight testing of these two equipments in an EC-135 aircraft under an evaluation program at the Air Force Avionics Laboratory. A development program for advanced technologies in support of airborne Strategic Force Element Terminals and small Tactical Airborne Terminals will be structured. Laboratory fabrication of EHF spacecraft technologies will commence. These technologies, including null steering antennas, on-board signal processors, and solid state amplifiers, will be needed in future generation military satellite communications systems to provide assured connectivity under stress from sophisticated electronic jamming threats. The Space Laser Communications System will be demonstrated at a full 1 gigabit per second data rate, with a data link between an airborne platform and a ground based terminal. In addition to the high data rates, this airborne laser flight test will also demonstrate the laser's inherent non-jammability and covertness features. Development of a Laser Space Measurement Unit (LSMU) will continue for launch in FY 1983. Space demonstration of other critical microwave technologies will be planned.

3. FY 1981 Planned Program: The Command Post Message Processor and the Small SHF/EHF Airborne Terminal will start flight testing in the EC-135 aircraft under Air Force Avionics Laboratory direction. Key aspects of an Advanced Tactical/Strategic airborne terminal development program will be initiated. Prototype subsystem technologies representative of a future tactical satellite communications system will be fabricated in the laboratory. Planning for the potential launching of a payload on a host vehicle with these technologies will continue. The airborne testing of the Space Laser Communications System will be completed. Development of the LSMU payload will continue.

Program Element: #63431F
DoD Mission Area: Satellite Communications, #133

Title: Advanced Space Communications
Budget Activity: Strategic Programs, #3

4. FY 1982 Planned Program: The Command Post Message Processor and the Small SHF/EHF (Super High and Extremely High Frequencies) Airborne Terminal will continue flight testing in the EC-135 aircraft. A SHF conformal antenna will be integrated with the aircraft for evaluation in comparison with a conventional parabolic dish in a protruding radome. Development and testing of EHF spacecraft technologies will continue. The Laser Space Measurement Unit will be delivered for spacecraft integration and a FY 1983 launch. Army, Navy, Air force, and Defense Communications Agency/ Military Satellite Communications Systems Office coordination on the planning for a future tactical Military Satellite Communications system will be accelerated. Detailed system concepts will be investigated to determine technology requirements. Prototype subsystems for potential orbital evaluation will be laboratory tested.

5. Program to Completion: This is a continuing technology development program. Component and communication subsystem development will continue to provide the requisite techniques, technologies, and concepts for future military satellite communications systems capable of surviving in the face of sophisticated electronic jamming environments.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	14,200	30,400	32,900	41,400		
1227	Terminal Segment Technology	3,000	8,300	9,600	10,200	Continuing	Not Applicable
2028	Space Segment Technology	4,900	15,100	13,300	15,200	Continuing	Not Applicable
2029	System Analysis/Demonstration	6,300	7,000	10,000	16,000	Continuing	Not Applicable

See project pages for budget comparison analyses.

Project: #1227 Title: Terminal Segment Technology
Program Element: #63431F Title: Advanced Space Communications
DoD Mission Area: Satellite Communications, #133 Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Military Services, the Commanders-in-Chief (CINCs), and the National Command Authorities require airborne command, control and communications (C^3) terminals that permit operation through designated satellite systems for command and control of United States force elements. Emphasis is placed upon increased survivability, performance and reliability for Single Integrated Operations Plan (SIOP) execution and management, crisis management and contingency operations. This project evaluates space communications system terminal requirements and develops concepts to meet these needs; evaluates the technology available to implement the concept and determines what additional technology development is required; conducts simulation and concept evaluation efforts; and assists operational systems in planning for evolutionary improvements in capability. These efforts support development of an integrated set of satellite communications capabilities for all defense requirements and insures that the technology development required to reduce risk is available prior to full scale development decisions.

RELATED ACTIVITIES: This project supports the planning activity for evaluation of space communications systems, including the Air Force Satellite Communications (AFSATCOM) System and the Strategic Satellite System, PE 33601F; the Defense Satellite Communications System (DSCS), PE 33110F; and future tactical satellite communications systems. The technology and systems planning are coordinated with Army and Navy terminal development efforts, in conjunction with the Defense Communications Agency/Military Satellite Communications System Office, which is responsible for overall architecture of satellite communications systems. Direct coordination with the systems program offices is used to insure responsive planning and to avoid overlap.

WORK PERFORMED BY: This project is the responsibility of Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA. Facilities supporting this project include the Communications Simulation and Evaluation Laboratory (CSEL) at Air Force Avionics Laboratory, Wright-Patterson AFB, OH., and flight vehicle test beds from Aeronautical Systems Division at Wright-Patterson AFB, OH. This project has approximately 20 contracts active or planned. Major contractors include: Raytheon, Wayland, MA., for dual frequency terminals; Linkabit Corporation, Redondo Beach, CA., for terminal modems; Ball Brothers, Boulder, CO., for conformal antennas; Signatron, Bedford, MA., for Communications Simulation and Evaluation Laboratory maintenance; Computer Science Corporation, Falls Church, VA., for CSEL interface modifications; and RCA, Camden, NJ, Collins Radio Group, Dallas, TX, and Sylvania, Boston, MA, supporting propagation testing. Federal Contract Research Support is provide by the MITRE Corporation, Bedford, MA.

Project: #1227
Program Element: #63431F
DoD Mission Area: Satellite Communications, #133

Title: Terminal Segment Technology
Title: Advanced Space Communications
Budget Activity: Strategic Programs, #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Lincoln Experimental Satellites (LES) 8 and 9 Ultra High Frequency (UHF) and Extremely High Frequency (EHF) airborne terminals have been successfully demonstrated from an airborne platform. A Dual Frequency Terminal (EHF/SHF - Extremely High and Super High Frequencies) for command post aircraft was developed and testing completed. A source selection was initiated on a Small SHF/EHF Airborne Terminal weighing approximately 1,200 pounds in comparison with an existing 5,500 pound terminal with similar performance. A Command Post Message Processor development was started for eventual control of command post satellite communications activities. A Solid State UHF Airborne Amplifier was developed.

2. FY 1980 Programs: The Command Post Message Processor and the Small SHF/EHF Airborne Terminal Development will continue. Planning will be initiated for FY 1981 flight testing in an EC-135 aircraft under an evaluation program at the Air Force Avionics Laboratory. Development will continue on an SHF Conformal Airborne Antenna to provide a flush mounted installation for potential replacement of parabolic dishes in protruding radomes. A development program for advanced technologies in support of Airborne Strategic Force Element Terminals and small Tactical Airborne Terminals will be structured.

3. FY 1981 Planned Program: The Command Post Message Processor and the Small SHF/EHF Airborne Terminal will start flight testing in the EC-135 aircraft under Air Force Avionics Laboratory direction. Key aspects of an Advanced Tactical/Strategic Airborne Terminal development program will be initiated.

4. FY 1982 Planned Program: The Command Post Message Processor and the small SHF/EHF Airborne Terminal will continue flight testing in the EC-135 aircraft. A SHF conformal antenna will be integrated with the aircraft to compare with the conventional parabolic dish/radome installation.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
1227	Terminal Segment Technology	8,300	9,600	7,500	8,500	Continuing	Not Applicable

Project: #1227 Title: Terminal Segment Technology
Program Element: #63431F Title: Advanced Space Communications
DoD Mission Area: Satellite Communications, #133 Budget Activity: Intelligence and Communications, #5

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
1227	Terminal Segment Technology	3,000	8,300	9,600	10,200	Continuing	Not Applicable

The decrease in the currently estimated $7,500 thousand for FY 1981 from last year's estimate of $10,200 thousand is attributed to a reassessment within the Department of Defense of the funds available for Advanced Space Communications.

Project: #2028
Program Element: #63431F
DoD Mission Area: Satellite Communications, #133

Title: Space Segment Technology
Title: Advanced Space Communications
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Military Services, the Commanders-in-Chief (CINCs), and the National Command Authorities require global, secure, jam-resistant and survivable satellite communications throughout the spectrum of war, including Single Integated Operations Plan (SIOP) execution and management, theater conflict management, crisis management, and contingency operations. Satellites provide significant advantages in terms of survivability and global coverage without dependence upon foreign based assets. This project develops configurations, subsystems, and components for spacecraft to meet identified technology requirements of new or improved space communications systems. Development is initiated when a detailed system concept is prepared or when a new requirement is identified which exceeds the capabilities of available technologies. Configuration development includes design of the space segment to provide increased survivability, connectivity, reliability and capacity. Space technology to support interference and jamming protection is addressed. Subsystem development includes highly advanced communications capabilities such as the Space Laser Communications System. Component development includes spacecraft communications amplifiers at new frequencies or with increased power, spacecraft antennas, communication processors, and improved reliability technology.

RELATED ACTIVITIES: The technology developed in this project is transitioned to operational space communications programs for implementation. The Air Force Satellite Communications (AFSATCOM) Program, PE 33601F, will use the technology and concept developments from this project to implement increased survivability, reliability and capability in the evolution to the Strategic Satellite System. The Defense Satellite Communications System (DSCS), PE 33110F, will evaluate the component technology for implementing spacecraft improvements. The basic technologies for a future tactical satellite communications system will be developed within this project.

WORK PERFORMED BY: This project is the responsibility of Air Force Systems Command, Space Division, Los Angeles, CA. Supporting organizations include: Air Force Avionics Laboratory, Wright-Patterson AFB, OH; Rome Air Development Center, Rome NY; and Air Force Weapons Laboratory, Albuquerque, NM. This project has over 50 active or planned contracts. The major contractors are: McDonnell Douglas Aircraft Corporation, St. Louis, MO, for the Space Laser Communications experiment; Raytheon, Wayland, MA, for space qualified communications processor; Watkins Johnson, Palo Alto, CA, and Hughes Aircraft, Malibu, CA, for Extremely High Frequency (EHF) power amplifiers; Sylvania, Mountain View, CA, for a sun pumped laser; and ILC, Sunnyvale, CA, for laser pump lamp development. Federal Contract Research Center support is provided by the Aerospace Corporation, Los Angeles, CA.

Project: #2028 Title: Space Segment Technology
Program Element: #63431F Title: Advanced Space Communications
DoD Mission Area: Satellite Communications, #133 Budget Activity: Strategic Programs, #3

1. FY 1979 and Prior Accomplishments: The Lincoln Experimental Satellites (LES) 8 and 9 were successfully launched (March 1976) and evaluated. Multi-year developments of Extremely High Frequency (EHF) Solid State Satellite Power Amplifiers at were initiated. The development has potential application with The Space Laser Communications System successfully completed laboratory testing and was moved to the White Sands Missile Range for field testing. Ground tests at White Sands were also successfully completed. Integration of the laser communications equipment into an EC-135 aircraft was accomplished for a flight test program starting in FY 1980. Development of a Laser Space Measurement Unit (LSMU) was initiated for launch in FY 1983 on a host vehicle to evaluate basic aspects of laser communications through the atmosphere to an orbital platform.

2. FY 1980 Program: The solid state amplifier development testing will continue. A solid state amplifier development will be initiated. A traveling-wave-tube amplifier (TWTA) will be jointly developed with NASA (National Aeronautic and Space Administration). Laboratory fabrication of EHF (Extremely High Frequency) technologies will commence. These technologies include null steering antennas, on-board processors, and solid state amplifiers. Planning for potential orbital demonstration of these technologies will commence. The Space Laser Communications System will be demonstrated at a full one (1) gigabit per second with a data link between an airborne platform and a ground based terminal. Development of a Laser Space Measurement Unit (LSMU) will continue toward a FY 1983 launch.

3. FY 1981 Planned Program: Solid state and traveling-wave-tube amplifier component developments will continue at the EHF frequency bands. Laboratory fabrication and testing of EHF technologies (null steering antennas, on-board processors, solid state amplifiers) will continue as well as the planning for a potential launch of a payload on a host vehicle. This payload would potentially, (1) demonstrate the integrated operation of EHF technologies, (2) be used by the Services for testing EHF terminal technologies, and (3) The airborne testing of the Space Laser Communications System will be completed. Development of the LSMU payload will continue.

4. FY 1982 Planned Program: Development and testing of EHF spacecraft technologies will continue. Prototype subsystems for potential orbital evaluation will be laboratory tested. The Laser Space Measurement Unit will be delivered for spacecraft integration and a FY 1983 launch.

5. Program to Completion: This is a continuing program. Development efforts are focused upon increased communications capacity and survivability in the space environment.

6. Milestones: Not Applicable

Project: #2028
Program Element: #63431F
DoD Mission Area: Satellite Communictions, #133

Title: Space Segment Technology
Title: Advanced Space Communications
Budget Activity: Strategic Programs, #3

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
2028	Space Segment Technology	15,100	13,300	11,900	14,800	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Fstimate	Additional to Completion	Total Estimated Costs
2028	Space Segment Technology	4,900	15,100	13,300	15,200	Continuing	Not Applicable

The decrease in the currently estimated $11,900 thousand for FY 1981 from last year's estimate of $15,200 thousand is attributed to a reassessment within the Department of Defense of the funds available for Advanced Space Communications.

Project: #2029 Title: Systems Analyses/Demonstration
Program Element: #63431F Title: Advanced Space Communications
DoD Mission Area: Satellite Communications, #133 Budget Activity: Intelligence and Communications, #5

DETAILED BACKGROUND AND DESCRIPTION: This project addresses the systems aspect of future Military Satellite Communications (MILSATCOM) system solutions (new systems and upgrades to existing systems). Space segment and terminal segment requirements identified by this project are pursued in Project 1227 (Terminal Segment Technology) and Project 2028 (Space Segment Technology). The basis of the system analysis performed in this project is the architectural requirements identified by the Defense Communications Agency/Military Satellite Communications System Office (DCA/MSO) for future MILSATCOM systems to meet the Department of Defense's (DoD) evolving satellite communications requirements. A primary concentration at this point in time is tactical satellite communications system requirements. This project further considers the integration of multiple technologies for orbital testing and evaluation.

RELATED ACTIVITIES: The successful accomplishment of this project calls for a close working relationship with the DCA/MSO to insure the development efforts within Advanced Space Communications are consistent with the evolving MILSATCOM architectural framework. Close coordination is also required with the Army for ground terminal developments and with the Navy for shipboard terminal developments to insure compatible future system solutions. The DCA/MSO provides the necessary leadership and a forum for the coordination of service technology programs.

WORK PERFORMED BY: Air Force Systems Command, Space Division (SD), Los Angeles, CA, is responsible for this project. Supporting organizations include Electronic Systems Division, L. G. Hanscom AFB, MA; Electromagnetic Security Command, San Antonio, TX; and Lincoln Laboratory, Lexington, MA.

Project: #2029 Title: Systems Analyses/Demonstration
Program Element: #63431F Title: Advanced Space Communications
DoD Mission Area: Satellite Communications, #133 Budget Activity: Intelligence and Communications, #5

1. FY 1979 and Prior Accomplishments: Space Division accomplished the basic Military Satellite Communications (MILSATCOM) alternatives analysis that resulted in the Department of Defense (DoD) decision on 17 January 1977 for a three segment future architecture which included the Defense Satellite Communications System (DSCS), the Strategic Satellite System (SSS), and the General Purpose Satellite Communications System (GPSCS). Space Division and other organizational participants also accomplished a range of system configuration alternatives for a GPSCS. Lincoln Laboratory participated in these analyses and structured a development program to address key system technologies. Space Division accomplished a first issue of a "Technology Roadmap" to guide the Advanced Space Communications development programs. Air Force Systems Command (AFSC) personnel participated on tri-Service working groups chaired by the Defense Communications Agency/Military Satellite Communications Systems Office (DCA/MSO) to refine the details of the three segment MILSATCOM architecture (published as the "Framework for MILSATCOM Development" in Nov 1978) and to define tri-Service compatible technology development goals to support the future MILSATCOM architecture (published as the "Technology Development Program Plan" in Nov 1979). System approaches were investigated for providing a future MILSATCOM capability for the Department of Defense's mobile/tactical forces. Driving considerations for this future capability are, (1) highly jam resistant communications in war fighting conditions in the face of a technically advanced, experienced, and dedicated adversary, and (2) low probability of intercept communications to minimize the chances of location and destruction by enemy anti-radiation missiles.

2. FY 1980 Program: The Space Division's "Technology Roadmap" will be refined to reflect the Air Force's technology development and demonstration responsibilities as described in the DCA/MSO's "Technology Development Program Plan." System alternatives for a tactical MILSATCOM system of the future will continue to be investigated. Potential upgrades to near-term MILSATCOM systems will be investigated to keep pace with the evolving threat.

Propagation studies and data collection will be accomplished at the Extremely High Frequencies (EHF) applicable to future MILSATCOM systems. Studies will be accomplished on orbital congestion trends, advanced MILSATCOM concepts, creative MILSATCOM applications, lease vs buy implications, interoperability (with other United States and Allied country communications equipments), and in other related areas. Results of these activities will influence the system planning for the potential launching of a payload for evaluation purposes representing the integration of technologies needed for a future tactical MILSATCOM system. Key subsystems of this payload will be fabricated to verify concepts. Activities in this area are coordinated with the Army and Navy advanced terminal development programs through tri-Service forums chaired by the Military Satellite Communications System Office (DCA/MSO).

Project: #2029 — Title: Systems Analyses/Demonstration
Program Element: #63431F — Title: Advanced Space Communications
DoD Mission Area: Satellite Communications, #133 — Budget Activity: Intelligence and Communications, #5

3. FY 1981 Planned Program: The "Technology Roadmap" will be updated, system alternatives for a future tactical Military Satellite Communications (MILSATCOM) system and for potential upgrades to near-term MILSATCOM systems will be investigated. Propagation analysis and other special studies will continue. Coordination with the Army, Navy, and DCA/MSO will continue on the launching of a potential payload representing tactical technologies. Prototype fabrication of key subsystems for this payload will continue and testing will be accomplished.

4. FY 1982 Planned Program: Army, Navy, Air Force, and DCA/MSO coordination on the planning for a future tactical MILSATCOM system will be accelerated. Requirements for all potential using communities will be refined. Detailed system concepts will be investigated including the space segment and all ground, sea, and airborne terminal segments. Architectural analyses will be accomplished including interoperability assessments between a tactical and other MILSATCOM systems and conventional communications systems. Planning, fabrication and testing of key sub-systems for a potential launch of a payload representing a tactical MILSATCOM system will continue. The "Technology Roadmap" currency will be maintained.

5. Program to Completion: This is a continuing systems analyses/demonstration project.

6. Milestones: Not Applicable

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
2029	Systems Analyses/Demonstration	7,200	10,000	7,600	20,900	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2029	Systems Analyses/Demonstration	6,300	7,000	10,000	16,000	Continuing	Not Applicable

The decrease in the currently estimated $7,600 thousand for FY 1981 from last year's estimate of $16,000 thousand is attributed to a reassessment within the Department of Defense of the funds available for Advanced Space Communications.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63438F
DoD Mission Area: Space Defense #123

Title: Satellite Systems Survivability
Budget Activity: Strategic Programs #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	21,305	27,000	33,300	38,500	Continuing	Not Applicable
2611	System Analysis & Integration	7,287	5,700	7,000	6,900		
2612	Satellite Survivability Technology	11,688	18,700	22,300	19,900		
2613	Link/Ground Survivability Technology	2,330	2,600	4,000	11,700		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Soviets have an aggressive range of threats which they could employ against United States satellites. The Soviet non-nuclear satellite interceptor operations have been resumed using a system that can attack U.S. satellites Advances are being made in ground based lasers that could Soviet military forces are a threat to U.S. launch facilities and ground stations. United States global military operations are becoming increasingly dependent on satellite systems because of increased mission effectiveness, cost, and geopolitical problems for terrestrial systems. The loss of U.S. space systems because of a Soviet attack could result in a military imbalance in favor of the Soviets. This program accomplishes the development and integration of survivability techniques for satellites, launch systems, and ground stations against the Soviet threats.

BASIS FOR FY 1981 RDT&E REQUEST: This program includes funds to develop a prototype package for low altitude satellites, techniques against a per square centimeter irradiance threat, a prototype portable antenna and communications link, adaptive sidelobe cancellation kits for antenna systems, sensor technology, a Military Standard to provide design criteria to protect against performance anomalies from spacecraft charging, and complete the development of a Laser Test System for testing one meter diameter test samples.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #63438F
DoD Mission Area: Space Defense #123

Title: Satellite Systems Survivability
Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: Space systems provide critical strategic and tactical support to military forces and decision makers at all levels of conflict in areas of missile attack warning, navigation, surveillance, communications, and meteorology. These systems provide support on a global basis, whereas other military systems are restricted by geopolitical boundaries, neutrality restrictions, and enemy defenses. This global capability must be protected to maintain effectiveness of United States terrestrial forces and to remove dependence on overseas bases. The Soviet resumption of non-nuclear anti-satellite (ASAT) operations in a intercept mode, advances in ground based laser and constant threat to ground stations and launch facilities represents a major threat to the continued use of space by the U.S. for global military operations. This situation could result in a military advantage to the Soviets if survivability techniques are not applied to U.S. space systems.

This program develops technology and prototype systems to protect satellites against non-nuclear, laser and other radiation, and electronic attacks, and to protect ground stations against physical attack. Initial integration of survivability aids onto satellites is also provided. Nuclear hardening technology is developed under subtasks of Program Element (P.E.) 62601F, Advanced Weapons, and P.E. 64711F, Systems Survivability. The program is divided into three projects. Project 2611 - System Analysis and Integration: develops survivability strategy models, analyzes satellite systems vulnerabilities and replenishment options and provides initial integration designs for survival aids (see separate Descriptive Summary for Project 2611). Project 2612 - Satellite Survivability Technology: develops attack warning sensors and countermeasures against enemy attack; determines laser vulnerabilities and develops countermeasure techniques (see separate Descriptive Summary for Project 2612). Project 2613 - Link/Ground Survivability: develops technologies for ensuring the survivability of essential telemetry, tracking, and control links between orbiting satellites and their ground elements. Technology for defense against potential attacks on satellite ground support facilities (data relays, command and control, and launch facilities) is also being pursued.

RELATED ACTIVITIES: This program is part of a single managed Space Defense effort involving four functional areas; Anti-satellite, Space Surveillance, Satellite Survivability, and Command and Control. P.E. 64406F, Space Defense System, develops those kill techniques and attack profiles this program is designed to counter. P.E. 63428F, Space Surveillance Technology, develops those tracking systems that work with on-board sensors to warn of or verify an attack on specific satellites and to support ASAT targeting. P.E. 63431F, Advanced Space Communications, develops survivability techniques applicable to specific communication satellites. Those efforts are coordinated with this program. P.E. 63211F, Aerospace Structural Materials, develops the basic laser hardening technology that is used in the satellite laser survivability efforts under this Program Element in Project 2612 - Laser Survivability. P.E. 12311F, North American Aerospace Defense Command Combat Operations Center (NORAD COC), develops the Space Defense Operations Center (SPADOC) to integrate and coordinate all elements of the Space Defense System Program and to insure the appropriate command and control is available for implementing the survivability techniques developed under this program. P.E. 63401F, Space Vehicle Subsystems, develops advanced space vehicle technology to improve space vehicle autonomy, life and reliability.

Program Element: #63438F
DoD Mission Area: Space Defense #123

Title: Satellite Systems Survivability
Budget Activity: Strategic Programs #3

WORK PERFORMED BY: Space Division, formerly Space and Missile Systems Organization, Los Angeles, CA, manages this program. General Research Corporation, Santa Barbara, CA, -- survivability technology planning, program/financial management support, and system integration and application analysis. Science Application, Inc, Los Angeles, CA -- support system planning for on-board countermeasures demonstration, spacecraft charging standard and model development. University of California - San Diego -- spacecraft potential measurements. There will be fifteen other contracts. Bidders on one of these (sensors and countermeasures) are Avco, Wilmington, MA, Boeing - Seattle, WA, General Electric - Utica, NY, Hughes Aircraft, Culver City, CA, ITT Avionics - Nutley, NJ, Northrop Corp. - Rolling Meadows IL, Martin Marietta Corporation, Denver, CO, Rockwell International, Space Systems Group - Downey, CA, and TRW Space and Missile Systems Group - Redondo Beach, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: An impact sensor that detects and reports a non-nuclear attack on a satellite was developed and deployed on the were also developed. Concept definition and preliminary design for a survivable launch system was completed. The Space Mission Survivability Implementation Plans were developed for the time periods 1977 to 1985 and 1985 to 2000. The Spacecraft Charging at High Altitude (SCATHA) space experiment was launched, and analysis of data taken during charging/discharging events has begun. Development of specifications began for a common use support system Space Defense Operations Center (SPADOC) to provide command and control for all space systems; this system will transmit satellite attack warning information to orbiting satellites and, in the future, transmit commands to activate on-board countermeasures.

2. FY 1980 Program: Development of a prototype system, Modular Responsive Defense System (MRDS) II, to protect low altitude satellite systems against threat will begin. will be developed. Sensor technology to provide a threat-insensitive 4 pi steradian coverage on-board sensor and other on-board sensors to detect nuclear and non-nuclear ASATs will also be developed. Laser countermeasure techniques against a per square centimeter laser threat will be tested. Assembly of a high power laser capable of irradiating a one meter diameter satellite part at per square centimeter and modification of a test chamber for these test samples will begin. Definition of requirements for a portable communications link (to replace damaged equipment at remote tracking sites) and specifications for automatic sidelobe cancellation kits for ground station antennas will be completed.

3. FY 1981 Planned Program: Development of the Modular Responsive Defense System (MRDS) II and technology for will continue. Assembly of the high power laser test system will be completed. Countermeasure techniques against a per

square centimeter laser threat will be developed. Flight testing of a on the Defense Meteorological Satellite will begin. Space qualification of the prototype Command Interference Detector will be completed. A prototype of an automatic sidelobe cancellation kit will be completed. Specifications for the portable communication link will be developed. The Electronic Countermeasures Training Course will be completed and presented to personnel operating the Defense Support Program (DSP) and the Defense Meteorological Satellite Program satellites. Performance specifications for a Modular Responsive Defense System (MRDS) III, a longer life, broader band system than MRDS II, will be developed. Definition of a Military Standard for preventing charge build-up on satellites and test techniques will begin, utilizing results from the Spacecraft Charging at High Altitude (SCATHA) experiment.

4. FY 1982 Planned Program: A prototype of the Modular Responsive Defense System (MRDS) II will be completed The Command Interference Detector Advanced on-board sensors and countermeasure packages will be developed, using the technologies developed in FY 1980 and FY 1981. Testing of the first automatic sidelobe cancellation kit will be completed, and integration onto an antenna for operational testing will begin. Testing of one meter diameter samples with the high power laser test system will begin. Development of countermeasure techniques against a per square centimeter laser threat will continue. A prototype of the portable communication link will be completed, and testing will begin.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Total for Program Element	8,700	23,200	30,000	35,000	Continuing	N/A

The reductions in FY 1980 and FY 1981 reflect the results of internal DoD review. See attached Descriptive Summaries for Projects 2611 and 2612 for analysis of redistribution of funding.

Project: #2611 — Title: System Analysis and Integration
Program Element: #63438F — Title: Satellite Systems Survivability
DoD Mission Area: Space Defense #123 — Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: The level of survivability required by a given satellite system (satellite/link/ground station) depends on the mission the system has in the total defense effort and the threats against the system components during the mission. Once these levels are determined, the survivability technologies that should be developed can be identified. This project provides assessment of threats, determines the effects of these threats on satellite systems, determines techniques to protect the satellite systems against these threats, and develops program plans to eliminate technology gaps preventing development of the survivability techniques. The required development work occurs in Projects 2612 and 2613. Initial integration of survivability techniques onto operational satellite designs is funded in this project.

The Threat Workbook and the Space Mission Survivability Implementation Plan, which contains schedules, plans, and programs for survivability options implementation by satellite system, are updated annually. Support is provided, as required, to satellite System Program Offices on survivability studies.

RELATED ACTIVITIES: Program Element (P.E.) 12311F, North American Aerospace Defense Command Combat Operations Center (NORAD COC), [illegible] ops the Space Defense Operations Center to integrate and coordinate all elements of the Space Defense Systems Prog[illegible] to insure that the appropriate command and control is available for implementing the survival techniques under [illegible]ogram.

WORK PERFORMED BY: Space Division manages this effort. General Research Corporation is performing survivability technology planning and system integration and applicable analysis. Science Applications, Inc. is performing support system planning for on-board countermeasures demonstration, and developing spacecraft charging standards and models. University of California, Sandiego, is measuring spacecraft potential in particle environment. Aerospace Corporation, El Segundo, CA, provides technical support.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Developed a Space Mission Survivability Implementation Plan for the time period 1977 to 1985 and initiated a Far Term Space Mission Survivability Implementation Plan for the time period 1985 to 2000. The Spacecraft Charging at High Altitude space experiment was launched. The [illegible] was integrated onto a Defense Meteorological Satellite. Survivability program plans were developed for the Defense Meteorological Satellite Program, the Defense Support Program, the Defense Satellite Communications System, the Strategic Satellite System, the Global Positioning System, the Air Force Satellite Control Facility, the Space Transportation System, and the Space Defense Systems.

Project: #2611
Program Element: #63438F
DoD Mission Area: Space Defense #123

Title: System Analysis and Integration
Title: Satellite Systems Survivability
Budget Activity: Strategic Programs #3

2. FY 1980 Program: The Threat Workbook and the Space Mission Survivability Implementation Plan (SMSIP) will be updated. units will be integrated on the Defense Meteorological System. Data reduction on the Spacecraft Charging at High Altitude (SCATHA) space experiment will continue. Specification development will continue for a common use support system, Space Defense Operations Center; to provide attack warning and activation of countermeasure signals to orbiting satellites. Survivability options for United States (U.S.) civil and scientific satellites will be pursued.

3. FY 1981 Planned Program: The Threat Workbook and the SMSIP will be updated. Integration of survivability aids on the Defense Meteorological System will continue. Specifications for the common use support system are completed. The SCATHA program will continue with development of a Military Standard and test techniques.

4. FY 1982 Planned Program: The Threat Workbook and the Space Mission Survivability Program Plan will be updated. The Military Standard on spacecraft charging and development of special test techniques will be completed. Integration of survivability aids into the surveillance and command and control system of the U.S. Space Defense System (anti-satellite) will begin.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	7,287	5,700	7,000	6,900	Continuing	N/A

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Project 2611, System Analysis Integration	3,950	9,400	13,700	20,600	N/A	N/A

The FY 1980 amount in this project is $8.0 million lower than the equivalent FY 1980 amount in the FY 1979 RDT&E Descriptive Summary, and the FY 1981 amount in this project is $13.6 million lower than the FY 1981 amount in the

Project: #2611 Title: System Analysis and Integration
Program Element: #63438F Title: Satellite Systems Survivability
DoD Mission Area: Space Defense #123 Budget Activity: Strategic Programs #3

FY 1980 RDT&E Descriptive Summary. The dollar requirements are lower in this submission, because system integration work is funded by System Program Offices, for example, the Defense Support Program now requires no survivability support from this project.

Project: #2612 — Title: Satellite Survivability Technology
Program Element: #63438F — Title: Satellite Systems Survivability
DoD Mission Area: Space Defense #123 — Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: The Soviets have resumed non-nuclear satellite interceptor operations; their system can attack United States satellites The Soviets are improving ground based laser systems that can In order to protect the roles of U.S. satellites during terrestrial military operations, they must be equipped with sensors and countermeasures. The sensors must be able to warn of an attacker, identify the nature and position of the attacker, activate and support countermeasures actions and confirm that a U.S. satellite has been attacked.

This project provides technology/subsystem/system development of sensors to warn of nuclear, non-nuclear, laser, and electronic attack and of countermeasures. It also provides development of simulators and computer codes for evaluating the effectiveness of sensors and countermeasures.

RELATED ACTIVITIES: Program Element (P.E.) 63428F, Space Defense Surveillance Technology, develops tracking systems that work with on-board sensors to warn of, or verify, an attack on specific satellites. P.E. 63431F, Advanced Space Communications, develops survivability techniques applicable to specific communication satellites; those efforts are integrated with this program. P.E. 63211F, Aerospace Structural Materials, develops the basic laser hardening technology that is used in the satellite laser survivability efforts in this project. P.E. 63401F, Space Vehicle Subsystems, develops advanced space vehicle system technology that will improve space vehicle autonomy, survivability, life, and reliability. The Air Force Materials Laboratory will manage the Integrated Test Program.

WORK PERFORMED BY: Space Division manages this effort. Potential sources for the sensor and countermeasure effort are Avco-Wilmington, MA; Boeing, Seattle, WA; General Electric, Utica, NY; Hughes Aircraft, Culver City, CA; ITT Avionics, Nutley, NJ; Northrop Corp, Rolling Meadows, IL; Martin Marietta Corp, Denver, CO; Rockwell International, Space Systems Group, Downey, CA; and TRW Space and Missile Systems Group, Redondo Beach, CA. There are six potential sources for Laser Countermeasures Demonstration and Advanced Environmental (Laser) Test Services. There are selected sources for each of the following efforts: Laser Test Services, Environmental Test Services, Advanced Laser Test Services, Test Engineering and Analyses, and Survivable Focal Plane Development.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Prototypes of several on-board sensors have been developed: earth-oriented and space-oriented and a command interference detector (CID), in early FY 1978, a detailed performance specification was developed for a Modular Responsive Defense System (MRDS) I to This system was not built due to changes in the threat. Detailed specifications were drawn up for MRDS II to counter the newer

threat. Plans were developed for a Laser Test System capable of testing one meter diameter satellite parts at irradiances up to per square centimeter, comparable to the projected space-based laser threat.

2. FY 1980 Program: Development of the Modular Responsive Defense System (MRDS) II for low altitude satellites will begin. echnology will be developed for longer-life multi-threat countermeasure systems. Sensor technology will be developed to provide a threat-insensitive 4 pi steradian coverage on-board sensor. Light Detection and Ranging (LIDAR), visible, Short Wavelength Infrared (SWIR), and Long Wavelength Infrared (LWIR) sensor technology will be evaluated for future applications. Assembly of the high power laser for the Laser Test System will begin. Laser countermeasure techniques against per square centimeter threat will undergo final test and evaluation.

3. FY 1981 Planned Program: Development of the Modular Responsive Defense System (MRDS) II and technology for advanced on-board satellite attack warning sensors and will continue. The Laser Test System capable of testing one meter diameter samples at per square centimeter will be completed. Upgrading the system to test at per square centimeter will begin. Development of countermeasure techniques against a per square centimeter laser threat will begin.

4. FY 1982 Planned Program: Development of the Modular Responsive Defense System (MRDS) II for low altitude satellites Performance specifications for a MRDS III for high altitude satellites will be developed. Testing on the Laser Test System will begin with evaluation of countermeasure techniques at per square centimeter. Development of countermeasure techniques against a per square centimeter laser threat will continue. Development will begin on advanced on-board sensors and counter easure packages, utilizing technologies developed in FY 1980 and FY 1981.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	11,688	18,700	22,300	19,900	Continuing	N/A

Project: #2612
Program Element: #63438F
DoD Mission Area: Space Defense, #123

Title: Satellite Survivability Technology
Title: Satellite Systems Survivability
Budget Activity: Strategic Programs #3

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2612	Satellite Survivability Technology	3,507	10,700	11,600	8,800	N/A	N/A

The FY 1980 budget for this project is $7.1 million higher than in the FY 1980 RDT&E Descriptive Summary, and the FY 1981 budget is $13.5 million higher than in the FY 1980 RDT&E Descriptive Summary. These budget increases are due to increased costs estimates for the Modular Responsive Defense System (MRDS) II and for the Laser Test System. The amount budgeted for MRDS in the FY 1980 RDT&E Descriptive Summary was an engineering estimate for a system that would The added complexity of MRDS II required to counter the current threat and additional performance requirements requested by the user program has lead to increased costs reflected in this Descriptive Summary. The amount budgeted for assembling the laser for the Laser Test System in the FY 1980 RDT&E Descriptive Summary was also an engineering estimate developed by a study-house contractor. An unsolicited proposal indicated actual costs would be double the engineering estimate.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 63439F
DoD Mission Area: Strategic Surveillance & Warning, # 132

Title: Advanced Space Applications Program
Budget Activity: Strategic Programs , # 3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	2,000	1,100	6,200	Continuing	Not Applicable
2465	Aerospace Vehicle Detection		1,200	600	4,700	Continuing	Not Applicable
2464	Space-Based Radar		800	500	1,500	Continuing	Not Applicable

DESCRIPTION OF ELEMENT AND MISSION NEED: This is a technology program to investigate and develop a space based mission atmospheric surveillance system. This system will provide warning of a bomber attack on the U.S., as well as provide a force multiplier for U.S. air defense,
The program develops mission requirements and technology for two sensor concepts; passive infrared and active radar. The program investigates sensor concept and detection techniques, processing techniques, analyzes measurements data and supports system component developments in the near term leading to an operational system in the 1990's.

These programs are integrated with Defense Advanced Research Projects Agency (DARPA) basic component and technology programs to provide a system overlay for the DARPA programs, develop outstanding systems level technologies and tailor the DARPA developments.

BASIS OF FY 1981 RDT&E REQUEST: The Aerospace Vehicle Detection efforts will study the data processing and reduction programs for the background and aircraft infrared signatures data collected by the DARPA TEAL RUBY experimental satellite. Additional required measurements will be identified and planned. These signatures will be used in the spectrum selection and system concept selection for a prototype infrared satellite. Limited component investigations will be conducted. A major system design study will continue. The space-based radar efforts will be limited to conceptual design studies to support the DARPA program prototype program definition and continuing studies for a space radar experiment using the shuttle. A command and control study will be continued to define the interfaces between the conceptual surveillance systems and the operational forces.

OTHER APPROPRIATION FUNDS: Not applicable

Program Element: # 63439F
DoD Mission Area: Strategic Surveillance and Warning, # 132

Title: Advanced Space Application Program
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The current surveillance system for bomber warning is inadequate in coverage and severely limited in detection range (line-of-sight limits). Furthermore, the threat is increasing with the deployment of the Backfire aircraft and cruise missiles. Space systems offer detection at great ranges from the Continential United States (CONUS) with an increased degree of survivability over fixed, remote ground sites. These systems inherently can also provide global coverage for other multi-mission roles such as

Most ground based surveillance and control systems, such as the Distant Early Warning bomber detection system, usually require large, often remote facilities. Such systems are subject to line-of-sight limitations, require multiple sites, have interference problems from the man-made and natural environment, ecology problems, high 24 hour operation and support costs and cannot easily adapt to changing threats.

The Advanced Space Applications Program will develop the space systems technology that could be available in the 1990's to provide atmospheric surveillance to support global military operations without those problems inherent in existing or planned ground-based systems. The program is divided into two areas: Aerospace Vehicle Detection - space based infrared detection techniques and space based radar - active microwave radar. Space systems based on these sensors will provide global threat detection and tracking capabilities, without the attendant problems asscciated with ground-based systems and with better survivability and flexibility. Furthermore, with earlier detection, warning and longer tracking, this system will provide a force multiplier due to more efficient use of interceptors and better knowledge on the attackers force deployment.

The program is addressing mission requirements and operational interfaces as well as developing the technology for the space based concepts. Air Defense Center, as the primary field planning organization, is developing all the Air Force requirements with support from Tactical Air Command, Strategic Air Command, and Military Airlift Command. Command and control studies will be conducted to determine the interface between the space systems and the operational forces.

The technology program is supporting and taking advantage of Defense Advanced Research Projects Agency (DARPA) component development and measurement programs with supporting systems developments. These efforts will lead to the development of a prototype system under this program.

The Aerospace Vehicle Detection effort will develop and flight test a capability to provide warning of a bomber attack on the CONUS through passive detection of

The planned program is to reduce and analyse the DARPA TEAL RUBY experiment data, develop a system design, gather complementary measurement data as required, and develop data processing hardware. The TEAL RUBY flight test is planned for FY 1983. Previous efforts include developing preliminary system concepts, initating system utility analysis, determining mission requirements, developing preliminary costs and a program roadmap. The Space Based Radar effort will lead to the experimental system flight test and is based on DARPA component development.

Program Element: # 63439F
DoD Mission Area: Strategic Surveillance & Warning, # 132

Title: Advanced Space Application Program
Budget Activity: Strategic Programs, # 3

This effort initially provides funds to conduct studies and tailor Defense Advanced Projects Agency (DARPA) developments to meet Air Force needs. In the outyears, the program addresses major system issues such as reliability, large structures and data processing leading to a prototype development.

RELATED ACTIVITIES: Program Element (P.E.) 63428F, Space Surveillance Technology, developed initial design concepts for space-based radars in FY 1976 and FY 1977. DARPA is developing the Teal RUBY experiment for detection of strategic aircraft, and is developing bi-static concepts and space-based radar components and techniques. In FY 1979, P.E. 63428F supported the scoping of the Teal RUBY data reduction and provided for monitoring and supporting these DARPA efforts. General Systems engineering is provided by the Aerospace Corporation Los Angeles, CA.

WORK PERFORMED BY: Space Division, Los Angeles, CA will manage these efforts. Potential bidders are: Hughes, Culver City, CA; Lockheed Missiles and Space Division, Sunnyvale, CA; Block Engineering, Cambridge, MA; Grumman Aerospace Corporation, Bethpage, NY; Perkin Elmer Corporation, Norwalk, CT; Honeywell Incorporated, Lexington, MA; and TRW, Redondo Beach, CA; Rome Air Development Center, Griffiss AFB NY; and the Air Force Geophysics Laboratory, Hanscom AFB , MA will support Space Division in these efforts. General systems engineering is provided by the Aerospace Corporation, Los Angeles, CA.

PROGRAM ACCOMPLISHEMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: This P.E. did not start until FY 1978. However, in FY 1976TQ the Air Force initiated a design trade-off study for a multiple mission space-based radar under P.E. 63428F, Space Surveillance Technology. This trade-off showed that the technology had progressed to the point that a experiment could be flight tested in the 1980's. The efforts were limited to development of space based design concepts for a radar and infrared system. The radar program defined antenna element sizing, hardware development requirements, satellite power requirements, and structural development needs. Also, the sizing of the data processing system was assessed as it varies with the mission. The major FY 1979 effort in space based radar was to monitor DARPA developments, provide a system overview and support component studies. The infrared program included a technology survey and preliminary system study. Program plans were initiated for both programs.

2. FY 1980 Program: Major efforts in this period will be an infrared system study, command and control study, limited component/development support and design of the TEAL RUBY data reduction analysis and experiment planning data system. System studies for defining the TEAL RUBY measurements and collection sequences will be conducted. Limited technology studies will be conducted to identify promising technology concepts for system implementation. Hybrid system concept studies will be conducted using the passive infrared, large area surveillance systems to detect targets for handoff to other sensors for tracking or reactive defensive responses.

The Space Based Radar effort will be limited to system concept support of DARPA's radar technology program and some outstanding component and processing technology to tailor DARPA's high risk program to Air Force requirements. The DARPA

and Air Force programs are developed and primarily conducted by the same Air Force Laboratory at Rome, NY. Mission utility and requirement studies will continue with strong user participation.

3. FY 1981 Planned Program: This period will continue those efforts initiated in prior years; including TEAL RUBY data reduction analyses and experiment planning, component studies, system concept support for the Defense Advanced Research Projects Agency (DARPA) and mission utility and requirement studies.

4. FY 1982 Planned Program: Accelerated development of TEAL RUBY supporting analysis and experiment planning tools, preliminary designs of prototype infrared sensors and development of space based radar components for reliability and environmental testing is planned. Detailed planning and review of DARPA technology will also be conducted.

5. Program to Completion: The program will develop technology at a low pace until the components and background data are in hand to conduct a space experiment on the radar or a prototype system proof of concept experiment in the mid to late 1980's. The DARPA program will be supported and used as the major data base for this program. System concept work will continue in an effort to minimize system cost and use existing and projected systems in a hybrid configuration. A major program review is planned in FY 1983 after TEAL RUBY flight and initial radar developments.

6. Milestones: TEAL RUBY experimental satellite launch: 1983

7. Resources: ($ in thousands) Not applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Funds	0.499	0	2.0	2.0	Continuing	Not applicable

Reduced level of hardware development

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 63703F
DoD Mission Area: Strategic Air Defense, #122

Title: CONUS Over-the-Horizon Radar System
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		11,194	11,900	12,100	4,200	TBD	TBD

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the development of an Over-the-Horizon Backscatter (OTH-B) radar to improve our present limited capabilities for providing tactical early warning against attack on North America by bombers and air-to-surface missile carriers. Development of an Over-the-Horizon (OTH) radar to provide long range surveillance down to the surface would extend coverage of the coastal approaches from approximately 200 nautical miles to over 1800 nautical miles; increase warning time for survival of retaliatory forces, communications nodes and for National Command Authorities reactions; and significantly enhance redeployment options of available defense forces.

BASIS FOR FY 1981 RDT&E REQUEST: FY 1981 funds will be used to complete the Experimental Radar System (ERS) technical feasibility testing, accomplish three months of limited Initial Operational Test and Evaluation (IOT&E), prepare for Defense Systems Acquisition Review Council (DSARC) II, maintain the ERS in caretaker status pending OTH-B operational decision and to continue OTH technology studies being accomplished by Stanford Research Institute. The nine month ERS technical feasibility test is scheduled to commence in April 1980. ERS technical feasibility testing will address the following: probability of detection, relative position accuracy, velocity resolution, track maintenance, ionosphere outages, radio frequency interference susceptibility and compatibility and real time identification and correlation of targets. The limited IOT&E will address electronic countermeasures and will provide for an independent assessment of technical feasibility. Test data from ERS technical feasibility testing and IOT&E will be collected, analyzed and made ready for the scheduled DSARC II in October 1981. Continued technology studies are directed at system risk reduction supporting evaluation of radar design, ionospheric modeling and characterization, and propagation prediction.

OTHER APPROPRIATION FUNDS: Not applicable

Program Element: # 63703F
DoD Mission Area: Strategic Air Defense # 122

Title: CONUS Over-the-Horizon Radar System
Budget Activity: Strategic Programs # 3

DETAILED BACKGROUND AND DESCRIPTION: The Continental United States (CONUS) Over-the-Horizon Backscatter (OTH-B) radar system will provide long range surveillance and tactical early warning to alert National Command Authorities (NCA) to potentially hostile aircraft in the coastal approaches to North America. Present and planned coastal radars are line-of sight limited, have significant low altitude gaps, and provide minimum probability of detecting penetrating bombers or standoff missile launches. Development of an OTH-B radar to provide long range (over 1800 nautical miles) surveillance down to the surface will complement Distant Early Warning (DEW) radar coverage by preventing end-runs to the east and west coastal approaches; will increase warning time for survival of our retaliatory forces and for reactions by National Command Authorities; and will significantly enhance redeployment options of CONUS defense forces. The initial phase, development and feasibility testing of an OTH-B radar, was approved by the Defense System Acquisition Review Council (DSARC IB) and concurred with by the World-Wide Military Command and Control System (WWMCCS) council in 1974. Based on an Air Force study of current status, alternatives, and the current and projected threat, the WWMCCS council in August 1976 reaffirmed the criticality of continuing OTH-B development to improve our bomber warning capabilities.

Due to projected cost and schedule problems, the program was restructured in FY 1977. The current program is the result of thorough evaluation of major restructuring alternatives. Alternatives considered included ways to continue a reduced development effort, and at the same time, to take advantage of the current investment in developed hardware and site hardware and site facilities where possible. The restructured program will reduce prototype design capabilities and scope to an experimental radar system required to conduct a real time demonstration of technical feasibility. Operational configuration and "ilities" will be deferred in implementing the design for the technical feasibility test.

In addition to providing the required engineering and test support, this program also provides for a continued level of-effort in OTH-B Technology. These efforts are designed to maintain acceptable program risk levels by increasing our knowledge of ionospheric limitations on performance; supplementing the radar development in design areas promising high, long-term payoff; and insuring the availability of OTH-B scientific expertise. Follow-on RDT&E funds are also programmed to adapt the feasibility test results to operational systems.

RELATED ACTIVITIES: The CONUS OTH-B radar system is being developed to provide all-altitude tactical early warning in support of our aerospace defense mission. Compatibility with related programs such as the Distant Early Warning (DEW) radars and their modernization (SEEK FROST), the Joint Surveillance System, the E-3A Airborne Warning and Control System and air defense interceptors is planned. Related OTH system developments by the Office of Naval Research and the Naval Research Laboratory in the areas of ship detection and weather/sea state determination are monitored by the Air Force, and joint funding agreements exist for research in the areas of potential corollary missions. Agreements with

the Federal Aviation Agency and the Canadian Departments of National Defence and Transportation exist to provide North American traffic in-flight data necessary during the testing. Acquisition of the operational Over-the-Horizon (OTH-B) radars will be accomplished within Program Element 12417F.

WORK PERFORMED BY: The development of the CONUS OTH-B radar system and supporting OTH technology efforts are managed by the Air Force Electronics System Division, Hanscom AFB, MA. The radar prime contractor is the General Electric Company, Syracuse, NY. Major subcontractors include Continental Electronics, Dallas, TX, for the transmitter subsystem and TRW, Redondo Beach, CA, for the software development. Subcontractors for the site preparation and construction efforts have been awarded to local Maine contractors in the Moscow/Caratunk area (transmitter site) and in the Washington County area (receiver site). Continuing OTH Technology efforts, analysis, engineering studies and support are provided by: Rome Air Development Center, Griffiss Air Force Base, NY; SRI International, Remote Measurements Laboratory, Menlo Park, CA; Defense Electromagnetic Compatibility Analysis Center, Annapolis, MD; Naval Research Laboratory, Washington, D.C.; MITRE Corporation, Burlington, MA; Air Force Aerospace Medical Division, Brooks Air Force Base, TX; Air Force Geophysical Laboratory, Hanscom Air Force Base, MA, and the Air Force Materials Laboratory, Wright-Patterson Air Force, OH.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The program was restructured in FY 1977 to reduce the prototype design implementation and test scope to an experimental radar required to demonstrate technical feasibility. Site preparation, erection of buildings and support services, and partial construction of the antennas were completed at both the transmitter and receiver sites in Maine. Configuration acceptance tests were completed on major hardware items, such as the transmitters, receivers, beamformer processor and the operator scopes. Software redesign was verified and coding initiated. Technology efforts were initiated in the areas of low-sidelobe antenna development, ionospheric modeling and prediction, adaptive beamforming, and radar performance assessment/management technologies. Development of the experimental radar system was continued in FY 79. Fabrication/delivery of major hardware subsystems and the central processor software have been completed. Installation of the antennas was continued during the construction weather window. Integration and equipment verification tests were initiated for the site controller software. Technology efforts to improve performance assessment techniques are being continued.

2. FY 1980 Program: In-plant testing of radar subsystems will be completed and major on-site activity will begin. Fabrication, installation and integration of major components, on-site system level integration and testing in preparation for the feasibility demonstration will be initiated. Initial testing will be conducted to verify environmental impact considerations, such as the electromagnetic interference/compatibility, biomedical and radio frequency interference analyses. Technology efforts will continue to evaluate alternative display formats and signal processing/radar control algorithms. System level acceptance tests will be completed and the radar system delivered. System performance testing

and demonstration of technical feasibility, including flight tests, will be initiated. Contractor operation and maintenance support during this period will be continued.

3. FY 1981 Planned Program: The technical feasibility testing and limited Initial Operational Test and Evaluation (IOT&E) will be completed in FY 1981 and the results reported to the Defense Acquisition Review Council (DSARC). IOT&E is scheduled for completion in April of 1981. The remaining six months of FY 1981 will be used to prepare all material for DSARC, hold the Experimental Radar System in caretaker status pending operational decision and to continue Over-the-Horizon Radar technology risk reduction studies.

4. FY 1982 Planned Program: Based on the evaluation of the test results and reassessment of the evolving threat, environmental assessments will be finalized and a deployment DSARC held in October 1981. If operational radars are approved, engineering, software development, integration and testing will be initiated to adapt the results to the site's ionospheric and environmental peculiarities for the operational systems.

5. Program To Completion: TBD

6. Milestones:

		Date
A.	System Definition Complete	Nov 73
B.	Prototype Contract Award	Mar 75
C.	Initiate Program Restructuring	Dec 76
D.	Conclude Technical Feasibility Test	Dec 80
E.	Conclude IOT&E	Apr 81
F.	DSARC Review and Deployment Decision	Oct 81
G.	Initial Operational Capability (NE & NW)	To be determined

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Actual	FY 1980 Estimated	FY 1981 Estimated	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		2,000	11,200	11,900	8,200	TBD	TBD

The FY 1981 estimate increased to reflect additional operational testing required to support the planned DSARC.

Budget Activity: Strategic Programs, # 3
Program Element: #63703F CONUS Over-the-Horizon Radar

Test and Evaluation Data

1. Development Test and Evaluation: The CONUS Over-the-Horizon Backscatter (OTH-B) radar is being developed to improve our present limited capabilities for providing tactical early warning against attack by bombers and air-to-surface missile carriers. In March 1975, a development contract for design and test of a limited coverage prototype in Maine was awarded to General Electric, Syracuse, New York. During FY 1977 design of the prototype radar was essentially completed and engineering verification tests were successfully run on critical subsystems, such as the transmitter, antenna elements, and selected software packages. Due to projected cost and schedule problems, action to restructure the program was initiated and the prototype was scoped down to an experimental radar. The restructured program reduced radar capabilities and test scope to the Experimental Radar System (ERS). The ERS was designed to demonstrate OTH-B technical feasibility. The System Performance Test scheduled from April of 1980 through December 1980, will address probability of detection, relative position accuracy, velocity resolution, track maintenance, ionospheric outages and predictability, radio frequency interference susceptibility and compatibility and real-time identification and correlation of targets. A three month limited Initial Operational Test and Evaluation (IOT&E) will follow the system performance test and is designed to provide an independent assessment of the experimental radar system performance objectives. Operational aspects and other "ilities" will be limitedly addressed during experimental radar technical feasibility testing. To the extent possible, reliability and maintainability data will be obtained and analysed to help identify Experimental Radar System deficiencies and better characterize operational system specifications. The OTH-B Test and Evaluation Master Plan is undergoing update rewrite and will be provided to all concerned in February 1980. The results of the technical feasibility demonstration are scheduled for Defense Systems Acquisition Review Council review in October of 1981.

2. Operational Test and Evaluation: The Air Force Test and Evaluation Center will conduct a three month limited IOT&E (January through March 1981) on the OTH-B ERS. Aerospace Defense Command, Air Force Logistics Command, Air Force Communications Service, Air Training Command, and Military Airlift Command/Air Weather Service will participate in the IOT&E effort.

Because the ERS was scaled back from a prototype, a significant amount of engineering and development work is anticipated following a Defense Systems Acquisition Review Council II decision to bring the system up to an operational configuration. Because the ERS is not required to be representative of the OTH-B system evisioned for production/deployment, the assessments drawn from IOT&E of the ERS may not be valid for an operational system.

The primary purpose of the IOT&E will be to estimate ERS operational effectiveness and suitability, and to the extent possible, to identify operational deficiencies requiring corrective action during OTH-B full scale engineering development. Identification and correction of deficiencies will enhance operational effectiveness and suitability of an operational OTH-B system.

Budget Activity: Strategic Programs, #3
Program Element: #63703F CONUS Over-the-Horizon Radar

Significant test milestones are as follows:

Event/Activity	Start Date	Completion Date
- System Performance Testing (technical feasibility)	Apr 80	Dec 80
- Interim technical feasibility to DSARC principals		Dec 80
- Initial Operation Test & Evaluation (IOT&E)	Jan 81	Apr 81
- IOT&E Final Report		Aug 81 Oct 81

IOT&E will be conducted at the Experimental Radar System (ERS) combined receiver/operations site near Columbia Falls, in Washington County, Maine. Some testing will take place at the transmitter site, near Moscow/Cartunk, Maine.

Major IOT&E operational effectiveness objectives include assessments of the radar's capability to detect, track, correlate, and identify targets within required user response times; determine position, velocity, and heading accuracies; Electronic Counter Measure recognition capabilities of the system; ionospheric outage predictability; and effectiveness of man-machine interfaces. Console operations during IOT&E will be performed by using command personnel to estimate the capabilities of Air Force operators to perform the OTH-B detection, tracking and identification functions.

ERS operational suitability assessments will be limited to monitoring contractor-performed maintenance, evaluating software maintainability and usability, and evaluating failure data to provide the using command with an initial estimate of OTH-B reliability and availability. Since integrated logistics support is not planned for the ERS, the logistics supportabilty assessment will be confined to a review of the contractors' logistics operations during System Performance Test and IOT&E.

The IOT&E will provide a limited assessment of OTH-B operational effectiveness and suitability. Futher Operational Test & Evaluation will be required on a representative, prototype radar following DSARC II.

3. System Characteristics:

	Objectives	Demonstrated
a. Detection and Tracking Range via Ionspheric Skip (nautical mile) (nm)		
Normal	500nm to over 1800nm	
Anomalous	500nm to 1200nm	

Budget Activity: Strategic Programs, # 3
Program Element: # 63703F CONUS Over-the Horizon Radar

	Objectives	Demonstrated
b. Angular Sector Coverage (degrees)	60	
c. Probability of Detection and Establishment of Track within 1200 nautical miles (nm) of Station (90% of the time)		
Mid-Latitude (%)		
Auroral (%)		
d. Position Accuracy (one standard deviation)		
Absolute		
Relative		
e. Target Velocity Resolution		

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64312F
Title: M-X
DoD Mission Area: Land Based Strike, #111
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	150,000	670,000	1,551,000	2,179,600	5,139,500	9,690,100

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides for the full-scale engineering development of the Advanced, Multiple Independently Targetable Reentry Vehicle Intercontinental Ballistic Missile (ICBM), M-X. Additionally, a basing mode more survivable than fixed silos will be developed because the growing quantity and quality of Soviet ICBM reentry vehicles could seriously erode United States (US) ICBM survivability by the early 1980s. This new basing mode and improved ICBM will insure continued deterrence via increased survivability of our ICBM force.

BASIS FOR FY 1981 RDT&E REQUEST: Fabrication and ground testing will be continued on all the major missile and basing subsystems. This will include the three booster motors (stage I, II, and III), the post-boost vehicle, guidance and control, reentry system, missile transportation and handling equipment, flight safety system, missile component tests, and engineering support. The basing vehicle subsystems will continue testing. The hardware for security and command and control will begin initial fabrication. Flight and targeting software design will be continued. Extensive flight and ground test planning and special test-unique hardware design will be continued. Major subscale and full scale high explosive test design and fabrication for the basing facilities will be initiated. Testing at the Engineering Test Bed will be continued to evaluate mechanical/transportation and handling concepts, command and control, power systems, physical security, preservation of location uncertainty, Strategic Arms Limitations Treaty verification, and other elements related to selected Multiple Protective Structure basing concepts.

OTHER APPROPRIATION FUNDS: ($ in thousands)

Program Element 11215F M-X Squadrons	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
Military Construction	-	62,400	17,100	372,700	20,260,500	20,712,700
Aircraft Procurement	-	-	-	-	572,800	572,800
Missile Procurement	-	-	-		20,731,000	20,731,000

Program Element: #64312F
DoD Mission Area: Land Based Strike, #111

Title: M-X
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The President directed full-scale engineering development of the M-X missile and horizontal dash basing mode in September, 1979. The objective of this program is to develop an advanced, Multiple Independently Targetable Reentry Vehicle Intercontinental Ballistic Missile (ICBM), M-X, for deployment in a Multiple Protective Structure (MPS) survivable basing mode in the mid-1980s. The major areas of effort are development of missile and basing subsystems, system integration and extensive system/subsystem testing to support the production/deployment decision. The missile subsystems are and will continue to be operational designs of the preprototype hardware developed in Advanced ICBM Technology Program (Program Element (PE) 63305F). The missile subsystems will include an advanced guidance set derived from the Advanced Inertial Reference Sphere (AIRS) prototype. The AIRS is an all-attitude guidance system designed for the transportable environment. The three booster stages will contain an advanced solid propellant and lightweight motor cases and advanced nozzles which will produce about twice the propulsion efficiency of current ICBM systems. The M-X Post Boost Vehicle (PBV), although significantly larger than the Minuteman PBV, will use a similar, well proven configuration. The M-X reentry will be the Mark 12A. The development of survivable basing mode elements will continue and include ground power systems; physical security hardware procedures; location uncertainty concept development; command control and communications systems development; and continued operational vehicle design and fabrication. In addition, design of deployment area roads and structures, and techniques for their construction will continue.

The requirement for M-X is a function of the need to respond to current and projected Soviet advanced ICBM developments. This will require a high degree of survivability. Further, the current ICBM systems are somewhat deficient in the measures of flexibility which will be required in the 1980s to maintain a high level of deterrence across the entire spectrum of potential response. The pace and scope of Soviet ICBM developments will result in a destabilizing imbalance between US and Soviet strategic capablity in the mid-1980s. M-X deployment is needed to alleviate this predicted asymmetry.

RELATED ACTIVITIES: This program is directly related to the result of efforts in the Advanced ICBM Technology Program (PE 63305F), M-X Squadrons (PE 11215F), and ABRES (PE 63311F). This program and the related programs are all managed within the Ballistic Missile Office, and thus close coordination is assured. PE 11215F contains the funding for both M-X military construction and missile/aircraft procurement.

WORK PERFORMED BY: The program will be managed by the Ballistic Missile Office, Norton Air Force Base. Testing facilities at Arnold Engineering Development Center, Tullahoma, TN, will be used for motor testing. Contractors include: Thiokol, Brigham City, UT; Aerojet General, Sacramento, CA; Hercules, Magna, UT; Rocketdyne, Canoga Park, CA; Autonetics, Anaheim, CA; Northrop, Hawthorne, CA, and Norwood, MA; Honeywell, St Petersburg, FL; Charles Stark Draper Lab, Cambridge, MA; Logicon, Torrance, CA; Westinghouse, Sunnyvale, CA; AVCO, Lowell, MA; Martin Marietta, Denver, CO; TRW, Ballistic Missile Division, Norton AFB, CA; Boeing, Seattle, WA; and others.

Program Element: #64312F
DoD Mission Area: Land Based Strike, #111

Title: M-X
Budget Activity: Strategic Programs, #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The President directed full-scale development of the M-X missile in the Multiple Protective Structure (MPS) basing mode on 7 September 1979. Funds requested in the FY 79 Supplemental were used to accelerate purchase of tooling and missile subsystems for the M-X flight test program. In addition, system definition of Multiple Protective Structure basing were accelerated, to include acceleration of the construction of an engineering test bed. This test bed is being used to investigate engineering solutions to problems associated with MPS basing such as preservation of missile location uncertainty, Strategic Arms Limitation Treaty verification, basing hardware to include physical security sensors, and vehicle roadibility testing.

2. FY 1980 Program: Fabrication and ground testing will be initiated on all the major missile and selected MPS basing systems previously developed under Program Element 63305 (Advanced ICBM Technology). This will include the three booster motors (stage I, II, and III), the post-boost vehicle, and guidance and control missile subsystems. The basing-unique vehicle subsystems will begin initial testing to validate the MPS basing concept in such a manner as to not commit the Congress to one basing mode. The hardware for the security and command and control will begin initial fabrication. Flight and targeting software design will be continued. Extensive flight and ground test planning and special test unique hardware design will be continued. Major subscale and full scale high explosive test design and fabrication for the basing facilities will be initiated. Testing at the Engineering Test Bed will be continued to evaluate various elements (power, security, preservation of location uncertainty, transportation/handling, command and control) associated with basing concepts. A deployment site(s) for the weapon system will be selected as will operating base locations. Finally, the missile and MPS basing design will be reviewed as an integrated system to establish the functional configuration baseline, review allocated requirements, approve operational and maintenance concepts, and ultimately approve the overall system design requirements.

3. FY 1981 Planned Program: A design of the operational assembly area facilities and roads and utilities will begin in the deployment area. Most of the FY 81 RDT&E request continues to be for missile development to include: propulsion stages; reentry system; guidance and control hardware and software; missile handling and transportation equipment; instrumentation and flight safety system; training equipment; data collection and evaluation; and general engineering support. The basing development includes design, fabrication and test of: transporter-launcher vehicles and the mobile surveillance shield; command, control and communications systems; ground power; physical security hardware and software; countermeasure techniques and equipment; environmental systems; targeting software, shelter closure development; facilities development; and environmental assessment. In addition, nuclear hardness and survivability testing wll be conducted, as well as basing tests and flight test preparation. Full scale engineering development efforts will continue on missile and basing subsystems, to include continued and refined design, fabrication and testing of the M-X missile in an MPS basing mode.

Program Element: #64312F
DoD Mission Area: Land Based Strike, #111

Title: M-X
Budget Activity: Strategic Programs, #3

4. FY 1982 Planned Program: Continue full-scale engineering development to include first flight hardware delivery, completion of blast and shock tests, and increased emphasis on basing mode peculiar concepts, and equipment.

5. Program to Completion: M-X system development will continue with the emphasis shifting to flight testing and baselining the final M-X system design. The system Initial Operational Capability is July 1986 and the RDT&E projection shows that FY 1989 will be the last year requiring Research and Development funds. Significant acquisition and Military Construction Program funding will be required starting in FY 1982 - FY 1983.

6. Milestones:

	Date
DSARC I	9 Mar 76
Validation Phase Initiated	1 Oct 76
DSARC IIa	5 Dec 78
DSARC IIb	31 Mar 79
DSARC IIc	14 Jul 79
DSARC IId	21 Jul 79
Initiate Full Scale Development	Sep 79
First Flight Test	Jan 83
DSARC III	Mid CY 1983
IOC (10 missiles)	Mid CY 1986
IOC (200 missiles)	End CY 1989

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data: ($ in Thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT	-	190,000	670,000	1,224,100	TBD	TBD

The FY 1980 Budget Data reflected $190.0M requested by the FY 1979 Supplemental, $150.M of which was made available to M-X. The FY 1980 requirement remained constant. The FY 1981 and outyear funding requirements included in the FY 1980 budget were best estimates made prior to a basing mode decision or resolution of entering full-scale engineering development of the 92" M-X missile.

Budget Activity: #3, Missiles and Related Equipment

Program Element: 64312F, Advanced ICBM M-X

Test and Evaluation Data

1. Development Test and Evaluation: In June 1979, the President directed the Full Scale Engineering Development (FSED) of the M-X missile. Subsequently, in September 1979, the President announced his decision on the basing mode of the M-X, called horizontal dash. These decisions were made in recognition of the growing vulnerability of our present fixed-silo Intercontinental Ballistic Missiles (ICBM) due to the increasing number and accuracy of Soviet warheads, and the importance of maintaining the ICBM leg of the Strategic Triad for deterrence of nuclear war. The requirement for an advanced, survivable ICBM was identified in the Strategic Air Command's Required Operations Capability Document in 1971, and subsequently revised in 1974. The validation phase was entered in 1976 as a result of Defense System Acquisition Review Council (DSARC) action, with emphasis to be placed on missile technology including guidance and propulsion, and survivable basing alternatives. Missile System definition subsequently begin in May 1978, paralleled with analysis of alternative basing modes including vertical shelters, trench, air mobile and various horizontal configurations. DSARC II meetings were held in December 1978, March 1979, and July 1979 for further analysis of basing alternatives and missile definition. As a result of DSARC II, the 92-inch M-X missile was selected, the largest allowed by the proposed Strategic Arms Limitation Treaty. In addition, the horizontal dash basing mode was chosen over all other concepts because it met all of the criteria initially established by the President: survivability; verifiability; affordability; environmentally sound; and it contributes to arms limitations goals.

Pre-FSED tests were conducted to establish confidence for a decison to enter FSED. The test data acquired provided a high confidence that the required weapon system performance can be met within the identified state-of-the-art technologies at a reasonable cost. Additionally, this testing has provided hardware design data which will assure more comprehensive specification and has allowed a more realistic estimate of life cycle system costs. Specifically, the Advanced Developmental Phase test program evaluated critical questions and areas of risk including guidance testing, propulsion performance, radiation characteristics, motor and nozzle performance, reentry system testing, launcher and shelter performance, command control communications testing, ground power studies, physical security system testing and nuclear hardness and survivability testing. Contractor test facilities were used for most of the testing as was the Arnold Engineering and Development Center at Tullahoma, Tennessee and Rocket Propulsion Lab at Edwards AFB, California. Pre-FSED results indicated the following: the M-X guidance design has acheived a greater accuracy than the Minuteman III guidance; high energy Class I Division I propellant is suitable for full-scale M-X motors; high stress levels are achievable in lightweight motor cases; the extendable nozzle exit cone is feasible for deployment on full-scale motors; materials can be developed which give better pebble impact and erosion resistance of the shroud and other external missile materials; launching a missile out of an inclined canister using a gas generator launch technique is viable; trench construction and breakout and erection through overburden of a simulated canisterized missile was demonstrated at the test site near Yuma, Arizona; horizontal shelter door and structure strength and strain

test results provided data for cost trades of protective shelter design; the vertical shelter engineering test bed program at Mercury, Nevada, provided data on shelter and road construction and mechanical and transporter systems performance; scale model and full scale antenna tests have demonstrated that a buried medium frequency antenna equals performance of a short vertical dipole in the air; lithium thionyl chloride batteries have been proven potentially viable for supply ground power during extended survivability periods; and other results which contributed to the decision to enter Full Scale Engineering Development (FSED).

M-X Developmental Test and Evaluation (DT&E) will be conducted during FSED to assist the engineering design and development process, to verify accomplishment of specification requirements, and to address and resolve DT&E areas of risk and critical questions. The goal of DT&E will be to verify, by test and evaluation, that the M-X missile and horizontal shelter deployment facilities and equipment have been designed to satisfy operational requirements; and that each of the DT&E areas of risk and critical questions has been resolved to a degree sufficient to permit a production decision to be made at DSARC III. Twenty test flights from the Western Test Range at Vandenberg AFB, California have been scheduled on approximately 60 day centers beginning in January 1983. The above DT&E goals will be achieved by accomplishing the following primary DT&E objectives: evaluate the capability of the M-X stage II and III motor extendable nozzle exit cone to survive and perform in actual M-X missile power flight; evaluate the capability of the Advanced Inertial Reference Sphere Guidance and Control units to achieve accuracy, reliability, and survivability goals in flight; determine M-X weapon system hardness and survivability; determine effectiveness of procedures to insure the preservation of location uncertainty; evaluate the capability of the command control and communication system in all environments; confirm the capability of each configuration item to meet specified design requirements; evaluate total M-X weapon system performance in the pre-, trans-, and post-attack mode; evaluate missile flight performance and reliability to include launcher, stages, guidance and control accuracy and reentry system footprint, and time of flight performance capabilities; demonstrate the capability of the instrumentation and flight safety system and its suitability for entering Operational Test and Evaluation (OT&E); and demonstrate the overall M-X weapon system readiness to enter OT&E.

2. Operational Test and Evaluation: a. Demonstration and Validation Phase. Elements of several tests conducted by the Ballistic Missile Office (BMO) during this phase have been judged to be operationally representative. These tests will be included in the Air Force Test and Evaluation Center (AFTEC) evaluation of system survivability, operational effectiveness, and operational suitability. The most important of these are summarized: (1) Preservation of Location Uncertainty (PLU). In conjunction with the BMO testing of a one million pound vehicle at the Nevada Engineering Test Bed (ETB), AFTEC has designed a series of PLU tests. The tests employ a large variety of existing sensors to characterize possible operational signatures. Preliminary evaluation results will be available in mid-1980; (2) Physical Security System. An M-X Security System Critical Components Test Program is currently underway in representative terrain and climate conditions at the Nevada ETB. The capability of infrared optical sensors and seismic sensors to detect intruders under various environmental conditions and to filter out false alarms is being evaluated. Test results will be available in February 1980; (3) Command and Control Testing. A medium frequency (MF) radio network will be used for post-attack communications within the M-X deployment area for transmitting status and control between the deployment area and surviving command and control elements. An MF network consisting of

Budget Activities: #3, Missiles and Related Equipment

Program Element: 64312F, Advanced ICBM M-X

8 transmitters located in mobile vans was tested at the Nevada Engineering Test Bed (ETB) to validate the communications concepts. Preliminary results indicate that the radio simulcast network was successful in transmitting and receiving data between valleys and mountain ranges and the bit error rates were within required performance parameters; and (4) Vehicle Testing. The Air Force Test and Evaluation Center (AFTEC) has provided five enlisted personnel from the current Minuteman Transporter Erector operational force to assist the Ballistic Missile Office (BMO) in conducting prototype vehicle tests at the ETB. These tests are providing human interface evaluation data applicable to the operation of very large vehicles over minimum dimension roadways and will continue through March 1980. In addition to the testing described above, the Strategic Air Command (SAC) is currently conducting Operational Test and Evaluation of the MK12A reentry vehicle on the Western Test Range using operational Minuteman missiles. The MK12A has been selected as the M-X deployment baseline reentry vehicle. Applicable data from this testing will be included in the AFTEC evaluation of operational effectiveness. b. Full Scale Engineering Development (FSED). Test and evaluation conducted during this phase will be combined Developmental Test and Evaluation/ Initial Operational Test and Evaluation (DT&E/IOT&E) with separate additional IOT&E events. OT&E objectives have been integrated into both the DT&E ground and flight test programs. A total of twenty flight tests are planned to support missile system development and performance evaluations. These flight tests will begin during DT&E/IOT&E and continue through Defense System Acquisition Review Council (DSARC) III and Follow-on Test and Evaluation (FOT&E). The flight test articles will be configured with test reentry vehicles and an in-flight safety system. The flight test series will begin in 1983. Initially (for approximately the next three years) AFTEC test involvement will focus on subsystem testing at Air Force and contractor test facilities. At least six months before the first flight test (January, 1983) AFTEC test team personnel will move to Vandenberg Air Force Base, California. Emphasis will then be placed on system testing -- in particular, testing from the mobile ground system test facilities. The operational suitability evaluation will include availability, reliability, maintainability, logistics supportability, operations and support costs, human factors, and training. The period of reliability and maintainability testing will be at least long enough to accomplish all operational tasks defined by the sytems's user, SAC. c. AFTEC will maintain overall management responsibility for M-X IOT&E through DSARC III. AFTEC will also retain management responsibility for FOT&E until the Initial Operating Capability, at which time it will transfer to SAC. SAC will operate and maintain the system. d. OT&E testing will be conducted at Vandenberg Air Force Base, California, Southwest United States locations and contractor facilities.

Budget Activities: #3, Missiles and Related Equipment

Program Element: 64312F, Advanced ICBM M-X

3. Systems Characteristics:

General:

Length:	71 feet
Diameter:	92 inches
Weight:	190,000 pounds
Throwweight:	7937 pounds
Payload:	10 reentry vehicles - constrained by SALT II
Design Accuracy:	Circular Error Probable feet

Comparisons:

- Two and one-half times the weight of the Minuteman
- Four times the throwweight of Minuteman
- About equal to size of Soviet SS-19
- Military equivalent to Soviet SS-19
- M-X has one half throwweight of Soviet SS-18

Performance Thresholds:

Performance goals and thresholds are under revision for the M-X missile deployed in the horizontal dash basing mode. They are expected to be available by March 1980. In general, the goals and thresholds will be defined as follows:

GOALS:	THRESHOLDS:
O&S COSTS	SURVIVABILITY
ACCURACY	MISSION EFFECTIVENESS
HARDNESS OF PROTECTIVE STRUCTURES	COST
PRESERVATION OF LOCATION UNCERTAINTY	
COUNTDOWN AND FLIGHT RELIABILITY	
PRE-ATTACK AVAILABILITY	
TARGETING EFFICIENCY	

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64361F
DOD Mission Area: Airborne Strike, #113

Title Air Launched Cruise Missile (ALCM)
Budget Activity Strategic Programs #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT	338,895	90,000	108,400	32,800	0	1,050,095

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Launched Cruise Missile (ALCM) is a small, long range, accurate, nuclear armed air-to-ground cruise missile planned for use on the B-52G. The full scale engineering development program featured a B-52G/ALCM system competition between the Boeing Aerospace AGM-86B and the General Dynamics/Convair AGM-109. The ALCM employed on the B-52G will provide increased bomber targeting and routing flexibility, and reduced B-52 exposure to defenses. Initially, 12 ALCMs will be loaded externally on each B-52G while current internal loads of gravity bombs and short range attack missiles are retained. In the mid-1980s, internal loading of ALCMs on the B-52G will begin. By 1990, all B-52Gs could be equipped with 20 ALCMs each.

BASIS FOR FY 1981 RDT&E REQUEST: This funding request will be used to complete the expanded follow-on flight tests by the winning missile from the test B-52G and to begin the ALCM integration flight tests on the offensive avionics system modified B-52G. It will also continue the development of support equipment needed for the first alert capability in September 1981. Transition of ALCM program management from the Joint Cruise Missiles Project Office to the Air Force will be completed during this fiscal year.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Missile Procurement (3020)	94,200	371,200	571,140	517,041	2,296,427	3,954,608*
(Quantity)	(24)	(225)	(480)	(480)	(2185)	(3418)
Military Construction (3300)		14,200	66,250	32,400	115,150	228,000
Department of Energy Costs (W-80 Warhead)						

* Includes initial spares

Program Element: #64361F
DOD Mission Area: Airborne Strike, #113

Title: Air Launched Cruise Missile (ALCM)
Budget Activity Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: The Air Launched Cruise Missile (ALCM) is a small, long range, accurate, nuclear armed air-to-ground missile for the B-52G. The initial ALCM was the Boeing AGM-86A developed from the cancelled Subsonic Cruise Armed Decoy program. The AGM-86A had a parallel advanced development with the General Dynamics Sea Launched Cruise Missile (SLCM). The SLCM, built for torpedo tube or ship deck launch, was designed as both a land attack and an anti-ship missile. The ALCM and the Land Attack SLCM shared a common engine (Williams F-107 turbofan); warhead (W-80 with and navigation/ guidance subsystems (Litton LN-35 inertial navigation element with terrain contour matching updates integrated by McDonnell-Douglas Astronautics). Both the ALCM and the SLCM were approved for Full Scale Engineering Development in January 1977. The Air Force was directed to give priority to the development of the long range AGM-86B. A Joir Cruise Missiles Project Office (JCMPO) was established, under Navy management, to ensure maximum commonality su systems and accomplish joint test and evaluation. The cancellation of the B-1 production increased the importance of the B-52/ALCM weapon system in the bomber leg of the Strategic Triad. An ALCM system competition was conducted between the Boeing AGM-86B and the General Dynamics AGM-109 to provide a more cost effective missile system. The ALCM will provide the B-52G force with a 2500 KM (system operational range) air-to-ground missile which can be launched from both inside and outside enemy defenses. The ALCM will greatly enhance the air-breathing leg by: stressing and diluting Soviet defenses thus improving the overall penetration prospects of the mixed, air breathing force; compelling the soviets to devote substantial resources to their national air defenses to counter this threat; increasing the number of weapons in our strategic forces in the near term; convincing the Soviets that their massive air defense efforts will not substantially blunt US air-breathing strike capabilities; and, providing the Soviets an incentive to agree in future SALT negotiations to further force reductions and perhaps to air defense limitations as well. Current plans call for the procurement of 3418 ALCMs to equip each of the 151 Primary Aircraft Authorization B-52G with 20 ALCMs. Initially, 12 ALCMs will be loaded externally on each B-52G. In the mid-1980s, eight more ALCMs, loaded internally on a rotary launcher, will replace the current load of gravity bombs and SRAM.

RELATED ACTIVITIES: The AGM-86B and AGM-109 ALCM, land attack SLCM, and the Ground Launched Cruise Missile programs are structured to have maximum commonality in engine and navigation/guidance subsystems. The ALCM and SLCM share the common W-80 nuclear warhead under development by the Department of Energy. All three missile programs, the engine, navigation/guidance, and mission planning projects are jointly managed through the JCMPO. The B-52 Squadrons, Program Element 11113F, is also related to the ALCM. The B-52 cruise missile carriage, offensive avionics system, and other projects require close coordination with the ALCM program to ensure full compatibility. A memorandum of understanding exists between the JCMPO and the Air Force Strategic Systems Program Office which delineates interface tasks.

Program Element: #64361F
DOD Mission Area: Airborne Strike, #113

Title Air Launched Cruise Missile (ALCM)
Budget Activity Strategic Programs #3

WORK PERFORMED BY: The Joint Cruise Missiles Project Manager works under the Naval Material Command in cooperation with the Air Force Systems Command. The Air Launched Cruise Missile (ALCM) program also interfaces with; Strategic Systems Program Office, Aeronautical Systems Division, Wright-Patterson Air Force Base (AFB), OH (B-52 interface); Department of Energy, Washington, DC (W-80 warhead); and Defense Mapping Agency, Washington, DC and St. Louis, Mo, Strategic Air Command and Joint Strategic Target Planning Staff, Offutt AFB, NE (terrain contour matching map and mission planning). Department of Defense in-house facilities include: Arnold Engineering Development Center, TN; Naval Ship Research and Development Center, Bethesda, MD; Naval Air Propulsion Center, Trenton, NJ; Radar Target Scatter Facility and White Sands Missile Range, Holloman AFB, NM; Air Force Weapons Laboratory and Air Force Test and Evaluation Center, Kirtland AFB, NM; 4950th Test Wing and the Flight Dynamics Laboratory, Wright-Patterson AFB, OH; 6514th Test Squadron, Hill AFB, UT; Air Force Flight Test Center, Edwards AFB, CA and the Pacific Missile Test Center, Pt Mugu, CA. The major contractors are: air vehicle - Boeing Aerospace, Seattle, WA and General Dynamics/Convair, San Diego, CA; carrier aircraft equipment/cruise missile integration - Boeing Military Aircraft Company, Wichita, KS; engine - Williams Research Corp., Walled Lake, MI and Teledyne CAE, Toledo, OH; navigation guidance - McDonnell-Douglas Astronautics St. Louis, MO, Litton Industries, Woodland Hills, CA, Litton Canada Ltd, Toronto, ONT, Minneapolis Honeywell, Minneapolis, MN; recovery system-Pioneer Parachute CO., Manchester, CT and Irvine Co., Los Angeles, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Boeing AGM-86A utilized the technology of the cancelled Subsonic Cruise Armed Decoy air vehicle and engine to produce prototype models for testing. Six advanced development test flights were conducted in 1976. Four were successful. Two tests suffered component malfunctions and loss of the missiles. These tests successfully demonstrated system integration in a flight vehicle, threshold performance, and design-to-cost estimates. The Milestone II review in January 1977 approved the Full Scale Engineering Development for the current cruise missile programs. After the B-1 production was cancelled, the General Dynamics AGM-109 was introduced into system competition with the Boeing AGM-86B. A Strategic Systems Program Office was formed at Wright-Patterson Air Force Base to integrate the ALCM into the B-52. The program included ALCM design and fabrication, B-52 integration, and rotary launcher and pylon development. In June 1978, Under Secretary of Defense for Research and Engineering deleted the Limited Operational Capability (June 1980) and redefined the Initial Operational Capability as one squadron of B-52G equipped with 12 ALCMs each in December 1982. Boeing Military Aircraft initiated modification of the first of three test B-52 aircraft in support of the competitive flyoff. Williams Research F-107 engine qualification tests were initiated. Teledyne CAE was selected as licensed second source for F-107 engine. Both ALCM contractors initiated the pilot production of 12 missiles each in September 1978. The major FY 1979 effort was the initiation of the competitive flyoff in July 1979. Seven missile flights were successful with two unsuccessful due to software problems that have since been corrected. An instrumented B-52, carrying dummy missiles from both contractors successfully conducted performance, flutter and missile jettison tests. Other activity included design and early development of a new radar altimeter for the missile, engine qualification tests, pylon and rotary launcher tests, and some support equipment development.

Program Element: #64361F
DOD Mission Area: Airborne Strike, #113

Title Air Launched Cruise Missile (ALCM)
Budget Activity Strategic Programs #3

2. FY 1980 Program: The initial FY 1980 Research Development Test and Evaluation (RDT&E) effort concentrated on completing the remaining 13 competitive flights and associated ground tests by January 1980. The source selection process is in progress with the winner expected to be announced in March 1980. A production decision is also expected in March. The winning missile will then begin a follow-on test and evaluation (FOT&E) program. The FOT&E program includes nine flights from the winner's B-52G during the remainder of FY 1980. Other development activities include formal qualification of the navigation/guidance system, completion of the engine qualification tests, development and flight testing of the new radar altimeter, maintainability demonstrations, and continuation of ground support equipment development to support the September 1981 first alert capability (FAC). The mission planning data preparation system will be delivered to Strategic Air Command. The RDT&E effort will also support the development of Air Launched Cruise Missile/Offensive Avionics System (ALCM/OAS) interfaces and plans for the FY 1981 ALCM/OAS flight test launches.

3. FY 1981 Planned Program: All activity in FY 1981 will be prioritized to meet the September 1981 FAC milestone. The ALCM FOT&E program will complete the last launches from the cruise missile integration configured carrier aircraft by mid-FY 1981. Pylon jettison tests are planned. Support will continue to the OAS program. Interface definition will be completed and final integration of ALCM/OAS compatibility will begin with the first ALCM launches from an OAS-configured B-52G. Development of the missile radar altimeter test assembly will be completed. Rotary launcher qualification will be completed and OAS interface activity will identify engineering changes required. Second sources will be qualified for the engine and navigation-guidance equipment. Software activity will continue for the electronic systems test set test package requirements. Organizational and intermediate level technical orders will be verified. Development of depot level support equipment will begin. Engineering changes resulting from the FOT&E program will be documented and incorporated into the production design. Retrofit kits will be developed to update missiles in the operational inventory to the approved configuration. The ALCM site activation task force will be active at Griffiss AFB, NY. Associated with site activation will be the initiation of interim contractor support to assist in maintaining initial operational readiness of the ALCM system.

4. FY 1982 Planned Program: The ALCM initial operational capability (IOC) will occur in December 1982 (FY 1983). All activity in FY 1982 will be prioritized to meet this critical program milestone. Flight test activities will include support for five launches from the OAS configured B-52 which are scheduled to verify the performance of software changes to be incorporated in the IOC configuration.

5. Program to Completion: There is a possibility of ALCM/B-52 development activity in FY 1983. The amount of any additional effort, if any, will depend on the progress of depot level support equipment development and whether or not any significant system integration problems surface.

Program Element: #64361F
DOD Mission Area: Airborne Strike, #113

Title Air Launched Cruise Missile (ALCM)
Budget Activity: Strategic Programs #3

6. Milestones:

		Dates
A.	Defense System Acquisition Review Council (DSARC) I (ALCM Program Initiated)(AGM-86A)	Feb 74
B.	DSARC II (AGM-86A)	Dec 74
C.	DSARC IA (AGM-86A)	Mar 75
D.	Jettison Tests Completed (AGM-86A)	Jun 75
E.	Engine Preliminary Flight Rating Test Complete	Oct 75
F.	Initial Department of Energy Phase III (Warhead)	Feb 76
G.	First Powered Flight (AGM-86A)	Mar 76
H.	First Guided Flight (AGM-86A)	Sep 76
I.	DSARC II (AGM-86A/B)	Jan 77
J.	AGM-86B/AGM-109 Competition Directed	Jul 77
K.	System Design Reviews	May 78
L.	First Full Scale Engineering Flight	*(Jun 79) Jul 79
M.	Source Selection/DSARC III	Mar 80
N.	First Alert Capability	Sep 81
O.	Initial Operational Capibility (IOC)	Dec 82 1/

* Dates presented in FY 1980 Descriptive Summary.
1/ IOC defined as one squadron of B-52Gs with 12 ALCMs each.

7. Resources: N/A

8. Comparison with FY 1980 Budget Data:

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
276,900	336,900	90,000	20,000		925,200

The FY 1979 estimate was increased $1.995 Million by reprogramming action to cover the Air Force share of costs associated with a previously unplanned live firing program as part of the cruise missile survivability evaluation. Part of the FY 1981 increase is also associated with the live firing program ($3.41 Million).

The remainder of the cost increase ($85.0 Million in FY 1981 and $32.8 Million in FY 1982) is related to FY 1980 cost increases and subsequent deferral of tasks to FY 1981-1982 plus the costs of expanding the flight test program from eleven to nineteen flights. The FY 1980 cost increases were primarily associated with engine costs overruns, delays in the flyoff and late receipt of the FY 1979 Supplemental. These increases caused deferral of FY 1980 development tasks, particularly in the support equipment area, to FY 1981 and FY 1982. Previously undefined depot level support equipment development also contributed to the increases.

Budget Activity: Strategic Programs #3

Program Element: 64361F, Air Launched Cruise Missile (ALCM)

Test and Evaluation Data

1. Development Test and Evaluation (DT&E): During the period FY 1975 through the first quarter FY 1977, six advanced development tests were conducted on the medium range Boeing AGM-86A Air Launched Cruise Missile (ALCM). Jettison tests were successful, demonstrating that the AGM-86A could be safely launched at low and high air speeds, and four of the six flight tests were successful. The fifth flight went out of control because the stable platform of the inertial navigational element tumbled, and the sixth flight failed to obtain an engine start.

The General Dynamics AGM-109 ALCM inherits the DT&E base of the BGM-109 Sea Launched Cruise Missile (SLCM). The SLCM has had a total of 48 flight tests as of 1 January 1980. Of these, 40 were successful while eight were failures. Previously identified problems have been resolved and will be reported by the SLCM program.

The Full Scale Engineering Development (FSED) program for the long range ALCM is structured into two phases. The first phase is the competitive flyoff between the AGM-86B and the AGM-109 with one being chosen to proceed into production. The second phase will consist of 19 follow-on flights to support B-52G/ALCM integration. The FSED test program began in April 1979 with B-52 flutter and jettison tests of each missile configuration. Two modified B-52Gs (one for each contractor) were delivered to Edwards Air Force Base (AFB), CA in May 1979 to begin the missile competitive flight test program. A third B-52 was used at Edwards AFB for performance, flutter and jettison tests. The competitive flight test program will run from July 1979 through January 1980 and consist of B-52 performance evaluations with ALCMs loaded; captive carry tests as required; live launches (ten flights per contractor); reliability and maintainability demonstrations; mid-air recovery; and survivability and vulnerability testing. The ten flights per competitor are further divided into three DT&E flights conducted by the contractors and seven DT&E/Initial Operational Test and Evaluation (IOT&E) flights conducted by a joint Air Force DT&E/IOT&E test team. IOT&E is managed by the Air Force Test and Evaluation Center. As of 6 January 1980, 17 ALCM flights have occurred. Ten were successful, four partially successful and two unsuccessful. Seven missiles were lost due to a variety of problems that have since been corrected. These problems included: software, wing actuation failure, an engine failure, and an air data computer failure. There have been no indications that expected performance will not be achieved.

Source selection is scheduled for March 1980. The selected missile will then complete an additional 11 flight follow-on test and evaluation program between March 1980 and January 1981 utilizing the winner's B-52G and eight integration flight from the Offensive Avionics System configured B-52 test aircraft during the March - December 1981 time frame. Wind tunnel testing was accomplished at Arnold Engineering Development Center and the Naval Ship Research Development Center. Engine flight qualification and calibration will occur in FY 1979 and FY 1980 at AEDC and the Naval Air Propulsion Center. Rotary launchers were proof qualification tested in FY 1979. Pylon proof testing began in February 1979.

Budget Activity: Strategic Programs #3

Program Element: 64361F, Air Launched Cruise Missile (ALCM)

The missiles being tested during the flyoff are representative of those that will be procured. Changes identified during the flyoff will be tested by the winner during the 19 flight follow-on phase. Included will be a new radar altimeter and the production configured engine. Support equipment, missile handling equipment and full capability electronic systems test sets will be tested during the follow-on test period.

The Air Launched Cruise Missile (ALCM) competition involved Boeing Aerospace, Seattle, WA, and General Dynamics Convair, San Diego, CA for the missile. Williams Research, Walled Lake, MI is the prime contractor on the engine. Teledyne CAE, Toledo, OH, will be the second source for the engine. Teledyne will start qualification testing of its copy of the engine in late 1981. McDonnell Douglas, St. Louis, MO is providing navigation/guidance hardware to both missile contractors, but is participating in competition with Boeing by providing navigational software to General Dynamics. Boeing Military Aircraft Company Wichita, KS is the cruise missile integration contractor responsible for B-52G modification and integration. Cruise missile development and initial production are managed by the Joint Cruise Missiles Project Office (JCMPO) with the Navy as lead service. Rear Admiral Walter M. Locke is Program Director. The ALCM responsible test organization is the Air Force Flight Test Center (AFFTC), Edwards Air Force Base, CA. The Air Force Test and Evaluation Center (AFTEC) is the independent operational test agency for ALCM.

Testing is being conducted out of AFFTC using primarily the Utah Test and Training Range and Pacific Missile Test Center for missile testing. A combined test team consisting of AFFTC and AFTEC personnel are conducting the tests under the management of the JCMPO. During the flyoff, 10 AGM-86Bs and 7 AGM-109s (3 will be refurbished and reflown) are being tested. The follow-on testing will use 11 missiles from the FY 1978 missile buy and 8 refurbished missiles.

The majority of the reliability and maintainability testing will be conducted following the selection of a winning missile when sufficient production configured support equipment is available. During the flyoff the contractors are expected to demonstrate a .744 test reliability for a hypothetical mission of 12 hours captive carry and 5 hours of free flight. Ground test demonstrations are being conducted during the flyoff and will be evaluated as part of the competition. These include pylon/launcher loading, ALCM vehicle exchanges, payload exchange and limited capability electronic systems test set testing. These tests are being conducted by AFFTC and AFTEC personnel at Edwards AFB, CA.

Environmental testing in FY 1979 consisted of static icing tests of the competing missiles. FY 1980 activities include simulated free flight icing tests of the missile in the Arnold Engineering Test Center wind tunnel and flight tests of the missile/pylon/B-52G combination using the KC-135 water spray tanker. The FY 1981 effort will consist primarily of test planning and facility set up for integrated missile/B-52G offensive avionics system cold weather tests at the Eglin AFB, FL climatic hanger.

Budget Activity: Strategic Programs #3

Program Element: 64361F, Air Launched Cruise Missile (ALCM)

2. Operational Test and Evaluation (OT&E)

a. The Joint Cruise Missiles Project Office (JCMPO) conducted an initial phase of survivability testing between January and September 1978. Seven test flights were flown with the TOMAHAWK Sea Launched Cruise Missile (SLCM) version against representative airborne and ground defensive threats to obtain generic detection and tracking data. Further generic test data will be obtained during a second phase of survivability flights involving both SLCM and Air Launched Cruise Missile (ALCM) versions. As of 1 November 1979, three such flights have been flown. The applicable results from these phases will be used in evaluating ALCM survivability.

b. The Air Force Test and Evaluation Center (AFTEC) is the OT&E agency responsible for accomplishing ALCM initial operational test and evaluation (IOT&E) and the early phase of follow-on operational test and evaluation (FOT&E). The AFTEC headquarters element is located at Kirtland AFB, CA. The IOT&E test team is comprised of approximately 125 personnel from AFTEC, Strategic Air Command, Air Force Logistics Command and Air Training Command.

c. A combined development test and evaluation/initial operational test and evaluation (DT&E/IOT&E) of the ALCM will be accomplished during FY 1979-1980. The ALCM program is a competitive fly-off between Boeing, Seattle, WA, and General Dyanmics Convair, San Diego, CA (prime contractors). The initial testing is divided into two phases, the first phase is the competive fly-off and is classified as DT&E/IOT&E. This phase began in July 1979 and will be completed in January 1980. The second phase will follow the Defense Systems Acquisition Review Council (DSARC) III decision and will be classified as DT&E/FOT&E. This phase of testing will take place between March 1980 and December 1981. During the competitive phase each contractor will launch 10 missiles. The follow-on phase will consist of 19 additional launches, eight of which will be from the offensive avionics system B-52G. Because of the competitive nature of the program some of the support equipment evaluation will occur after the competitive phase.

d. The significant milestones associated with the ALCM program are: Source selection and DSARC III March 1980, First Alert Capability September 1981, and Initial Operational Capability December 1982.

e. The Joint Test Force, of which AFTEC personnel are a part, is located at Edwards AFB, CA. All the flight tests originate from Edwards, and most of the support equipment evaluation will be accomplished there. IOT&E flight test will be conducted over, and between, several western test ranges, i.e., Utah Test and Training Range, Pacific Missile Test Range and Edwards Range. In addition a series of captive carry flights will be accomplished over the western part of the United States, including Alaska.

Budget Activity: Strategic Programs #3

Program Element: 64361F, Air Launched Cruise Missile (ALCM)

f. The purpose of Initial Operational Test and Evaluation (IOT&E) is to estimate the operational effectiveness and suitability of the Air Launched Cruise Missile (ALCM) system to support the source selection and Defense System Acquisition Review Council (DSARC) III decision points. IOT&E test objectives have been structured to provide the appropriate information at the decision points. The objectives cover the following areas: operational performance parameters, mission reliability, compatibility and interoperability, survivability, mission planning, availability, logistics reliability, maintainability, logistics supportability, operations and support cost, training, human factors and software suitability.

g. Testing of the ALCM is being affected by a number of issues both internal and external to the program. Fiscal and time constraints have limited the number of actual missile launches to 10 per contractor prior to DSARC III and delayed availability of various pieces of support equipment at the test site until after the production decision. Action is being taken to reduce the effect of these constraints. Updating of the B-52 with the new offensive avionics system (OAS) has also caused some change in the test programs for both systems. Several test objectives which are important to the ALCM program have been delayed until an OAS equipped B-52 is available, and will be accomplished in conjunction with the OAS test program instead of the ALCM test program. Examples of these objectives are: total system mission reliability, interoperability, compatibility and some maintainability and logistics supportability.

h. No test information or results are provided due to the competitive nature of the program; such data are source-selection sensitive.

i. Following Initial Operational Capability in December 1982, Strategic Air Command will manage follow-on operational test and evaluation which will start after the first wing is fully equipped with missiles, support equipment and trained personnel.

Budget Activity: Strategic Programs #3

Program Element: 64361F, Air Launched Cruise Missile (ALCM)

3. System Characteristics: Performance data are Decision Coordinating Paper thresholds/goals.

Physical Characteristics	Boeing AGM-86B	General Dynamics AGM-109
Length (ft)	20.75	20.0
Diameter (in)	27.3	20.0
Weight (lb)	(2500-3500)	(2500-3500)
Wing Span (ft)	12.0	8.62
Wing Area (sq ft)	11.0	12.0
Warhead Yield (kt)		
B-52 Internal Carriage (ea)	8	8
B-52 External Carriage (ea)	12	12

Performance Data	Threshold	Goal	Demonstrated
Max Low Alt Speed (MACH)			See Text--
Min Launch Altitude (ft)			Competition
Min Enroute Altitude (smooth) (ft)			Sensitive
Propulsion Range (km)1/			Information
Sys Opnl Range (km)	2500	2500	
Accuracy (CEP) (ft)2/			

1/ Low altitude at MACH

2/ At MACH

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 64406F
DoD Mission Area: Space Defense, # 123

Title: Space Defense Systems
Budget Activity: Strategic Programs, # 3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		78,168	80,500	110,400	99,400	Continuing	Not applicable
2134	Miniature Systems	64,368	63,000	77,400	65,200	Continuing	Not applicable
2135	Advanced Systems	500	500	7,000	7,000	Continuing	Not applicable
2136	Conventional Systems	4,900	1,000	0	5,000	Continuing	Not applicable
2241	Instrumented Vehicle	7,900	16,000	26,000	22,200	Continuing	Not applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program is developing anti-satellite (ASAT) systems in response to guidance contained in National Security Council/Presidential Directive -37 (NSC/PD-37: National Space Policy). These systems are designed to remove the sanctuary status the Soviets currently enjoy in space by providing a capability to deny them the use of those space assets which enhance the effectiveness of their land, sea and aerospace forces.

BASIS FOR FY 1981 RDT&E REQUEST: This request funds the continuing development of the baseline Miniature Air-Launched System (MALS) ASAT, development of an Instrumented Test Vehicle (ITV) to serve as an orbital target for ASAT testing and investigation into the possible application of high energy lasers as ASAT weapons. The initial flight-test Miniature Vehicle warheads for the MALS ASAT will be delivered and the ITV will begin qualification testing. MALS integration into flight-test configuration will begin.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: # 64406F
DoD Mission Area: Space Defense, # 123

Title: Space Defense System
Budget Activity: Strategic Programs, # 3

DETAILED BACKGROUND: Space systems provide for global support of military operations without infringing on foreign territorial boundaries. The Soviet reliance on military space support is growing at a rapid pace. The present-day Soviet military satellite population varies between 74-101 active satellites on orbit.

The United States (US) does not have a capability to deny the Soviets the use of space for strategic and tactical forces support. As a result, space is a sanctuary from which the Soviets can effectively project military power around the globe free from direct, foreign intervention and political entanglements. The Air Force anti-satellite (ASAT) systems are being developed to deny the Soviets the use of space as a force multiplier and to remove the current sanctuary status the Soviets enjoy in the space environment.

The Air Force is not developing an anti-satellite as a counter to the in-being Soviet ASAT system. However, the presence of a Soviet ASAT does complicate the situation since, in the absence of a comparable US system, the Soviets could gain a distinct military advantage. Under the current situation (no US ASAT), the US is left with three alternatives to a Soviet ASAT attack: do nothing, attempt a political solution, or escalate the situation by attacking ground-based forces.

A United States anti-satellite will have several favorable characteristics over the employment of other weapon systems. It will not violate sovereign territory or threaten people. As a limited strategic option, it can be used for selective mission denial and for a show of determination. Finally, it could deter the immediate use of a Soviet ASAT by providing a counter threat to their space systems.

The program consists of engineering development efforts for a Miniature System ASAT and the critical components for a Conventional ASAT. The Miniature System ASAT can be ground or air-launched. The baseline system currently in prototype development is the Miniature Air-Launched System consisting of a Short Range Attack Missile first stage, an ALTAIR II second stage and a Miniature Vehicle terminal warhead stage. The Conventional ASAT developments are being pursued to assure the availability of a physical attack ASAT system in the if the approach fails. Instrumented Test Vehicles will provide orbital test targets for evaluating the anti-satellite systems.

The Miniature System is a potentially l w cost, lightweight, and highly responsive system. However, it depends on achieving a circular error of probability which will involve a moderate risk development effort. The high payoff in cost effectiveness and operational flexibility has led the Air Force to aggressively pursue this anti-satellite option. The Conventional Anti-satellite development is being pursued as a technical hedge to the The requirement for an assured anti-satellite demonstration in the requires that a low risk off-the-shelf option be developed using proven technologies. While the selected Conventional anti-satellite design will meet this requirement, it will be costly to deploy and will be limited only to low altitude intercepts because of limited boost vehicle energy and guidance radar range.

Program Element: # 64406F
DoD Mission Area: Space Defense, # 123

Title: Space Defense Systems
Budget Activity: Strategic Programs, # 3

The Prototype Miniature Air-Launched System (PMALS) proceeded into hardware design and development in the fourth quarter FY 77. Hardware assembly and test of subsystems commenced in FY 1978. If directed by the Secretary of Defense, this will lead to demonstation flights beginning in against targets being developed under Project 2241, Instrumented Test Vehicle. The Conventional Anti-satellite (ASAT) efforts proceeded into design definition in FY 1978. Following this definition, a program decision will be required to continue development.

During the course of this program, the Air Force will participate in the DoD ground and space-based laser efforts so that when this technology matures, lasers can be evaluated for use as anti-satellite weapons.

RELATED ACTIVITIES: This program is part of an integrated Space Defense Systems Program effort involving four functional areas: Anti-Satellite, Space Surveillance, Space Survivability, and Command and Control. Program Element (P.E.) 63438F, Satellite Systems Survivabililty, relies on the anti-satellite program for information about ASAT techniques so that effective countermeasures can be developed. P.E. 63428F, Space Surveillance Technology, P.E. 12311F, North American Air Defense Command Combat Operations Center, and P.E. 12424F, SPACETRACK, provide the needed tracking capability and command and control so that the anti-satellite system can be targeted.

WORK PERFORMED BY: Air Force Systems Command's (AFSC) Space Division in Los Angeles, CA manages this program. Aerospace Corporation, El Segundo, CA provides technical support. Miniature System contractors are: Vought Corporation, Grand Prairie, TX and Boeing Aerospace Corporation, Seattle, WA. The Conventional ASAT design definition is being conducted by the Boeing Corporation, Seattle, WA under separate contract. If a decision is made to develop the Conventional ASAT, potential bidders are: McDonnell Douglas Corporation, Huntington Beach, CA; RCA-Astro Electronics Division, Highstown, NJ; Hughes Aircraft Corporation, Culver City, CA; Rockwell International, Downey, CA; Lockheed Missiles and Space Corportation, Sunnyvale, CA; Martin-Marietta Corporation, Denver, CO; Boeing Company, Seattle, WA; TRW Corporation, El Segundo, CA; and Grumman Aerospace Corporation, Bethpage, NY. The Instrumented Test Vehicle development was awarded to AVCO, Wilmington, MA. The Arnold Engineering Development Center and AFSC's Space and Missile Test Organization are both supporting the PMALS development and test efforts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Two Miniature System ASAT concepts were pursued through preliminary design. The Vought/Boeing team was selected in the fourth quarter FY 77 for prototype development and ground tests. The warhead development model has been completed and targeting and flight planning software design was initiated. Preliminary test and operational support requirements for the Space Defense Operations Center and the Prototype Mission Operations Center have been defined.

The Conventional Anti-satellite (ASAT) preliminary design efforts have been completed and all contractual efforts will be complete by February 1980. A full-scale development decision for Conventional ASAT will depend on the success of the Miniature Air-Launched System (MALS) program. As long as the the MALS development results are satisfactory, no addi-

tional contractual efforts for a Conventional ASAT are anticipated. If the MALS approach fails, a Conventional ASAT will be developed.

Laser systems will be continually reviewed for possible advanced ASAT applications. Conceptual designs for a Ground Based Laser ASAT system have been completed including potential locations, support facilities and technical equipment (see separate Descriptive Summary for Project 2135).

Detailed design of the Instrumented Test Vehicle has been initiated following award of the develoment contract to AVCO in May 1979.

2. FY 1980 Program: Engineering development of the baseline miniature system anti-Satellite (ASAT) and its companion Instrumeted Test Vehicle will continue. Fabrication of initial ground-test vehicle warheads and dispensers and attitude control sub-systems will be completed and ground-tests initiated. Successful conclusion of a Defense System Acquisition Review Council meeting on the air-launched system will lead to execution of a flight-test contract option. Work will be completed on preliminary design of a conventional ASAT as a backup to the miniature system and investigations of advanced ASAT techniques such as lasers will continue.

3. FY 1981 Planned Program: Ground test of the Miniature Vehicle warhead for the Miniature Air-Launched System (MALS) will continue. MALS integration efforts will accelerate and launch aircraft and ASAT system interfaces will be tested. Final development and qualification testing for the Instrumented Test Vehicle (ITV) will be completed.

High energy laser ASAT technology efforts will concentrate on trade-offs between and ground-based applications. Cost/benefit assessments conducted in FY 80 will guide the choice of a baseline approach.

4. FY 1982 Planned Program: Ground tests of the warhead continue. System integration efforts will continue toward certification of the prototype's readiness for flight test. Testing of the interfaces between the ITV and its Scout booster will begin. Activities at the Air Force Flight Center at Edwards AFB, CA will accelerate toward a first flight of the Miniature System ASAT.

Conventional ASAT funding in FY 1982 will only be needed if development test results indicate major problems with the Miniature Air Launched System.

Advanced Development of a ground or High Energy Laser (HEL) will continue in FY 82 with efforts concentrating on system prototyping if a HEL is chosen for development and operational site transition efforts if a ground-based HEL ASAT is chosen for demostration. Definition of the preferred option is anticipated in FY 80.

5. Program To Completion: This is a continuing program. If a space test is directed by the Secretary of Defense, the MALS will be demonstrated in This program would continue to support as required the deployment of an operational ASAT capability.

Program Element: # 64406F
DoD Mission Area: Space Defense, # 123

Title: Space Defense Systems
Budget Activity: Strategic Programs, # 3

6. Milestones:

a. MALS demonstration
b. Conventional Anti-satellite demonstration
c. First Instrumented Test Vehicle on-orbit

* Date presented in FY 1979 Descriptive Summaries
** No Conventional ASAT demonstration unless development problems experienced with MALS.
*** Reflects one-year slip in initiation of flight tests due to funding constraints in FY 80 and FY 81.

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data:

Program Element 64406F Space Defense Systems

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion
TOTAL FOR PROGRAM ELEMENT	41,600	73,000	80,500	108,600	Continuing
2134 Miniature Systems	22,100	45,300	58,000	67,900	Continuing
2135 Advanced Systems	9,800	14,000	2,500	10,000	Continuing
2136 Conventional Systems	2,600	5,200	5,000	5,000	Continuing
2241 Instrumented Vehicle	6,400	7,900	15,000	25,200	Continuing
2498 Computer War Gaming	700	600			

- No change at Program Element level in FY 80. Additional funding for Project 2134 reflects increased development costs for baseline anti-satellite system. Reduction in Project 2136 reflects decision not to fund further work on a Conventional anti-satellite unless baseline system experiences development problems.

Project: # 2134 Title: Miniature Systems
Program Element: # 64406F Title: Space Defense System
DoD Mission Area: Space Defense, # 123 Budget Activity: Strategic Programs, # 3

DETAILED BACKGROUND AND DESCRIPTION: United States (US) anti-satellite (ASAT) development efforts

This guidance followed growing recognition of (1) the growing asymmetry between the US and the Union of Soviet Socialist Republics (USSR) in ASAT capabilities and (2) the disincentive the lack of a US ASAT capability represented to the Soviets to seriously negotiate an ASAT treaty. Thus, the development of an ASAT capability will enable the US to respond to a Soviet ASAT attack by providing the means to destroy Soviet satellites which enhance their war fighting capabilities.

Air Force ASAT development efforts have concentrated on miniature, non-explosive, This type of system is cost effective, operationally flexible and has growth potential for attacks against high-altitude targets. The baseline ASAT system, currently in prototype development consists of a Short Range Attack Missile first stage, an ALTAIR II second stage and a Miniature Vehicle terminal warhead stage. This Miniature Air-Launched System (MALS) ASAT weighs approximately pounds and is designed to attack targets at altitudes less than nautical miles. The warhead weighs pounds, is approximately uses a sensor to detect and track a target satellite and, using small rockets, itself into the orbital path of the target satellite to at relative velocities from feet per second.

Competitive design contracts for the MALS were carried through preliminary design review in FY 1977. A Vought Corporation design for a sensor was selected in the fourth quarter FY 1977 for full-scale development. The Vought design will be developed and ground-tested through A contract option for flight test of the vehicle will be exercised in FY 1980 assuming a successful Defense Systems Acquisition Review Council IA. The first flight demonstration would occur in against an Instrumented Test Vehicle being developed under Project 2241.

RELATED ACTIVITIES :

Program Element (P.E) 63428F, Space Surveillance Technology, develops the satellite targeting sensors so the range and the prediction accuracy of SPACETRACK can be improved. This supports the MALS program by reducing the requirements during the attack engagement and enhancing the probability of kill. P.E. 12511, North American Air Defense Command Combat Operations Center, is developing the Space Defense Operations Center to provide the command control of ASAT operations.

WORK PERFORMED BY: Air Force Systems Command's Space Division, formerly Space and Missile Systems Organization, in Los Angeles, CA manages this program. The primary contractors are LTV Corporation, Grand Prairie, TX and Boeing Aerospace Corporation, Seattle, WA. Aerospace Corporation, El Segundo, CA provides technical support.

Project: # 2134
Program Element: # 64406F
DoD Mission Area: Space Defense, # 123

Title: Miniature Systems
Title: Space Defense Systems
Budget Activity: Strategic Programs, # 3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Two competitive Miniature Vehicle design efforts were initiated in FY 1976. The efforts included the preliminary design of the and the spin-up and release mechanism, limited system simulations and cost trade-offs against variations in mission requirements and investigations into booster interfaces and deployment concepts. In the fourth quarter of FY 1977, the Vought Corporation design was selected for Miniature Air-Launched System (MALS) development leading to demonstration flights beginning in Selection was primarily based on system performance, risk as defined by hardware state-of-the-art, applicability to existing booster systems, and cost. FY 79 efforts included development sensor tracking and sensitivity tests at Arnold Engineering Development Center, redesign of the flight computer for more storage capacity and bench tests of attitude control subsystems. Carrier aircraft and MALS engineering interfaces were further refined and targeting algorithm design was initiated.

2. FY 1980 Program: Developement of all components of the MALS will continue. Fabrication of the warhead development models will be completed and ground tests initiated. This will include a number of drop tests to develop a detailed statistical model of the ability to detect and track a simulated target. Integration testing will be conducted with the the spin-up mechanism, the carrier, and the aircraft system. A validation effort will be performed for the targeting and flight planning software. This will include tests with the SPACETRACK system and the Space Defense command and control system being developed under Program Element (P.E.) 12311F, North American Air Defense Command Operations Center. A decision on whether or not to exercise the flight-test contract option will be made in the Spring of 1980.

3. FY 1981 Planned Program: Ground tests of the will continue. Analyses of drop tests and data will be performed to support a technical go/no-go decision for a flight test demonstration of the system. Integration of MALS components into flight test configurations and detailed flight-test planning will be initiated. Certification of the weapon system to the carrier aircraft will be accomplished.

4. FY 1982 Planned Program: Integration of MALS components into flight test configurations will be completed. Exhaustive integrated system tests will certify interfaces and evaluate critical sub-system performance. Flight-test planning will concentrate on maximizing data return from each of a limited number of test flights.

5. Program to Completion: If directed by the Secretary of Defense, MALS test flights are planned in Limited Operational Capability may be declared during the test program if system performance so warrants. Development efforts for a ground-launched miniature system anti-satellite will begin in if operational requirements dictate. This P.E. will continue to support the MALS through transition to an operational capability.

Project: # 2134
Program Element: # 64406F
DoD Mission Area: Space Defense, # 123

Title: Miniature Systems
Title: Space Defense Systems
Budget Activity: Strategic Programs, # 3

6. Milestones: Not applicable

7. Resources:

RDT&E Funds Miniature Systems	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	64,868	63,000	77,400	65,200	Continuing	Not appliable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Miniature Systems	22,100	45,300	58,000	67,900	Continuing	Not applicable

- In FY 80 and FY 81, projected costs in Miniature System development will require additional funding. Efforts will be adjusted within Program Element to provide required funding.

Project: #2135
Program Element: #64406F
DoD Mission Area: Space Defense #123

Title: Advanced Systems
Title: Space Defense Systems
Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: This project examines those systems that can provide a high payoff in the future but have not matured to a point where consideration can be given to full-scale development, and those systems that can augment other developments in this program element and therefore provide the National Command Authorities with a broad range of weapon system options.

There is currently a national effort to develop lasers as a military weapons. The Army, Navy, Air Force and the Defense Advanced Research Projects Agency (DARPA) are all involved in laser developments as they apply to their particular mission areas. These developments apply to the Space Defense mission. Ground-based lasers in the power region could threaten satellites up to Space-based lasers could offer a highly responsive anti-satellite (ASAT) system against all satellites. This project will provide for systems definitions, technology evaluations, and system tradeoffs with respect to ongoing laser developments. As a result, the Air Force will be able to evaluate the potential of the laser developments and will be in a position to proceed with full-scale development should the technology mature to an acceptable level. The Air Force is currently pursuing the development of advanced ASAT techniques. These techniques will be used to augment any operational ASAT.

RELATED ACTIVITIES: This project interfaces with all of the DoD laser efforts conducted by the Army, Navy, Air Force and DARPA.

WORK PERFORMED BY: Air Force Systems Command's Space Division, formerly Space and Missile Systems Organization in Los Angeles, CA, manages this project. Aerospace Corporation, El Segundo, CA, provides technical support. Current contractors and potential bidders are: Lockheed Missiles and Space Corporation, Sunnyvale, CA; Rockwell International, Downey, CA; TRW, Redondo Beach, CA; and Martin Marietta Corporation, Denver, CO.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A survey was conducted of all DoD ground-based laser assets to determine their applicability to the ASAT mission. The Air Force participated with DARPA in a space-based ASAT design study. A joint DARPA/Air Force Memorandum of Understanding detailing how DARPA technology will transition to the Air Force was drafted and coordination begun. Preliminary site configurations and locations for a ground-based laser ASAT have been defined.

2. FY 1980 Program: Trade-off studies of space-based vs. ground-based high energy lasers (HEL) will be conducted. Definition of a space-based laser program will be developed. This definition will identify all technical issues remaining to be solved and the schedule for achieving the solutions. A configuration for a ground-based laser program will be selected and the key technologies identified for engineering development. Based on results of system trade offs, a decision will be made on whether to emphasize ground-based or space-based HELs.

Project: #2135
Program Element: #64406F
DoD Mission Area: Space Defense #123

Title: Advanced Systems
Title: Space Defense Systems
Budget Activity: Strategic Programs #3

3. FY 1981 Planned Program: Assuming a commitment to demonstrate a ground-based laser anti-satellite (ASAT), a program will be initiated to identify technical operational issues in an ongoing Air Force Weapons Laboratory (AFWL) ground based laser effort. These efforts will be to exploit the ground based laser at the earliest possible date for an ASAT capability. The Air Force development and integration of advanced ASAT approaches will proceed.

4. FY 1982 Planned Program: Assuming a commitment to demonstrate, efforts will concentrate on supporting preparations for a demonstration of a ground-based laser ASAT capability in conjunction with the AFWL. If space-based applications are to be stressed, planning for transitioning Defense Advanced Research Projects Agency technology into a near-term space-based demonstration will continue.

5. Program to Completion: This is a continuing program to transition advanced technology in meaningful ASAT capability.

6. Milestones: Not applicable.

7. Resources:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	500	500	7,000	7,000	Continuing	N/A

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	9,800	14,000	2,500	10,000	Continuing	N/A

Reduction in FY 81 of 3,000 reflects Office of the Secretary of Defense direction to use existing laser hardware at White Sands Missile Range, NM.

Project: #2241 Title: Instrumented Test Vehicle
Program Element: #64406F Title: Space Defense Systems
DoD Mission Area: Space Defense #123 Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: Instrumented Test Vehicles (ITV) are required as orbital test targets for evaluating the effectiveness of anti-satellite (ASAT) systems being developed by other projects in this program. The ITV will contain sufficient on-board instrumentation for determining destruction and for assisting ground tracking stations in collecting ASAT performance parameters; e.g., miss-distance information for determining the ASAT's trajectory. The objective of this program is to collect sufficient ASAT performance information so that a go/no-go decision can be made on deployment of the system. For the Miniature Air-Launched System with its Miniature Vehicle warhead, the target will be required to resolve miss-distances from the target centroid to evaluate the circular error probable (CEP). Specifications call for a CEP of The chosen concept is a diameter balloon with variable signatures and instrumentation. Two to three ITV's will be launched using SCOUT boosters.

For the Conventional ASAT, the target vehicle must measure the in order to evaluate the effectiveness and the kill probability of the system. Instrumented vehicle requirements to support laser ASAT tests are being evaluated.

RELATED ACTIVITIES: This project is required to support Miniature System and Conventional ASAT flight demonstrations conducted under Project 2134 and 2136, respectively.

WORK PERFORMED BY: This project is managed by Air Force Systems Command's Space Division, formerly the Space and Missile Systems Organization, Los Angeles, CA. The Aerospace Corporation, El Segundo, CA, provides technical support. AVCO Corporation, Wilmington, MA, was awarded the development contract for the ITV in May 1979.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Preliminary designs for the ITV were examined under Project 2134, Miniature Systems. A survey was conducted of all DoD instrumentation agencies to identify existing off-the-shelf hardware and techniques that could be applied to the development of instrumented vehicles. Analysis was performed to establish initial kill verification requirements and kill criteria. A competitive design definition was initiated. The use of existing orbital objects or piggyback payloads as ASAT targets was examined and found to be unsatisfactory. Only a dedicated and adequately instrumented ASAT target could verify ASAT performance. AVCO Corporation won the competitive procurement for this effort.

2. FY 1980 Program: Development of the ITV will continue. development tests will be completed. Sub-system development tests will begin. Assuming a successful Critical Design Review, the flight test contract option will be exercised.

Project: #2241
Program Element: #64406F
DoD Mission Area: Space Defense #123

Title: Instrumented Test Vehicle
Title: Space Defense Systems
Budget Activity: Strategic Programs #3

3. FY 1981 Planned Program: System and sub-system qualification testing will be initiated. Full-scale deployment tests in vacuum and zero-gravity drop tests will be conducted. Booster/payload interface testing and flight-test planning will be complete..

4. FY 1982 Planned Program: The first target vehicle will be launched into earth orbit in to support the Miniature Air-Launched System (MALS) anti-satellite (ASAT) testing. Targets will be placed in high-enough orbits to allow reuse if they are missed during the tests. additional instrumented target vehicles are planned for launch as required to support MALS testing.

5. Program to Completion: Assuming a successful development test and engineering effort for MALS, this program will complete in the FY 84/85 time period. Target vehicles for advanced ASAT techniques such as laser may require additional Research, Development, Test and Evaluation (RDT&E) funding in the out years.

6. Milestones:

- Instrumented Test Vehicle (ITV) Contract Award	May 1979
- Critical Design Review	Sep 1980
- First Flight	Spring 1983

7. Resources:

RDT&E	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
ITV	7,900	16,000	26,000	22,200	Continuing	N/A

8. Comparison with FY 1980 Budget Data:

RDT&E	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
ITV	6,900	7,900	15,000	25,200	Continuing	N/A

Budget Activity: Strategic Programs, # 3
Program Element: # 64406F

Test and Evaluation Data

1. Development Test and Evaluation: (S) All subsystem Preliminary Design Reviews (PDR) on the Miniature Air-Launched System (MALS) have been successfully completed. The System PDR was successfully held in January 1980 and the Critical Design Review is now scheduled for November 1980. A number of major subsystem and system development tests have been conducted:

(a). A critical sub-system of the Miniature Vehicle warhead is the sensor used to detect and track the target satellite. The baseline sensor was developed by Hughes Aircraft Corporation and tested at the Arnold Engineering Development Center (AEDC), TN. Testing was performed in a cryogenically ccoled vacuum chamber and AEDC were used to establish the calibrated radiance levels. The tests were designed to measure focal plane array (FPA) sensitivity, responsiveness, noise level, dynamic range and off-axis signal rejection. Test results indicated that both sensor sensitivity and off-axis signal rejection were below specification but adequate to detect all low-altitude targets. As a result of these tests, the Aerojet Corporation was funded to develop a second source FPA. This FPA differs from the Hughes FPA in that Aerojet uses a different doping material and the FPA is monolithic instead of discrete. Monolithic arrays have been found to be easier to produce, have less stray capacitance, have more uniform response and provide more precise detector area definition and element alignment. During tests at the Naval Ocean Systems Center, the Aerojet array exhibited a distinct performance advantage over the Hughes FPA but was out of specification by approximately 20%. The Aerojet array has been selected to replace the Hughes FPA in the baseline design and efforts are underway to bring the Aeroject FPA up to specification requirements.

(b). The Maneuver Propulsion Assembly (MPA) is used to maneuver the after release from the SRAM/ALTAIR II booster and provides propulsion during the mid-course and terminal end-game. A series of tests were conducted to evaluate, among other things, igniter performance, burn rates, nozzle erosion and ballistic performance of the baseline tapered grain design. Test results verfied the design. No erosive burning with the tapered grain was evident and the end-game motors were shown to be unaffected by duty-cycle heating.

(c). A series of wind-tunnel tests were conducted at AEDC to evaluate the aerodynamics of the Short Range Attack Missile/ ALTAIR II/ combination. Parametric runs were made on the following configuration variables: moveable fin size, fixed fins, roll altitude, nose shape, interstage angle, and missile length. A solid body rocket motor plume simulator was used to access the effects on missile stability and control. Tests were run from Mach 0.5 to Mach 4.5. Based on test results, additional tests were run on bigger moveable and fixed fins and a new nose configuration. Missile plume effects testing was conducted in November, 1979. Plume induced flow separation changes the stability and control characteristics. A model with a cold gas blown exhaust was used to evaluate stability and control. Additional tests are scheduled for March and April 1980. This series of tests will provide detailed aerodynamic data for the missile configuration. These data are required to support the performance, stability and control and loads analysis. The test will include the following: free stream, more exhaust plume force, pressure, aircraft loads and missile separation tests.

While no environmental tests have been conducted to date, a series of Acceptance, Flight Worthiness, and Qualification tests are scheduled. Acceptance verifications of each item of Government Furnished Equipment and each new design component will be accomplished prior to assembly of components. Complete functional checkout of applicable items will be conducted at laboratory ambient conditions to verify that the component will operate within specified tolerances. Flight Worthiness Tests will be performed on one set of components and one and Dispensor, and one fully assembled missile prior to first flight. The tests will be performed at maximum predicted environmental extremes plus factors of safety and will serve to supplement acceptance tests prior to qualification. Formal qualification tests will demonstrate that the design, implementation and manufacturing methods have resulted in hardware conforming to specification requirements. The test levels will be those that account for variations in hardware and environments and that provide a factor of safety.

2. Operational Test and Evaluation: The Initial Operational Test and Evaluation (IOT&E) of the Miniature Air-Launched System (MALS) will be conducted by the Air Force Test and Evaluation Center (AFTEC), with personnel and assistance from the Aerospace Defense Center (ADC), Tactical Air Command (TAC), Strategic Air Command (SAC), Air Force Logistics Command (AFLC), and Air Training Command (ATC) as part of a combined Development Test and Evaluation/ IOT&E program. IOT&E will serve the dual functions of providing information for the Defense Systems Acquisition Review Council (DSARC) III production decision, and for evaluating the extent to which a Limited Operational Capability (LOC) exists. More specifically, IOT&E will evaluate the effectiveness and suitability of the anti-satellite system and the capability of surveillance, command and control and communications systems to provide adequate support. Combined test and evaluation is currently scheduled to begin in June 1983 and is expected to be completed in late

a. IOT&E will accomplish the following major objectives. It will evaluate:

(1) The capability of the surveillance sensors to collect and provide ephemeris data on designated targets with the required degree of accuracy and timeliness.

(2) The capability of command and control elements to perform all required functions, to include decision making, and dissemination of execute, recall, terminate and other commands.

(3) The capability of the communications system to pass required information between system elements in an accurate and timely manner.

(4) The capability to launch the Short Range Attack Missile/ALTAIR II missile, with associated dispenser and Miniature Vehicle from the F-15 aircraft within required accuracy and timeline contraints.

(5) The capability of the to acquire the target and accomplish negation through

(6) System suitability, to include reliability, availability, maintainability, logistic supportability, and compatibility with other systems, computer hardware and software.

b. The Initial Operational Test and Evaluation (IOT&E) will be accomplished through evaluation and demonstration of the various system segments, computer simulation, and tests of the entire system. Segment tests will evaluate the performance capabilities of individual system segments such as surveillance sensors, command and control elements, communications systems, etc. System testing will involve dry runs to exercise and evaluate all system segments to the point of weapon launch. Live fire testing, involving all segments, to include launching the weapons against an Intrumented Test Vehicle will be used to support evaluation of the entire system.

c. The initial period of the combined Development Test and Evaluation/IOT&E (DT&E/IOT&E) program will emphasize technical testing to system specifications. The emphasis will shift to operational tests as the program progresses, with emphasis most heavily on OT&E late in the program. DT&E and IOT&E test will be performed concurrently when possible. IOT&E will be conducted under as near operational conditions as possible, with Air Force personnel of the same type and skill that will be employed operationally.

d. Prototype weapons, including a destruct package and beacon and telemeter transmitters, and equipment will be used for testing during DT&E/IOT&E. The destruct and beacon systems increase the burnout weight and therefore affect performance in terms of altitude and impact geometries. Early stages of testing will be conducted using test support equipment (TSE). Operational support equipment will be available during latter stages but before the end of IOT&E. Testing of this equipment will be conducted concurrent with remaining IOT&E.

e. Primary test team elements will be located at Edwards AFB, CA, with some captive carry and other segment tests being conducted on the Air Force Flight Test Center range. Other captive carry, dry run and live fire tests will involve flying from Edwards AFB to the Space and Missile Test Organization (SAMTO) range off Vandenberg, AFB, AFB, CA where dry run and live fire tests will be monitored by SAMTO sensors. The Air Force Satellite Control Facility will also contribute by controlling and tracking instrumented test vehicles. Evaluators will also be located in the North American Air Defense Command (NORAD) Cheyenne Mountain Complex to evaluate mission operations center actions.

f. The number of test articles to be available for testing has not been finalized. AFTEC has identified the following resources as required for IOT&E:

(1) Data from valid live fire tests.
(2) Two modified aircraft with associated pylons, carrier aircraft equipment, support equipment, etc.
(3) One weapon for maintainability studies.
(4) A detailed simulation model of system performance from launch of the missile to
(5) Sufficient Instrumented Test Vehicles to support all live fire tests.
(6) Thirty four dedicated IOT&E captive carry missions.

If these test resources are not available, reduced test data, lower confidence in test results, and/or risk will result.

g. Reliability, availability and maintainability (RAM) test and evaluation will be conducted using resources available, support and test equipment, and captive-carry missions. RAM goals have not yet been established. "Blue Suit" maintenance personnel of the type expected to perform maintenance in the operational environment will be evaluated in the performance of their tasks. The exact mix of contractor and Blue Suit personnel during test and the LOC time frame has not yet been determined.

h. Follow-on Test and Evaluation (FOT&E) will be conducted by AFTEC and the using command. Production weapons and using-command aircraft will be used to test areas not adequately tested during IOT&E.

3. System Characteristics:

a. First Stage: Standard Short Range Attack Missile (SRAM) plus two fixed fins

		Objective	Demonstrated
- Weight:	(Pounds)	7211	7211
- Thrust:	(Pounds)	-65 to +140	-65 to +140
- Temperature:	(Degrees Fahrenheit)	251,000	251,000
- Total Impluse:	(Pound-seconds)		

b. Second Stage: ALTAIR II

- Weight	(Pounds)	671	671
- Thrust	(Pounds)	5,950	5,950
- Burn Time	(Seconds)	27.4	27.4
- Total Impluse	(Pound-seconds)	170,000	170,000

c. Miniature Vehicle

- Sensor
- Weight
- Dimensions
- Destruct Mechanism

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 64711F
DOD Mission Area: Airborne Strike, #113

Title Systems Survivability (Nuclear Effects)
Budget Activity Strategic Programs #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	10,570	14,200	13,904	13,000	Continuing	N/A
2485	S/V Assessment of C^3 Systems	1,928	1,600	1,504	2,100	Continuing	N/A
3763	S/V Assessment of Aerospace Systems	5,370	9,600	8,900	6,600	Continuing	N/A
4695	S/V Assessment of Satellites	3,272	3,000	3,500	4,300	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The thrust of this program is to assess, through analysis and testing, the effects generated by a nuclear weapon on the survivability/vulnerability (S/V) of Air Force aerospace (aircraft, missiles), command and control communications (C^3) systems and satellites, and to develop the engineering technology for hardening these systems.

BASIS FOR FY 1981 RDT&E REQUEST: This program will develop and use analytical techniques and the electromagnetic pulse (EMP) and system generated EMP (SGEMP) test facilities needed to assess the nuclear S/V of aerospace systems associated structures (Project 3763), ground based C^3 systems and communications network overlays (Project 2485), and satellites and communication links (Project 4695).

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: 64711F
DoD Mission Area: Airborne Strike, #113

Title: Systems Survivability (Nuclear Effects)
Budget Activity: Strategic Program #3

DETAILED BACKGROUND AND DESCRIPTION: The objectives of this program are to assess the survivability/vulnerability (S/V) of Air Force aerospace and communications systems that may be required to operate in a nuclear environment, and to develop engineering technology for their hardening. The Air Force Nuclear Criteria Group establishes hardness criteria levels for developmental systems early in their design phase and for operational systems upon request. Requirements involving operational systems are provided by using commands. For some types of nuclear weapons effects, available assessment and hardening technology must be extended before application to complex modern systems. The assessments include: analyses to determine the paths and amounts of energy coupled into systems and to identify critical components and circuits; laboratory tests to measure the response of components, circuits, and subsystems to that energy; and simulation tests of full-scale systems to verify analyses and laboratory results, and to increase confidence in the techniques used for system hardening. The development of hardening guidelines uses the assessment results to specify methods to control energy entry into systems and to increase the resistance of susceptible components and subsystems.

The program is currently divided into three projects: Project 2485, S/V Assessment Command and Control Communications (C^3) Systems, consists of the development, acquisition, and use of assessment techniques and Electromagnetic Pulse (EMP) measured test data to determine the nuclear S/V of critical ground command and control communications including data links; and, Project 3763, Survivability/Vulnerability (S/V) Assessment of Aerospace Systems, mainly consists of the assessment (analysis and testing) and hardening of aircraft and missiles such as the E-3, E-4, EC-135, F-16, B-52, B-1, Navy A-7, F-14, F-18, Air Launched Cruise Missile (ALCM), Ground Launched Cruise Missile (GLCM), MX, etc. when they are subjected to various nuclear environments; Project 4695, S/V Assessment of Satellites, consists of the development and use of analysis and testing techniques for the Systems Generated EMP (SGEMP) and Transient Radiation Effects (TRE) to assess space systems and their communications links with primary emphasis on warning, alerting and controlling the strategic forces. Hardening assistance and design guidelines are provided to Strategic Air Command (SAC) and many Program Offices (PO's).

RELATED ACTIVITIES: This Program is related to Air Force programs to develop and maintain a survivable strategic force with associated command and control communications systems. A joint working group between the Air Force, the Defense Communications Agency, and the Defense Nuclear Agency has been established to coordinate command and control communications assessment plans and to effect timely exchange of results. Program Element, 64747F/Project 1209, Nuclear Effects Simulation Test Facilities and Program Element, 62601/Project 8809, Nuclear S/V Technology, Program Element 63438F, Satellite Systems Survivability and PE 63244F, Aircraft Nonnuclear Survivability are related. (Test facilities for this program are acquired under Program Element 64747F, Project 1209, Nuclear Effects Simulation Test Facilities.)

WORK PERFORMED BY: The program is managed by the Air Force Weapons Laboratory, Kirtland AFB, NM. Contractural work is performed by Nanofact Corporation, Chicago, Il; Textronics, Inc., Beaverton, OR: New Mexico School of Mines, Socorro, NM; T&M Electronics, Albuquerque, NM: University of Arizona, Tuscon, AR; EG&G Incorporated, Alburquerque, NM: Computer Sciences Corporation, Falls Church, VA; R&D Associates, Santa Monica, CA: TRW Incorporated, El Segundo, CA; Intelecom Radiation Technology, San Diego, CA; Mission Research Corporation, Santa Barbara, CA; Physics La Jolla, CA; and Mission Research Corporation, Albuquerque, NM.

Program Element: 64711F
DoD Mission Area: Airborne Strike, #113

Title: Systems Survivability (Nuclear Effects)
Budget Activity: Strategic Programs #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 79 and Prior Accomplishments: An Air Force Strategic Command, Control and Communications (C^3) Data Base, directed by Program Management Directive (PMD) was initiated to cover all projects. Project 1088 transferred to PE64747F/1209. In Project 2485 a ground based High Altitude Radiation Detection System (HARDS) was also developed, tested, and installed at an operational location. An Electromagnetic Pulse (EMP) validation test of the Defense Support Program (DSP) satellite simplified processing stations (SPS) was completed. Inputs for redesign of an Air Force Satellite Communications System (AFSATCOM) modem to mitigate propagatgion disturbances were provided the Program Office (PO). Final hardening design of Ground Launched Cruise Missile (GLCM) C^3 systems was studied. Fiber optics have great potential as nuclear hardening technique and technology development was started. The Parachute Supported Radio Relay (PSRR) proof of concept and prototype system demonstrated as a viable survivable alternate means of communication in a nuclear environment. The tactical and strategic C^3 review was completed. Hardening inputs for communication ground terminals was initiated. PAVE PAWS Electromagnetic Pulse (EMP) Survivability/Vulnerability (S/V) studies were continued.

In Project 3763, An EMP assessment was performed on the EC-135, E-3A, E4B, B-52, the Navy C-1300 Take Charge And Move Out (TACAMO) Aircraft and the Air Launched Cruise Missile (ALCM). An evaluation of EMP upset and permanent damage for E-4 subsystems was completed. Analytical tools to address external coupling, deliberate antennas and aircraft inadvertent penetrations were developed. A corona study on trailing wire antennas and an in-flight EMP test of the Navy TACAMO aircraft with trailing wire extended were completed. A system level analytical model was developed for the B-1. An advanced Intercontinental Ballistic Missile System (ICBM) systems nuclear technology requirements study was started. Nuclear blast, thermal and shock effects on aerospace systems were studied to develop necessary hardening techniques and guidelines for Program Offices. These techniques and others were integrated into the Technology data base. The EMP assessment of the advanced fighter aircraft using the F-16 as the test bed was started.

In Project 4695, an Systems Generated Electromagnetic Pulse (SGEMP) experiment was successfully fielded on the Diablo Hawk underground test. A laboratory SGEMP experimental program to include development of low-level photon sources and their use in analysis and testing of complex satellite models and subsystems was started. The laboratory system generaged EMP experimental program received increased emphasis. Satellite systems Fleet Satellite Communications System, Strategic Satellite System, Defense Communications Satellite System, Air Force Satellite Communications System, Global Positioning System were assessed for nuclear S/V, and alternate means of hardening hardening were provided to the POs as design guidelines. The application/validations of current hardening techniques were addressed in conjunction with limited simulation techniques verification and validation. Further, communication links were analyzed to determine the effect of propagation disturbance due to nuclear environments.

Program Element: 64711F
DoD Mission Area: Airborne Strike, #113

Title: Systems Survivability (Nuclear Effects)
Budget Activity: Strategic Programs #3

2. FY 1980 Program: In Project 2485, the Strategic Air Command (SAC) Wing Command post Electromagnetic Pulse (EMP) hardening effort will be concluded. A program for SAC communication systems hardening will begin. Efforts that will continue include: PAVE PAWS studies; Ground Launched Cruise Missile (GLCM) survivable Command, Control and Communications studies; survivable warning system architecture; communication satellite ground terminal hardening efforts; and, fiber optics technology development.

In Project 3763, an unhardened B-52 will undergo EMP proof testing in the TRESTLE threat level inflight simulator. The advanced Intercontinental Ballistic Missile System systems nuclear technology requirements effort will continue as will the blast, thermal and shock study initiated in FY 1979. Added emphasis will be placed on the application of EMP testing and analytical capabilities to generic aircraft and missile problem areas. A life cycle survivability program involving the Program Offices (PO's) and Air Force Logistics Command will be initiated. EMP hardening design guidelines will be formalized into a set of Military Specifications. The EMP assessment of the advanced fighter aircraft using the F-16 as a test bed will continue. Hardening designs will be finalized and fixes will be fabricated and tested.

In Project 4695, the validation/application of hardening techniques and limited simulation techniques will continue. A satellite constrained design model will be developed and tested. Analytical codes will be revised and propagation path and communication link studies will be continued. Hardness design guidelines will be developed for satellite POs.

3. FY 81 Planned Program: In Project 2485, the definition of survivable C^3 systems will be completed. Hardening of the Operational Support Center and satellite ground terminals will continue. And development of fiber optics as a hardening technique will also continue.

In Project 3763, the A-7E and F-14 aircraft along with the Ground Launched and Sea Launched Cruise Missiles will undergo EMP testing in the Air Force Weapons Laboratory EMP simulators. The EMP assessment of the advanced fighter aircraft using the F-16 as a test bed will be completed. The life cycle survivability program for aircraft and missiles involving the Program Offices and the Air Force Logistics Command will continue. Specific efforts include: EMP damage screen development; advanced tactical nuclear environment study; EMP nuclear hardening techniques development; and time domain scale model measurements.

In Project 4695, the Fleet Satellite Communications SGEMP photon tests will be concluded. Continuing efforts include SGEMP simulation technique development, hardening design guideline development, and satellite communication system network analysis.

4. FY 1982 Planned Program: In Project 2485, survivable C^3 systems concept validation will begin. EMP hardening of facilities and development of fiber optics as a hardening technique will continue.

Program Element: 64711F
DoD Mission Area: Airborne Strike, #113

Title: Systems Survivability (Nuclear Effects)
Budget Activity: Strategic Programs #3

In Project 3763, the life cycle survivability program for aircraft and missile involving the Program Offices (POs) and Air Force Logistics Command will continue. Several separate studies concerning the Electromagnetic Pulse (EMP) testing and analysis of aircraft and missiles will be accomplished. Specific efforts include: generic cruise missile testing; EMP damage screen development; system upset methodology application; advanced simulator/object/test stand interaction studies; hardening of system elements; and simulator Electromagnetic (EM) analysis.

In Project 4695, the development of complex models for Systems Generated Electromagnetic Pulse tests will be completed. Continuing efforts include SGEMP hardening design guidelines, hardening assessments for POs, and simulation technique improvements.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 80 Budget Data: Not applicable, no change.

Project: #3763 Title: S/V Assessment of Aerospace Systems

Program Element: #64711F Title: Systems Survivability (Nuclear Effects)

DOD Mission Area: Airborne Strike, #113 Budget Activity Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: Project 3763 develops the technology for analyzing and testing the survivability and vulnerability (S/V) response of current and future aerospace systems to nuclear effects. The nuclear effects of interest are: Blast, Electromagnetic Pulse (EMP), Shock, System Generated Electromagnetic Pulse (SGEMP), Thermal, Transient Radiation Effects (TRE) and X-Rays. The eventual results of these efforts will be hardening techniques for aerospace systems so that they can effectively accomplish their missions in a war-created nuclear environment. The approach used to accomplish the S/V assessment of aerospace systems to nuclear effects is based on several parallel efforts. An effort concerning generic technology, heavily weighted towards assessment capability, is continuing. Included in this generic effort for the future are studies leading to recommendations on how to implement hardness life cycle survivability, military standards and specifications, and production standards and techniques. Parallel with this effort, evaluation and, when appropriate, development of basic analytical and testing techniques to accomplish S/V assessment will be continued. The third parallel effort will include as much support to the Program Office (POs) and other organizations in assessing the S/V of their particular aerospace system as the full resources of Project 3763 can accommodate.

RELATED ACTIVITIES: Electromagnetic radiation test facilities required for this project are developed in Program Element (PE) 64747F Project 1209. Related technology for this project is developed under PE 62601 Project 8809, Nuclear S/V Technology.

WORK PERFORMED BY: Air Force Systems Command manages this project through the Air Force Weapons Laboratory, Kirtland Air Force Base, NM. Contractors for various analyses and test performed under this project include: BDM Corp., Albuquerque, NM: Boeing Company, Wichita, KS; Kaman Avidyne Burlington, MA: EG&G Alburquerque, NM; Mission Research Corp., Santa Barbara, CA; Physics International, San Leandro, CA; R&D Associates, Marina Del Ray, CA; Science Applications Inc., Albuquerque, NM; TRW, Redondo Beach, CA; General Dynamics, Fort Worth, TX.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: An advanced Intercontinental Ballistic Missile System systems nuclear technology requirements study was started. Nuclear blast, thermal and shock effects on aerospace systems were studied with the aim of developing the associated hardening techniques and guidelines for Program Offices (PO's). Several separate studies concerning the EMP analysis and testing of aircraft and missiles were completed. EMP hardening techniques currently used, or to be used, on aircraft and missiles were evaluated and integrated into the project 3763 technology data base. An Electromagnetic Pulse (EMP) and the air launched cruise missile assessment was performed on the E-3A, E-4B, B-52, the aircraft using the F-16 as a test bed began. A corona study on trailing wire antennas and an in-flight (fly-by) EMP test of the Navy Take Charge and Move Out (TACAMO) aircraft with trailing wire extended was completed. Previously, a systems level analytical model was developed for the B-1. A B-1 one-fifth scale model was tested in the EMP facilities as were the F-111 model and Short Range Attack Missile (SRAM).

Project: #3763 Title: S/V Assessment of Aerospace Systems
Program Element: #64711F Title: Systems Survivability (Nuclear Effects)
DOD Mission Area: Airborne Strike, #113 Budget Activity Strategic Programs #3

In addition, an evaluation of Electromagnetic Pulse (EMP) upset and permanent damage for the E-4 subsystems was completed. A Programmable Universal Direct Drive EMP simulator to test subsystems was developed. Analytical tools to address external coupling, deliberate antennas, and aircraft inadvertent penetrations were developed. Efforts to identify important aircraft points of entry for EMP and to analyze the effects of test objects in paralled plate EMP simulators were continued.

2. FY 1980 Program: A concept to use the TRESTLE EMP simulator for maintaining and surveying aircraft hardness will will be tested. An unhardened B-52 aircraft will be used as the test object. The goal of this test is to determine feasibility and cost effectiveness of this testing concept. An EMP test of the advanced fighter aircraft using the F-16 as the test bed craft will continue. The advanced Intercontinental Ballistic Missile (ICBM) systems nuclear technology requirements study will continue as will the blast, thermal and shock study initiated in FY 1979. Added emphasis will be placed on the application of EMP testing and analytical capabilities to generic aircraft and missile problem areas. A life cycle survivablity program for aircraft and missile involving the Program Offices and Air Force Logistics Command will be initiated. EMP hardening design guidelines will be formalized into a set of Military Specifications. Specific efforts will include: Advanced Tactical Nuclear Environments Study; EMP low field/low frequency study; B-1 EMP pretest analysis; simulator/object/test stand interaction study; and static/dynamic component testing.

3. FY 1981 Planned Program: The Electromagnetic Pulse (EMP) assessment of the advanced fighter aircraft using the F-16 aircraft as the test bed will be completed EMP simulator testing of the A-7E, F-14, Ground Launched Cruise Missile, Sea Launched Cruise Missile is planned. The advanced Intercontinental Ballistic Missile System nuclear technology requirements study will continue as will the blast, thermal and shock study initiated in FY 1979. The life cycle survivability program for aircraft and missiles involving the Program Offices and the Air Force Logistics Command will continue. And, several separate studies concerning the EMP testing and analysis of aircraft and missiles will be completed. Specific efforts will include: EMP damage screen development; advanced tactical nuclear environment study; EMP nuclear hardening technique development; and time domain scale model measurements.

4. FY 1982 Planned Program: The life cycle survivability program for aircraft and missiles involving the Program Offices and Air Force Logistics Command will continue. Several separate studies concerning the EMP testing and analysis of aircraft and missiles will be accomplished. Specific efforts include: generic cruise missile testing; EMP damage screen development; system upset methodology application; advanced simulator/object/test stand interaction studies; hardening of system elements, and simulator Electromagnetic analysis.

5. Program to Completion: Not Applicable.

6. Milestones: Not Applicable.

Project: #3763
Program Element: #64711F
DOD Mission Area: Airborne Strike, #113

Title: S/V Assessment of Aerospace Systems
Title: Systems Survivability (Nuclear Effects)
Budget Activity Strategic Programs #3

7. Resources:	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Estimated Costs
TOTAL FOR PROGRAM ELEMENT	10,570	14,200	13,904	13,200	Continuing	N/A
PROJECT 3763-S/V Assessment of Aerospace Systems	5,370	9,600	8,900	6,600	Continuing	N/A

8. Comparison with FY 1980 Budget Data: Not applicable, no change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64758F
DOD Mission Area: Airborne Strike, #113

Title: Companion Trainer Aircraft (CTA)
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT			15,100	5,047		20,147

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Companion Trainer Aircraft (CTA) addresses the need to maintain a high degree of combat readiness and to enhance in-flight training for Strategic Air Command's combat crew force as military flying becomes increasingly expensive due to rising fuel cost. The CTA is a United States Air Force initiative to investigate the use of an off-the-shelf, low cost modified business jet to provide B-52 aircrews with real in-flight training in basic airmanship, navigation, crew coordination, and primary mission task. This training would be conducted at a much lower cost (fuel and operations and maintenance) than actual B-52 operations and would contribute to extending the service life of the aging B-52 aircraft.

BASIS FOR FY 1981 RDT&E REQUEST: The CTA program will commence with initiation of conceptual efforts to provide systems definition and basis for a Request for Proposals for Full Scale Engineering Development. These efforts will address cost for development, acquisition, operation and support of a CTA. Based on the preliminary investigations and anticipating the use of an off-the-shelf airframe, two prototype aircraft will be purchased in FY 1981 for Research, Development, Test and Evaluation (RDT&E).

OTHER APPROPRIATION FUNDS:	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Procurement (3010)				157,700	148,100	305,800

Program Element: #64758F
DOD Mission Area: Airborne Strike, #113

Title: Companion Trainer Aircraft (CTA)
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: Maintaining combat readiness of the strategic air attack force is required to insure a viable deterrent for the free world. The aircrews who provide the combat capability of the United States airbreathing strategic attack forces must be capable of responding to a variety of employment tasks. This capability can only be assured through intensive, quality, and recurring aircrew training. The B-52, a product of technology from the 1950s, is powered by engines which use excessive fuel as compared to the significantly efficient engines used on the modern aircraft of today. A national need for efficient energy management drives the requirement to examine alternate methods of accomplishing in-flight training. Additionally, the level of flying experience of Strategic Air Command's (SAC) current combat crew force is less than the level of flying experience for the SAC aircrews of the late 1960s and early 1970s. This experience cannot be overcome with potentially continued reductions in the amount of total flying time available. The B-52 Weapon System Trainer (WST), a flying simulator now within the procurement cycle, will provide aircrews a capability for concentrated aircrew training in an academically controlled environment. The WST, however, can never totally replace the need for actual in-flight experience. Therefore, the significant savings and training that could be realized by augmenting B-52 flying characteristics must be realized. The Companion Trainer Aircraft will bring the potential to reality.

RELATED ACTIVITIES: P.E. 64758F will lead into production within P.E.11113F, B-52 Squadrons. Air Training Command (ATC) is investigating a dual-track training system that will require an additional training aircraft, the Tanker, Transport, Bomber (TTB) Trainer. The operational life of Military Air Command's (MAC) T-39 fleet is expected to expire in the late 1980s. The performance requirements for both these potential requirements closely match those of the CTA. The advantages of Operational Support Aircraft (OSA), Tanker, Transport, Bomber (TTB) Trainer, and Companion Trainer Aircraft (CTA) commonality will be considered as the programs are individually initiated. In our solicitation of Office of the Secretary of Defense (OSD) support (Mission Element Need Statement validation) for satisfaction of the separate MAC/ATC/SAC needs, we will identify the potential for commonality with an eye to program combination. The Milestone I decision point is the most appropriate time for program combination as this approach will maximize potential for commonality while, at the same time, preserve the integrity of the individual requirements.

WORK PERFORMED BY: The initial Program Office cadre has been identified. Initial efforts will be restricted to limited preliminary in-house studies and will not result in commitment of funds prior to program approval. The program will be in the formulative stage until FY 1981 and contractors are not yet involved.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable. This program is scheduled for first funding in FY 1981.

Program Element: #64758
DOD Mission Area: Airborne Strike, #113

Title: Companion Trainer Aircraft (CTA)
Budget Activity: Strategic Programs, #3

2. FY 1980 Program: The Program Manager has been designated and the initial Program Office cadre has been formed at Wright-Patterson Air Force Base, Ohio. This action was based on Air Force Requirements Review Group (RRG) validation of Strategic Air Command's (SAC) Statement of Need. A Mission Element Need Statement approval is expected in FY 1980. In-house efforts will provide planning and scheduling data necessary for issuing a Request for Proposals for source selection in early FY 1981.

3. FY 1981 Planned Program: Initial funding anticipated in FY 1981 will be used to acquire prototype aircraft and start full scale engineering test and evaluation. Prototype testing in FY 1981 will also evaluate fidelity of training and the quality and amount of training transfer from the Companion Trainer Aircraft to the B-52. It is anticipated that these efforts will lead to initial long leadtime procurement which should begin in late FY 1981.

4. FY 1982 Planned Program: Completion of test and evaluation of prototype aircraft, to include evaluation of the variable stability modification, will occur in FY 1982. Production of aircraft to meet Initial Operational Capability (IOC) will be initiated in FY 1982.

5. Program to Completion: Purchase of 28 aircraft in FY 1982 and 30 aircraft in FY 1983 will complete the program and provide CTA capability for SAC.

6. Milestones: Not applicable

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data: This program will be an FY 1981 new start. No FY 1980 budget data was submitted.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	73,200*	96,299	142,400	107,500	Cont	N/A
2365	Common Strategic Doppler	300					2,100
2405	SACDEF	500	500	1,843	1,900	Cont	N/A
2406	B-52 Offensive Avionics System (OAS)	40,800	55,000	45,000	3,700		185,800
2548	Nuclear Hardness Study/EMP	3,400	16,000	28,400	39,200	22,700	111,400
2570	Electronic System Test Set (ESTS)	21,500	13,500	23,400	1,900		62,300
2571	B-52 Aircraft Modernization Program	2,200	2,400	6,200	10,100	62,700	83,600
2601	Strategic Radar/EAR		1,500	17,900	21,200	23,000	63,600
2632	OAS/CMI WST Modification		5,899	7,157	700		13,756
2633	B-52H Cruise Msle Integration				15,000	30,000	45,000
2635	ODs/FRODs	4,000					4,000
2691	Blast/Thermal Evaluation		1,500				1,500
2692	Autopilot			12,500	13,800		26,300
	Other Projects	500					2,200

*Includes December 1979 Reprogramming.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Cruise missiles will become an important element of the air-breathing leg of the strategic TRIAD and an adequate carrier for these missiles must be provided. The nation is now committed to employ the B-52 as the first cruise missile carrier aircraft and the Air Force, at this time, believes that with reasonable improvements in maintainability, reliability, nuclear hardness, and selected avionics upgrades, the B-52G/H should serve as an effective and economical cruise missile carrier into the 1990s. The purpose of this program element is to develop the B-52 cruise missile carrier modifications and to evaluate and develop the weapon system upgrades necessary for maintaining the viability of the B-52 weapon system throughout the coming decade. The first priority is to upgrade the B-52G/H bombing navigation system (BNS) and to integrate this upgraded system with the electronics and carriage gear required to carry and launch cruise missiles. The B-52 Offensive Avionics System (OAS) program, formerly

called the B-52 Avionics Update - Phase One, provides for the full scale engineering development (FSED) of the necessary improvements to the bombing navigation system (BNS) and will lower present avionics system support costs through replacement of selected components with components of improved reliability and maintainability. Other major program efforts will provide for improved flight safety, assess the current nuclear hardness of the aircraft and identify changes to improve hardness, develop an improved radar update, and develop an Electronics System Test Set (ESTS) to support the Air Launched Cruise Missile (ALCM) and Short Range Attack Missile (SRAM). The program also provides for modification of the B-52 Weapon System Trainer (WST) to incorporate avionics updates and cruise missile integration changes.

Thus, the Avionics Update - Phase Two Project which was to have provided this capability has been restructured and renamed, the Aircraft Modernization Program. This restructured program will improve B-52 reliability and maintainability and support use of the aircraft as a cruise missile carrier into the 1990s.

BASIS FOR THE FY 1981 RDT&E REQUEST: The B-52 Offensive Avionics System (OAS) project RDT&E efforts involving software development and system integration will continue in FY 1981. The B-52G OAS test aircraft is scheduled to begin the combined OAS development test and evaluation (DT&E) and initial operational test and evaluation (IOT&E) flight test program beginning in September 1980 and continuing through FY 1981. The Nuclear Hardness Study/Electromagnetic Pulse (EMP) project will assess existing B-52G/H EMP hardness and develop mod kits as required to achieve acceptable levels of EMP invulnerability. Development of the Electronic System Test Set (ESTS) which is being designed to analyze and test the Air Launched Cruise Missile (ALCM), Short Range Attack Missile (SRAM), and Missile Interface Units (MIU) developed in the OAS project will also continue during FY 1981. ESTS should be fully operational shortly after the ALCM initial operational capability (IOC) in December 1982. Sufficient ESTS capability must be available to support the first alert capability in September 1981. The B-52 Aircraft Modernization Project is aimed at follow-on improvements in critical B-52G/H subsystems to support the likely continued use of these aircraft as an all standoff cruise missile force in the late 1980s and into the 1990s. A complete aircraft and mission requirement evaluation was done in FY 1980 and a full scale engineering and development (FSED) contract is scheduled for the first quarter of FY 1981. Thus far the following items are considered minimum requirements for this program: radar power supplies, integrated pilot/copilot heading displays, autopilot update, increased/update of electrical power system, and an improved environmental control system. Tasks identified in the FY 1978 Life Extension study will begin also. A study to determine the feasibility of a reduced crew configuration will also be initiated under this project during FY 1981. The Autopilot project provides for the start-up in FY 1981 of an effort to integrate a new autopilot and a new heading system into the B-52D to alleviate safety of flight concerns. Due to commonality of aircraft, the output from this project will provide an autopilot for the B-52G/H also. The Strategic Radar/EAR project represents a restructured program beginning in FY 1981 to provide a needed update of the current forward looking radar (FLR) system which is based on 1950s technology. The Offensive Avionics System/Cruise Missile Integration Weapons System Trainer (OAS/CMI WST) project provides for the on-going engineering development necessary to modify the B-52 WST to include provisions for the OAS update as well as cruise missile integration.

Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: B-52 Squadrons
Budget Activity: Strategic Programs #3

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Cruise Missile Carriage, B-52G (Mod #3022)						
Procurement (1100)	30.8	79.7	115.0	114.0	534.5	879.0
(Quantity)	(3)	(22)	(40)	(40)	(241)	(346)
Initial Spares (1600)	5.7	1.6	.4	4.2	8.0	19.9
Installation (3400/540)			.7	2.7	57.2	60.6
(Quantity - Input)			(3)	(28)	(315)	(346)
(Quantity - Output)			(1)	(13)	(332)	(346)
Offensive Avionics System, B-52G/H (Mod #3023)						
Procurement (1100)	59.8	323.4	239.4	199.1	347.8	1169.0
(Quantity)	(5)	(31)	(64)	(61)	(108)	(269)
Initial Spares (1600)	10.8	16.4	52.7	8.3	1.2	89.4
Installation (3400/540)			8.1	21.4	93.4	122.9
(Quantity - Input)			(5)	(41)	(223)	(269)
(Quantity - Output)			(2)	(16)	(251)	(269)
Observable Differences/Functionally Related Observable Differences (ODs/FRODs), B-52G (Mod #3041)						
Procurement (1100)		28.8	10.0	5.7	7.8	52.3
(Quantity)		(24)	(40)	(40)	(69)	(173)
Initial Spares (1600)		.1	0			.1
Installation (3400/540)		1.2	5.1	7.6	22.4	36.3
(Quantity - Input)			(3)	(28)	(142)	(173)
(Quantity - Output)			(1)	(13)	(159)	(173)

Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Automatic Flight Control System (AFCS) and Compass System (Mod #B18420B)						
Procurement (1100)				14.0	25.8	39.8
(Quantity)				(16)	(63)	(79)
Initial Spares (1600)						
Installation (3400/540)					2.1	2.1
(Quantity - Input)					(79)	(79)
(Quantity - Output)					(79)	(79)

Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: Each of the projects under this program is described below. A more complete description of each of the major projects is provided on separate descriptive summaries which are attached.

The Common Strategic Doppler project will fulfill Strategic Air Command (SAC) requirements for a standardized common doppler that is nuclear hardened. C/KC-135 modification began in FY 1979 under program element number 11142F. Installation on the B-52G/H is integrated into the B-52 Offensive Avionics System (OAS) modification package scheduled to begin in FY 1981.

The Strategic Avionics Crewstation Design Evaluation Facility (SACDEF) ground tests new avionics systems required by SAC and accomplishes human engineering studies prior to avionics flight testing. Subtasks include ground checkout of systems with SAC crewmembers prior to flight test programs. This is a continuing project.

The B-52 Offensive Avionics System Project (OAS) will provide an avionics update package for the B-52G/H. This update responds to a 1975 SAC requirement to increase aircraft effectiveness and reduce support costs. The present bombing navigation system (BNS) is 1950 analog technology and is clearly becoming less reliable, less effective, and more costly to maintain. This project also responds to the immediate needs to integrate with the cruise missile program, develop support equipment, and accelerate delivery of first operational aircraft.

The B-52 Nuclear Hardness Study/Electromagnetic Pulse (EMP) project will improve the survivability and vulnerability (S/V) of the B-52 aircraft to nuclear effects. The first phase of the study laid out program needs. The current phase is analyzing the aircraft for blast, thermal, and EMP hardness. The study will develop and verify a nuclear hardened baseline design for the entire B-52G/H weapon system for nuclear blast/thermal/EMP weapon effects. The test program on the trestle EMP test facility was greatly expanded in FY 1980 to fully evaluate B-52 vulnerability to EMP. Analyses of blast, thermal, and base escape effects were also expanded. These expansions and increased RDT&E investment were recommended by the Defense Science Board (DSB) in studies during 1979 and 1980. The project will develop EMP fixes for modification of critical aircraft systems that support launch and release of weapons, but not included in Offensive Avionics System (OAS) and Air Launched Cruise Missile (ALCM) updates.

The Electronics System Test Set (ESTS) project provides for the design and development of the necessary support equipment to checkout the Air Launched Cruise Missile (ALCM) and the Short Range Attack Missile (SRAM) as well as the missile interface units from the B-52 Offensive Avionics System (OAS) program. The project was initiated under the SRAM B program and was transferred when that weapon program was terminated. The ESTS will provide maintenance analysis and test capability for B-52/missile weapon system in time to meet OAS/ALCM initial Strategic Air Command (SAC) alert aircraft capability in September 1981.

Program Element: #11113F
DOD Mission Area: 113, Airborne Stirke

Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

The B-52 Aircraft Modernization Program is a completely restructured and revised program formerly called Offensive Avionics System - Phase Two. It now focuses on two primary objectives. The first supports the transition of the B-52G/H force mission. This transition will require updates to maintain aircraft operationally effective. The second purpose is to ensure the force remains supportable through its predicted extended life into the next century. Analyses have been completed in FY 1980 to identify potential problem areas in essential systems. A Full Scale Engineering and Development (FSED) contract is scheduled for release in the second quarter of FY 1981. The shift of outyear mission requirements provided by Headquarters Strategic Air Command (HQ SAC) and future aircraft problem predictions provided by Headquarters Air Force Logistics Commmand (HQ AFLC) have been incorporated into the definition and scope of this program. The project will coordinate planning, definition, integration, and eventual flight testing of the overall aircraft modernization.

The Strategic Radar/EAR project is a reconstructed effort from what was formerly known as the Electronically Agile Radar (EAR) project. With the decision not to develop the requirement for a forward looking radar as sophisticated as EAR was eliminated. Therefore, the project will provide a critically needed updated radar which is less complex than the original EAR but which is suitable for the B-52 to perform the mix of penetration and standoff missions envisioned for the 1980s.

Offensive Avionics System/Cruise Missile Integration (OAS/CMI) Weapon System Trainer (WST) Modification provides the necessary development engineering to ensure that the B-52 Weapon System Trainer under development by the Simulator System Project Office (SPO) is compatible with the modification efforts resulting from the OAS and cruise missile programs.

The B-52H Cruise Missile Integration project will begin in FY 1982. This is a follow-on effort to protect the option for B-52H employment with cruise missiles. Current efforts, prior to FY 1982 are aimed only at the B-52G.

Observable Differences/Functionally Related Observable Differences (ODs/FRODs) is a project which defines a distinctive modification for the B-52G aircraft capable of launching cruise missiles of ranges greater than 600 KM. This project supports strategic arms limitations (SAL) negotiations.

The Blast/Thermal Evaluation project is an addition to the ongoing electro-magnetic pulse (EMP) analysis also included under this program element as expanded by the Defense Science Board. While carrying out the EMP analysis, it was determined a more complete B-52 survivability/vulnerability examination to include blast and thermal vulnerabilities was required. This effort is currently programmed to last one year.

Autopilot project is a new start for FY 1981 and is a two year effort. Activities include design, fabrication, and integration of a new flight control system and a new heading system for tne B-52D aircraft. These updates are required to replace the current systems having supportability and safety of flight problems. Due to commonality of aircraft, the output from this project will also provide an improved autopilot for the B-52G/H. B-52D modification begins in FY 1982. B-52G/H mod will begin in FY 1983 or 1984.

RELATED ACTIVITIES: The B-52 Squadrons program will receive benefits from the Low Life Cycle Cost Avionics (PE 63705F), the Electronically Agile Radar (EAR) (PE 63241F), the Standard Precision Navigator (SPN/GEANS) (PE 64201F), and other similar ongoing Research and Development (R&D) efforts in Air Force Systems Command (AFSC), as well as contractor internal research and development (IR&D) efforts. The program will support the B-52 avionics update requirements as stated in Strategic Air Command Required Operational Capability (SAC ROC) 6-75 and SAC ROC 12-76. The cruise missile development program will be integrated with the offensive avionics update projects.

WORK PERFORMED BY: The original avionics study which identified avionic subsystems requiring upgrading under this program was accomplished by Boeing Military Airplane Company (BMAC). The development program has been assigned to BMAC on a sole source basis. The major subsystems/subcontracors were selected by BMAC with Air Force approval. The list of contractors is as follows:

Prime Contractor:	Product:
Boeing Military Airplane Company, Wichita, Kansas	Offensive Avionics System (OAS)
Major Subcontractors for OAS	
Lear Siegler, Grand Rapids, Michigan	Attitude and Heading Reference System (AHRS)
Sperry Flight Systems, Phoenix, Arizona	Controls/Displays
IBM, Owego, New York	Processor
Norden, Norwalk, Connecticut	Radar Mod
Honeywell, Minneapolis, Minnesota	Radar Altimeter
Honeywell, St. Petersburg, Florida	Inertial Navigation Set
Softech, Waltham, Massachusetts	Jovial 3B Compiler
Sundstrand, Redmond, Washington	Data Transfer Unit, Data Transport Devices
Teledyne - Ryan, San Diego, California	Doppler Velocity Sensor

Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: B-52 Squadrons
Budget Activity: Strategic Programs #3

Associate Contractors on OAS (Through the Joint Cruise Missile Program Office (JCMPO)

General Dynamics, San Diego, California	AGM-109 Cruise Missile
McDonnell Douglas, St. Louis, Missouri	AGM-109 Cruise Missile Software
Boeing Aerospace Co, Seattle, Washington	AGM-86 Cruise Missile

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The major focus of the FY 1976 program was to study numerous alternative update systems, packages, and approaches for updating the B-52 offensive avionics system. The study was completed, the update system was defined, and both Headquarters Air Force and the Office of the Secretary of Defense (OSD) gave their approval. The doppler program started a Research, Development, Test and Evaluation (RDT&E) effort to develop a nuclear hardened doppler velocity sensor for strategic bomber application. The Strategic Avionics Crewstation Design and Evaluation Facility (SACDEF) was converted and secured for program support. The B-52 Antiship Capability Study was completed and the GBU-15 integration was tasked to the GBU-15 program element.

The 1977 program finalized the RDT&E contract for the B-52 Offensive Avionics System (OAS) development effort. This represented the first major offensive avionics update approved for the B-52 and therefore it required a careful definition in concert with expected future missions. The doppler project completed source selection and two contractors were selected for the flight test/flyoff phase along with survivability analysis tests to be conducted by the Air Force Weapons Laboratory. The SACDEF completed crewmember tests and evaluations to establish a baseline of present capabilities against which to design/evaluate future changes.

In 1978, the Common Strategic Doppler contractors submitted doppler radar sets for a flight test evaluation and competition. The winner was Teledyne Ryan. The SACDEF established the baseline of present avionics for comparisons and assisted in the planning of effective controls and displays. The B-52 Offensive Avionics System (OAS) project, formerly known as the B-52 Avionics Update - Phase One, was accelerated one year with funds from the FY 1978 Supplemental Budget. The program completed a Systems Requirements Review, contractor awards were made, and software development was initiated. The total OAS RDT&E contract was signed. The studies for B-52 life extension and nuclear hardness were initiated. The Electronic System Test Set (ESTS) development was continued. No efforts were accomplished in FY 1978 on a B-52 Avionics Update - Phase Two program which was planned as a follow-on to the OAS - Phase One program.

In 1979, the Common Strategic Doppler project was completed and efforts were initiated to integrate the modification on the C/KC-135 force and to integrate the hardened sensor into B-52G/H OAS. The Strategic Avionics Crewstation Design Evaluation Facility (SACDEF) completed human engineering testing with B-52 crewmembers on the B-52 Offensive Avionics System (OAS) project package prior to flight testing. Under the OAS project, subsystem deliveries were received for integration into the OAS package, fabrication of the system integration laboratory and test facility (SILTF) was begun, and testing efforts were initiated. Long lead procurement funding was released for cruise missile external pylons.

Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

The Avionics Update Phase Two project, now restructured and renamed the B-52 Aircraft Modernization Program, began in FY 1979 with trade studies, system definition, and initial system design. Efforts identified in the Life Extension Study which required development or prototyping were included. The Nuclear Hardness Study was completed. These results will be used to develop and verify a hardness baseline for nuclear blast/ vulnerability assessments for the B-52G/H system. The Electronic System Test Set (ESTS) project continued development. The observable differences/ functionally related observable differences (ODs/FRODs) development project was initiated and completed.

2. FY 1980 Program: The OAS program production decision and contract actions were completed in the fourth quarter of FY 1979. The OAS efforts in RDT&E include completing software development and system integration laboratory and test facility (SILTF) integration. The flight test aircraft (B-52G) modification will begin flight testing in September 1980. The combined developmental test and evaluation (DT&E) and initial operational test and evaluation (IOT&E) is scheduled from September 1980 through FY 1981. The nuclear hardness study/EMP project began testing of a B-52G on Trestle. If the tests show that aircraft EMP mods are required, they will be developed and then produced and installed. The ESTS project continued development of the support equipment. FY 1980 is the second year of efforts on the B-52 Aircraft Modernization Program. The outyear B-52 modernization efforts were completely revised in 1980. Under this effort changes have been identified to provide for sustained use of the B-52 as an all standoff cruise carriage force into the 1990s.

Crew task loading studies were initiated to determine outyear mission needs due to reduced penetration requirements and the need to reduce support costs. Tasks identified in the FY 1978 Life Extension Study were also included under this project. With the deletion of the need for a forward looking radar with the full capability of the electronically agile radar (EAR) was diminished. Therefore, the project is being restructured to provide a radar update/replacement more suitable to the new outyear B-52 missions. Development of engineering data to incorporate offensive avionics system/cruise missile integration (OAS/CMI) package into the B-52 Weapon System Trainer (WST) has been initiated.

3. FY 1981 Planned Program: The combined DT&E and IOT&E of the OAS is to begin and is scheduled to be completed in September 1981. This is the same date for first alert capability of a B-52G with integrated ALCM and OAS capability. Modification of both B-52G and H aircraft with the OAS mod package begins this year. Some nuclear weapon certification testing may continue into the next year. Combined testing with launches of the Air Launched Cruise Missile (ALCM) and the Short Range Attack Missile (SRAM) take place late in this year. The Strategic Avionics Crewstation Design Evaluation Facility (SACDEF) will concentrate on the human engineering aspects of the design and layout of Aircraft Modernization Program efforts, to include pilot compartment evaluations. In the Nuclear Hardness Study/EMP project, the development of the modification fixes to provide protection to aircraft systems from the effects of EMP will be initiated. The scope and definition of this project reflects the expansion recommended by the Defense Science Board (DSB) to provide greater assurance of aircraft survival against the effects of nuclear detonations. The Electronic System Test Set (ESTS) project will be continued in this year with concentration on development of software and test package sets (TPS) for the Air Launched Cruise Missile (ALCM) and the Short Range Attack Missile (SRAM) support. In the Aircraft Modernization Program, the full scale engineering and development (FSED) contract is to be

signed. The selected subcontractors are to begin fabrication of subsystems for delivery the following year. Integration and software design is to begin in the laboratory in anticipation of hardware delivery. Final refinements to architecture and interfaces with the B-52 Offensive Avionics System (OAS) project are scheduled. A new project will be initiated to design, fabricate, integrate, and flight test an automatic flight control system (AFCS) and heading system for the B-52D. Because of commonality in all models of the B-52, this project will also provide data for a follow-on autopilot for B-52G/H. The strategic radar/EAR project will begin fabrication of the radar hardware and software for eventual input to the Aircraft Modernization Program. In addition, the Offensive Avionics System/Cruise Missile Integration (OAS/CMI) Weapon System Trainer (WST) mod package development will continue this year.

4. FY 1982 Planned Program: During this year, the OAS project will be completed and the test aircraft will be transferred to the B-52 Aircraft Modernization Program (AMP) because aircraft modification for this project begins this year for DT&E/IOT&E in FY 1983. All electromagnetic pulse (EMP), blast, thermal, and related aircraft structural problems should be fully identified and efforts will concentrate on developing aircraft modifications. The ESTS project will be completed this year except for necessary items uncovered during IOT&E and early FOT&E. This year will be the major investment year for the strategic radar because of hardware procurement, aircraft integration, and software interfaces. The modification to the weapon system trainer (WST) for OAS and ALCM will be completed this year. The autopilot project will be completed this year with the B-52D aircraft going to modification in FY 1982. The B-52G/H data will be integrated for AMP flight testing. The SACDEF project will continue and during this year, one new start will be initiated - B-52H Cruise Missile Integration (CMI). This project protects the option to deploy cruise missiles on the B-52H. These missiles could be either the current ALCM or a follow-on generation of cruise missiles with improved penetration capabilities.

5. Program to Completion: The modification develoment for EMP fixes and associated aircraft survivability and vulnerability (S/V) problems ends in FY 1983. The B-52 AMP program continues with a production decision scheduled for either late FY 1983 or FY 1984. Cruise missile integration for the B-52H will be completed. If further cruise missile or weapon system introductions are made, then their integration will be required. The AMP program will require an update to the WST system and/or the Companion Trainer Aircraft (CTA) program. Additional B-52 projects may be required for role and mission conversions.

6. Milestones:

	Date
A. Common Strategic Doppler:	
(1) Initial Contracts Signed (2)	Feb 77
(2) Delivery of First Models (from each)	Oct 77

(3)	CDR	Jul 77
(4)	Initiation of IOT&E/OT&E	Mar 78
(5)	Completion of IOT&E/OT&E	Jun 78
(6)	Production Award	Sep 78
(7)	Production Funding (C/KC-135/B-52)	FY 1979

B. B-52 Offensive Avionics Systems (OAS) (Formerly Avionics Update - Phase One):

(1)	Initial Contract Signed (Studies)	Jan 76
(2)	Phase 0 Definition Contract Signed	Oct 77
(3)	Phase 1 Contract	Aug 78
(4)	Production Decision/Approval	Jul 79
(5)	Initiation of DT&E/IOT&E	Sep 80
(6)	Completion of DT&E/IOT&E	Sep 81
(7)	Release Long Lead Production Funds for Cruise Missile Pylon	Sep 78
(8)	First Aircraft - In (Boeing)	Dec 80
(9)	First Aircraft - Out (Boeing)	Jun 81
(10)	First Aircraft Delivery to SAC	NLT Aug 81
(11)	First Aircraft - Alert ALCM with OAS	Sep 81
(12)	IOC - B-52G Squadron (16 UE) with ALCM and OAS	Dec 82

C. B-52 Aircraft Modernization Program (AMP) (Formerly Avionics Update - Phase Two):

(1)	Definition/Trade Studies	FY 1979/1980
(2)	FSED Contract	Jan 81
(3)	Prototyping Initiation	FY 1982
(4)	Production Decision - Total Package	FY 1983-1984
(5)	First Aircraft - In/Out	FY 1985

D. Electronic System Test Set (ESTS):

(1)	Critical Design Review (CDR)	Oct 77
(2)	First Fabricated Set	Oct 77
(3)	System Software CDR	May 78
(4)	Planned Production Start	Jan 80
(5)	Initial Alert Capability	Sep 81
(6)	Initial Operational Capability (IOC)	Dec 82

E. Nuclear Hardness Study/EMP

(1)	Start Studies	FY 1978
(2)	Dipole Testing	FY 1979
(3)	Trestle Testing	FY 1980
(4)	Modification Development	FY 1981-1983
(5)	Production Funding	TBD

F. Strategic Radar (Formerly Electronically Agile Radar/EAR)

(1)	SAC ROC 6-75 Approved	Dec 76 (EAR)
(2)	Initiation of Engineering	Oct 79 (EAR)
(3)	Completion of Advanced Development (PE 63241/PE 11113F)	Jan 80 (EAR)
(4)	Delivery of RDT&E Model	Oct 81
(5)	Start Flight Testing	Jan 83
(6)	Complete Flight Testing	Mar 84

G. Observable Differences/Functionally Related Observable Differences (ODs/FRODs):

(1)	Complete Definition Efforts	FY 1979
(2)	Initiate Acquisition Contracts	FY 1980
(3)	Initial Modified Aircraft	FY 1981
(4)	Complete Modification of B-52G Aircraft	FY 1987

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data: All significant changes are addressed in the individual project descriptive summaries which are attached.

Project: #2406 — Title: B-52 Offensive Avionics System (OAS)
Program Element: #11113F — Title: B-52 Squadrons
DOD Mission Area: 113, Airborne Strike — Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The present B-52G/H bombing navigation system (BNS) and other systems were designed with technologies available in the early 1950s and are experiencing increasing maintenance costs (e.g., the present Mean Time Between Failure (MTBF) of the BNS in the B-52G/H fleet is hours and the overall reliability is approximately Projected improvements in the enemy defensive threat demand navigation accuracy and target recognition ability The trend toward decreasing weapon yields and increasing target hardness generates the need for improved accuracy. Additionally, _

' Effective accomplishment of these strike options requires improved navigation and bombing accuracy. The immediate nature of these requirements demands attention and will shape the first priorities of this program. In addition, a study of avionics systems, completed in October 1976, found that selected offensive avionics system support costs could be reduced by as much as two-thirds if high cost, low reliability components and subsystems identified in the study were exchanged with suggested replacement items.

Of equal importance is the need to modify the B-52G aircraft to be compatible with the carriage and launch of cruise missiles. The need to accommodate cruise missile carriage in the B-52 has taken on added importance subsequent to the cancellation of the B-1 procurement.

The B-52 Offensive Avionics System (OAS) project, formerly known as the B-52 Avionics Update - Phase One, responds to the immediate need to improve the performance of the B-52G/H bombing navigation system, to reduce avionics system support costs, and to integrate cruise missile carriage on the B-52G. The urgency of the need for improved performance and cruise missile carriage, tempered by the desire to effect significant Operational and Support (O&S) cost savings shapes the priorities of this project.

The OAS project includes an improved heading system; integrated controls and displays; a reliability modification to the present forward looking radar; a high accuracy inertial navigation system; the addition of digital processing and a new data bus; and a new doppler and radar altimeter. As well as accommodating cruise missile carriage, the new avionics developed under the OAS project will provide stored data and integrated sensor updates to the missiles (Air Launched Cruise Missile - ALCM and Short Range Attack Missile - SRAM) prior to launch from the aircraft. Precision initialization is required prior to launch of ALCM to insure a high probability of acquiring the first terrain correlation matching (TERCOM) guidance update point. Other benefits to the cruise missile are a two-fold increase in system reliability and nuclear hardness to electromagnetic pulse (EMP)/transient radiation effects on electronics (TREE).

The first B-52G upgraded with the integrated OAS package is scheduled to be alert capable with external ALCMs in September 1981. The program IOC date, which consists of the first full squadron (16 UE B-52G) updated with OAS and capable of carrying and launching cruise missiles, is December 1982.

RELATED ACTIVITIES: The B-52 Squadrons program benefits from the Low Life Cycle Avionics (PE 63705F), the Electronically Agile Radar (EAR) (PE 63241F), the Standard Precision Navigator (SPN/GEANS) (PE 64201F), and other similar R&D efforts in AFSC, and contractor IR&D efforts. The program will support the B-52 avionics update requirements as stated

Project: #2406
Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: B-52 Offensive Avionics System (CAS)
Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

in Strategic Air Command Required Operational Capability (SAC ROC 6-75 and SAC ROC 12-76. The cruise missile development program will be integrated with the B-52 Offensive Avionics System (OAS) project.

WORK PERFORMED BY: The avionics study which identified avionic subsystems for incorporation into this program was accomplished by Boeing Military Airplane Company (BMAC). The development program has been assigned to BMAC on a sole source basis. The major subsystems/subcontractors were selected by BMAC with Air Force approval. The list of contractors is as follows:

Prime Contractor	Product
Boeing Military Airplane Company, Wichita, Kansas	Offensive Avionics System (OAS)
Major Subcontractors for OAS	
Lear Siegler, Grand Rapids, Michigan	Attitude and Heading Reference System
Sperry Flight Systems, Phoenix, Arizona	Controls/Displays
IBM, Owego, New York	Processor
Norden, Norwalk, Connecticut	Radar Mod
Honeywell, Minneapolis, Minnesota	Radar Altimeter
Honeywell, St. Petersburg, Florida	Inertial Navigation Set
Softech, Waltham, Macsachusetts	Jovial 3B Complier
Sundstrand, Redmond, Washington	Data Transfer Unit
Teledyne - Ryan, San Diego, California	Doppler Velocity Sensor
Associate Contractors on OAS (Through JCMPO)	
General Dynamics, San Diego, California	AGM-109 Cruise Missile
McDonnell Douglas, St. Louis, Missouri	AGM-109 Cruise Missile Software
Boeing Aerospace Co., Seattle, Washington	AGM-86 Cruise Missile

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The major effort of the FY 1976 program was to study numerous alternative update systems, packages, and approaches for upgrading the B-52 offensive avionics. The study was completed, the update system was defined, and both Headquarters Air Force and the Office of the Secretary of Defense (OSD) gave their approval to proceed.

The 1977 program finalized the RDT&E contract for the B-52 OAS project development. This represented the first major offensive avionics update approved for the B-52 and required a careful definition in concert with expected future missions.

Project: #2406 — Title: B-52 Offensive Avionics System (OAS)
Program Element: #11113F — Title: B-52 Squadrons
DOD Mission Area: 113, Airborne Strike — Budget Activity: Strategic Programs, #3

In 1978, the B-52 Offensive Avionics System (OAS) project, known then as the B-52 Avionics Update - Phase One, was accelerated one year with funds from the FY 1978 Supplemental Budget. The program completed a System Requirements Review, contractor awards were made, and software development was initiated. Total Phase One RDT&E contract was signed in August 1978.

In 1979, the hardened sensor developed under the Common Strategic Doppler project was completed. This sensor will be integrated into B-52G/H under the OAS project. Deliveries were received for integration into the OAS package, fabrication of the system integration laboratory and test facility (SILTF) was begun, and testing efforts were initiated. Long lead procurement funding will be released during FY 1979 for cruise missile external pylons to meet the programmed September 1981 initial alert requirement.

2. FY 1980 Program: The OAS program production decision and appropriate related contract actions occurred in the fourth quarter of FY 1979. The efforts in RDT&E include completing software development and SILTF integration. The flight test aircraft (B-52G) modifications begin this year with flight testing starting in September 1980. The combined developmental test and evaluation (DT&E) and initial operational test and evaluation (IOT&E) is scheduled from September 1980 through FY 1981.

3. FY 1981 Planned Program: Flight testing is the main task for this year. Both testing of the OAS and then integration with the Air Launched Cruise Missile (ALCM) and Short Range Attack Missile (SRAM) will take place. In FY 1981, the combined DT&E and IOT&E of the OAS is scheduled to be completed in September 1981. This is the same date for first alert capability of a B-52G with integrated ALCM and OAS capability. Modification of both B-52G and H aircraft for OAS will begin this year.

4. FY 1982 Planned Program: Flight testing is scheduled for completion during the prior year. If the ALCM program slips some flight testing may extend into this year.

5. Program to Completion: The OAS update testing will complete in FY 1982 with nuclear weapons certification and the test aircraft will transition to the B-52 Aircraft Modernization Program.

6. Milestones:

		Date
A.	Initial Contract Signed (Studies)	Jan 76
B.	Phase 0 Definition Contract Signed	Oct 77
C.	Phase I Contract	Aug 78
D.	Initiation of DT&E/IOT&E	Jun 80
E.	Completion of DT&E/IOT&E	Sep 81
F.	Release Long Lead Production Funds for Cruise Missile Pylon	Sep 78

Project: #2406
Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: B-52 Offensive Avionics System (OAS)
Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

G.	Planned Production Decision/Approval	Jul 79
H.	First Aircraft - In (Boeing)	Dec 80
I.	First Aircraft - Out (Boeing)	Jun 81
J.	First Aircraft Delivery to SAC	Not Later Than Aug 81
K.	First Aircraft - Alert ALCM with OAS	Sep 81
L.	IOC - B-52G Squadron (16 UE) with ALCM and OAS	Dec 82

7. Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Total for Project #2406	40,800	55,000	45,000	3,700		185,800

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2406	B-52 Avionics Update - Phase One	38,700	38,100	55,000	45,000	3,700	183,100

The funding increased in FY 1979 from $38,100 to $40,800. To partially offset this $2,700 increase, $1,900 was realigned from other projects to meet contract requirements. The remaining $800 was reprogrammed to fund an added Headquarters Strategic Air Command requirement to provide software for Air Launched Cruise Missile (ALCM) flexible targeting provisions. Current estimates are based on the contract with the Boeing Military Airplane Company (BMAC).

Budget Activity: Strategic Programs #3

Program Element: 11113F - B-52 Squadrons, Project 2406, B-52 Offensive Avionics System (OAS)

Test and Evaluation Data

1. Development Test and Evaluation: The test program will be a combined Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) effort extending for 24 months. The flight testing portion begins in September 1980 with completion scheduled for September 1981. The flight test program will definitely extend for 12 months with an additional follow-on 12 months possible to complete the operational command checkout for Strategic Air Command (SAC).

The objective of the B-52 Offensive Avionics System (OAS) program is to test and evaluate the operational effectiveness and operational suitability of the selected OAS package including the integration of the Air Launched Cruise Missile (ALCM). The test environment will represent the actual combat conditions as close as possible using a modified B-52G. Operational deficiencies will be identified and changes/trade offs will be recommended. Information will be provided for refining training concepts, refining tactics, techniques and doctrine, updating publications, and refining operating and support (O&S) cost estimates.

The test team crewmembers will be drawn from the mainstream of the SAC crew force in order to provide a more realistic appraisal of the new equipment.

The program provides an update to the B-52G/H offensive avionics package. The effort will include design, fabrication, and integration of an offensive avionics system for a flight test evaluation program leading to a Class V modification to the B-52G/H fleet.

The new avionics systems will include as a minimum, but not be limited to, the addition and/or modification of the following systems/capabilities:

a. Attitude and heading reference system (AHRS) - Replace present heading and attitude systems with a more reliable, accurate system.

b. Radar altimeter - Replace radar altimeter with a more reliable system capable of performing terrain correlation.

c. Digital processor(s) - Replace present analog BNS computers providing bombing, navigation, and air-launched missile computations.

d. Military-Standard (MIL-STD)-1553A Data Bus - Insures resultant system architecture will meet Air Force digital time division multiplex standard.

e. Controls and displays - Provide necessary controls and displays to ensure proper man/machine interface.

f. Doppler Velocity Sensor (DVS) - Replace present APN-89A Doppler radar with the common strategic doppler.

g. Mapping radar modification - Modify the present radar system to improve performance, reliability, and maintainability.

h. Inertial navigation capability - Provide an inertial navigation capability sufficient to meet the stated requirements in SAC ROC 6-75 for a high precision navigator. The capability must be Air Force-qualified and nuclear-hardened to stated requirements. No Research Development Test and Evaluation (RDT&E) funds are provided for either nuclear hardening or prototype systems other than USAF government furnished equipment (GFE)

i. Terrain correlation - An operational evaluation of terrain correlation as a navigational aid in the performance of the strategic mission.

j. Air-launched missile(s)/aircraft avionics tie-in - Integration of development software/hardware required to support air-launched missile delivery.

The development contractor is the Boeing Military Airplane Company in Wichita, Kansas. The Development Test and Evaluation (DT&E) service program manager is the Aeronautical System Division (ASD) at Wright-Patterson AFB, Ohio. The Operational Test and Evaluation (OT&E) service program manager is the Air Force Test and Evaluation Center (AFTEC) at Kirtland AFB, New Mexico. The test location will be the Boeing Wichita plant 13. The Edwards AFB facilities may be used for a portion of the combined (missiles and aircraft) test requirements.

Particular emphasis will be placed on testing the operational effectiveness of the fault detection/isolation capabilities of the new equipment. Initial Operational Test and Evaluation (IOT&E) test team personnel will maintain the updated avionics system using the same available organizational/intermediate level techniques/equipment (BIT/FIT/ATE, etc.) that are to be used when the system is deployed.

Preliminary validated technical orders (TO) will be provided to DT&E/IOT&E test team personnel to perform maintenance associated with the new systems. These TOs will be verified during DT&E/IOT&E to provide final tech data for system deployment.

An evaluation of software for the B-52 Offensive Avionics System (OAS) will be performed by the software assessment team at Boeing Military Airplane Company and Oklahoma City-Air Logistics Center (OC-ALC). In the test team, contractor development and test activities, as well as flight testing, will be monitored to assess software performance and suitability factors. The effectiveness of software development tools to support future software maintenance will also be assessed. At OC-ALC, computer programs and the associated documentation will be evaluated to judge their adequacy for software maintenance.

In addition, a limited simulation capability for the Offensive Avionics System (OAS) computer complex is planned to allow some performance evaluation of OAS Operational Computer Programs. This activity also begins a buildup of Air Force expertise at Oklahoma City-Air Logistics Command (OC-ALC) on which to base future organic support for B-52 OAS software.

A high degree of similarity exists between the items tested during Development Test and Evaluation (DT&E), those tested during Initial Operational Test and Evaluation (IOT&E), and those in the production configuration. Except for minor installation and wiring differences, the subsystems should be completely interchangeable. Software will be continually updated with test findings.

Below are sections for special item of concern which will be evaluated and will affect the T&E portion of this program.

a. Reliability:

(1) Primary Mission Equipment (PME) shall have a minimum mean time between failure (MTBF) of 43 hours evaluated by burn in, qualification testing, ground tests, and flight tests.

(2) Interface equipment shall have a minimum MTBF of 2500 hours.

(3) Group A equipment shall have a minimum MTBF of 400 hours.

b. Maintainability:

(1) The total "on aircraft" maintenance time for new equipment shall not exceed 140 hours per 1000 system operating hours.

(2) The mean time to restore failed equipment "on aircraft" shall not exceed 1 hour.

(3) The mean time to restore failed equipment at the intermediate level shall not exceed 1.5 hours.

c. Environmental Qualification Testing:

(1) All new PME will be tested for explosion proof, temperature shock, temperature-altitude, vibration, shock, acoustics, humidity, sand and dust, fungus, salt atmosphere, moisture, solar radiation, and overpressure using the appropriate Military-Standard (MIL-STD).

(2) Vibration testing includes 11 hours of random vibrations at two temperature levels, -55° and 71°C.

d. Test Flights: The program has combined DT&E/IOT&E flights. The DT&E testing requires 44 successful test flights.

e. Management: The test and evaluation program management for the Offensive Avionics System (OAS) and air launched cruise missile (ALCM) integration is broken out below.

(1) The development portion will be a combined Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) program and will continue that way through the full scale engineering and development (FSED) contract. The test portion is from September 1980 through September 1981. The overall program manager is the Strategic SPO (ASD/YY) who is also in charge of DT&E. Air Force Test Evaluation Center (AFTEC) is responsible for the IOT&E portion under the Strategic SPO.

(2) Beyond the DT&E/IOT&E program, an Follow-on Test and Evaluation (FOT&E) is planned with two phases. The first phase (Jan-Dec 82) will be the responsibility of AFTEC. After December 1982 (Initial Operational Capability (IOC)) or after the IOC occurs, HQ Strategic Air Command (SAC) assumes responsibility for management of this second phase.

2. Operational Test and Evaluation Data:

a. Testing is scheduled to begin Sep 80 and continue through Sep 81.

b. Testing is to be conducted as combined development test and evaluation/initial operational test and evaluation (DT&E/IOT&E) using one B-52G aircraft staging from the Boeing Wichita/McConnell AFB, KS facilities. Ranges to be used include White Sands Missile Range, Nellis Range, Utah Test and Training Range, and Tonopah Range. Boeing Wichita Company is the prime contractor. AFTEC, with SAC, Air Force Logistics Command (AFLC), and Air Training Command (ATC) support, will have overall responsibility for the operational test and evaluation. The objectives of the IOT&E are to:

(1) Evaluate the operational effectiveness of the B-52 to perform the SAC operational mission with the updated offensive avionics installed (i.e., quick reaction launch, air alignment of the inertial measurement unit, tanker rendezvous, overwater flight, landfall fix, weather avoidance, high and low altitude simulation and actual, Short Range Attack Missile/Air Launched Cruise Missile (SRAM/ALCM) interoperability, and aircraft recovery).

(2) Evaluate the operational suitability of the updated avionics (i.e., system reliability, maintainability, supportability, and availability. Operational suitability verification test of reliability and maintainability parameters will consist of exercising the system on 58 planned flights and ground operation, performing maintenance and capturing and analyzing relevant data. Additional operational test force maintainability events will be conducted to explore the whole range of possible operational maintenance events). Identify system characteristics or deficiencies which significantly impact operating and support (O&S) costs. Identify operational deficiencies. Recommend or evaluate desirable changes or trade offs in production configuration. Evaluate the effectiveness of the computational subsystem software, to include functional performance, degraded mode operations and software man-machine interface.

c. Several items of intermediate level (field shop) support equipment will be available for testing during IOT&E; in particular, the AN/ASM-479 (modified), and the AN/GSM-263 electronic systems test set. The System Avionics

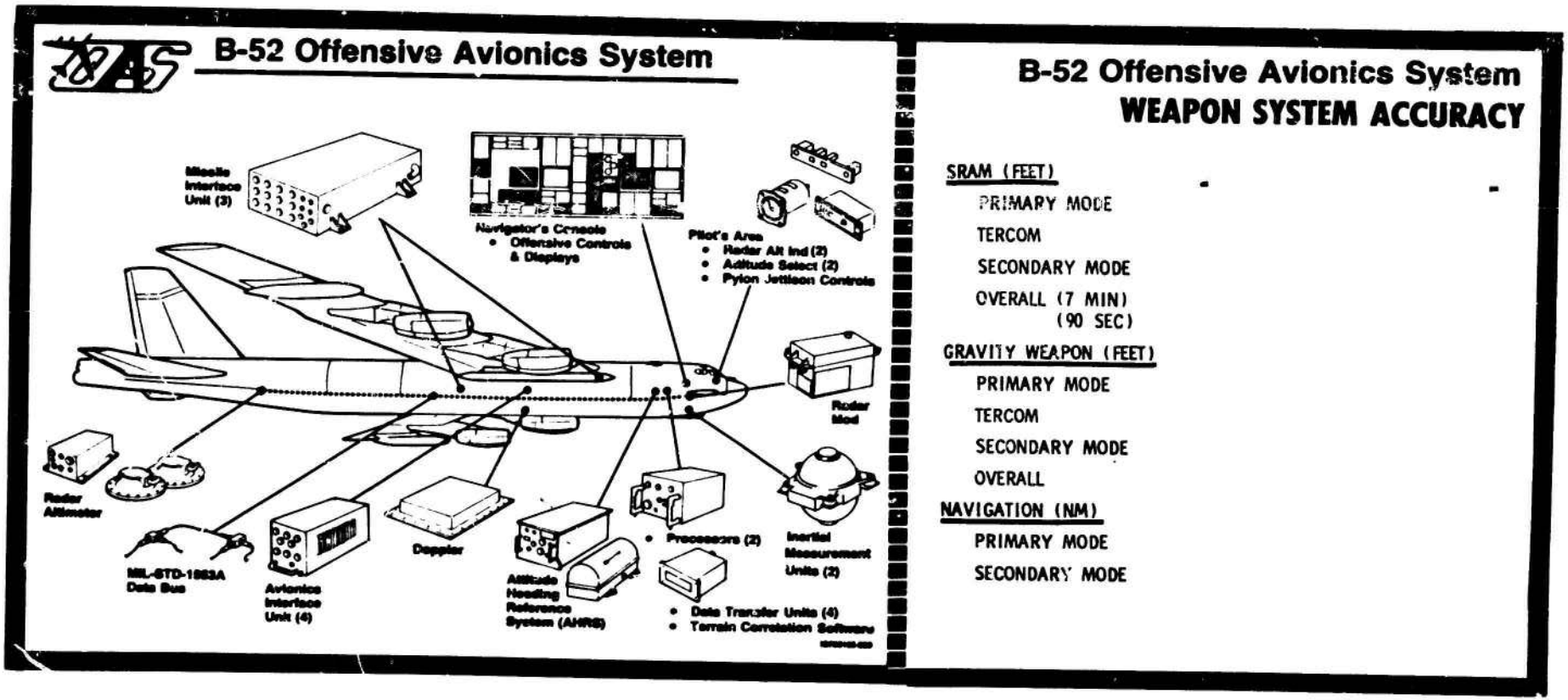
Tester will be available for the last three months of Initial Operational Test and Evaluation (IOT&E). All three items will be tested in Follow-on Operational Test and Evaluation (FOT&E). During FOT&E, intermediate level maintenance will be performed largely by the contractor using special test equipment. Estimates of operational reliability and maintainability for the level of maintenance will consequently be degraded. Supportability of the test set will be evaluated during FOT&E.

d. The system and subsystems to be tested will be the system put into production. Due to the integration of air launched cruise missile program with the avionics update, changes in software may occur in final production versions. Operational Test and Evaluation (OT&E) operations and maintenance personnel will be representative of the user's personnel.

e. With the concurrency of the full scale development and production programs, some long-lead production decisions will be made prior to the completion of flight testing. Follow-on operational test and evaluation and nuclear certification testing will be scheduled for FY 82.

Program Element: 11113F Title: B-52 Squadrons, Project 2406

3. Systems Characteristics: The following are general characteristics of the new offensive avionics system to be modified on the B-52G/H aircraft.



Project: #2548 Title: Nuclear Hardness Study/EMP
Program Element: #11113F Title: B-52 Squadrons
DOD Mission Area: 113, Airborne Strike Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The purpose of the B-52 Nuclear Hardness Study/Electromagnetic Pulse (EMP) project is to improve the survivability and vulnerability (S/V) of the B-52G/H to nuclear effects. The first phase of the study identified program needs. The next phase analyzed the basic aircraft for blast, thermal, and EMP vulnerability. The project will develop and verify a nuclear hardened baseline design for the entire B-52G/H weapon system. The project will continue to develop, for modification, EMP fixes to critical aircraft systems not included in the B-52 Offensive Avionics System (OAS) and Air Launched Cruise Missile (ALCM) efforts.

During 1979, an evaluation of the project by the Defense Science Board (DSB) recommended an expanded test program to gather more data. The additional data will permit the consideration of various modification options to increase the probability of aircraft survival against the effects of nuclear weapons.

RELATED ACTIVITIES: PE 64711F Systems Survivability (Nuclear Effects) supports EMP testing of the B-52. PE 64711F develops test methodology, procedures, and prescribes trainers needed for Air Force testing. PE 64747 Electromagnetic Radiation develops the nuclear simulator for testing (Project 1209).

WORK PERFORMED BY: The test facilities at the Air Force Weapons Laboratory (AFWL), Kirtland AFB NM, will be used for the majority of the actual aircraft, subsytem, and/or piece part testing. Computer facilities at AFWL and selected civilian contractors will also be used.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Headquarters Air Force directed the AFWL to lay out a total evaluation program for the B-52G/H. Phase One was completed by AFWL in 1976. The program was suspended shortly thereafter to allow facility testing to be concentrated on B-1 requirements. Following the cancellation of B-1 production, the B-52 program was re-established in the FY 1978 Supplemental Budget. Efforts through FY 1978 defined the test program, prepared for basic aircraft testing, and initial computer analysis was performed. In FY 1979, basic aircraft testing began at AFWL on the dipole facility.

2. FY 1980 Program: Testing begun in the preceding year will be completed. In addition, the aircraft is being tested on the Trestle facility in FY 1980. The Trestle testing originally proposed in this program was expanded considerably this year to clear up the EMP uncertainties of the B-52. Data from the EMP portion of the tests will be analyzed to initiate development of EMP fixes to protect selected subsystems.

3. FY 1981 Planned Program: The project will continue to analyze by subsystem testing and/or by computer analysis the effects of EMP on the B-52 in order to develop corrective fixes. Production funding for aircraft retrofit will be programmed once the fixes are defined, approved, and developed for modification.

Project: #2548 — Title: Nuclear Hardness Study/EMP
Program Element: #11113F — Title: B-52 Squadrons
DOD Mission Area: 113, Airborne Strike — Budget Activity: Strategic Programs, #3

4. FY 1982 Planned Program: Development of the EMP hardness modification package will continue this year. The package will provide a high probability of an aircraft surviving the EMP threat. Modifications needed to provide aircraft protection against the effects of blast and thermal, if required, will be developed under another project.

5. Program to Completion: The program will complete in FY 1983. Efforts this year will continue to develop fixes to priority aircraft subsystems.

6. Milestones:

		Date
A.	Start Studies	FY 1978
B.	Dipole Testing	FY 1979
C.	Trestle Tesintg	FY 1980
D.	Modification Development	FY 1981-1983
E.	Production Funding	TBD

7. Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Total for Project #2548	3,400	16,000	28,400	39,200	22,700	111,400

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2548	Nuclear Hardness Study/EMP	1,700	1,500	6,000	21,000	11,000	41,200

When the project was expanded to include development of EMP fixes for B-52G/H, funding was added in FY 1979, 1980, 1981, 1982, and 1983. The increase in funding is due to a change in the scope and definition of project objectives following an evaluation of the project by the Defense Science Board (DSB). The modification program, originally scheduled to begin in FY 1981, has been deferred until after the Trestle and related tests.

Project: #2570 — Title: Electronic Systems Test Set (ESTS)
Program Element: #11113F — Title: B-52 Squadrons
DOD Mission Area: 113, Airborne Strike — Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The goal of developing automatic test equipment (ATE) common to SRAM and cruise missiles was highlighted in January 1976 when Strategic Air Command (SAC) identified its requirements for such equipment. In the SRAM B trade study, different options were evaluated to find the most cost-effective common test equipment for the AGM-69A, AGM-69B, AGM-86A, B-52 missile related carrier aircraft equipment (CAE), and B-1 applications. A preferred concept resulting from the study was a computerized ATE common to the two missiles and missile related aircraft systems. The Electronic System Test Set (ESTS), formerly the Integrated Computerized Test Set (ICTS), was selected to complement the concept. The advantages of common ATE, in addition to effecting major changes in projected life cycle costs are: growth potential, system software change flexibility through on-line edit capability and improved operational capability associated with testing all aircraft and missile systems with a single piece of equipment.

The SRAM Program Management Directive (PMD), September 1976, directed the SRAM System Project Office (SPO), to develop the ATC common to the AGM-69A, AGM-69B, AGM-86A, B-1 gravity weapons, and B-52/B-1 munitions related carrier aircraft equipment. The required operational capability for the ALCM also stated a need for common ATE.

When the B-1 and SRAM B missile production were cancelled in July 1977, all SRAM B work except the ESTS was stopped. ESTS work continued and was expanded to include the AGM-109 which had been introduced into the air launched cruise missile competition. Thus ESTS satisfies the ATE requirement for the AGM-69A, AGM-86B, AGM-109 and combination of the SRAM and ALCM missiles, loaded and empty launcher and pylons, and B-52 CAE at the B-52 integrated maintenance facility (IMF).

A review completed in November 1977 reconfirmed the requirement and effectiveness of continuing the development of a common set of ATE.

RELATED ACTIVITIES: The B-52 Offensive Avionics System (OAS) modernization program with new digital systems and cruise missile integration and the B-52/SRAM weapon system will benefit from this development effort. The B-52/SRAM/Cruise Missile/Avionics interface units developed under the OAS program can be checked for maintenance corrective action using the Electronic System Test Set (ESTS).

The cruise missile program will provide funds to develop ESTS peculiar cruise missile software to support the competitive flyoff and will also provide later updates to integrate the ESTS with the selected cruise missile.

WORK PERFORMED BY: The efforts will be accomplished in three areas. One part, represented by the funds shown here under Project 2570, will be carried out by the Boeing Company under contract to the Aeronautical Systems Division of Air Force Systems Command. This part will support the B-52 weapon system and associated missiles. The other two parts will be managed by the Joint Cruise Missiles Program Office (JCMPO) and will be performed by Boeing and General Dynamics in support of their individual missile candidates.

Project: #2570
Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: Electronic System Test Set (ESTS)
Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. FY 1979 and Prior Accomplishments: Development of ESTS began under the SRAM program element reacting to requirements for integrated automatic test equipment (ATE). The program was interrupted by B-1 and SRAM B production cancellation decisions and a concomitant loss of funding. In 1978, the Electronic System Test Set (ESTS) development continued with remaining SRAM B funds. A total of $1,999 thousand was reprogrammed into this project in FY 1978. Hardware and system software development along with the fabrication of the first seven ESTS developmental sets will take place.

In 1979, the weapon system peculiar test package sets, which are an intergal part of the ESTS, began development by the competing missile subcontractors. This effort consisted primarily of software and adapters. In addition the first production configured ESTS entered fabrication. These five sets will be used for qualification testing, software validation/verification, and compatibility. Total system capability for the B-52G/H, SRAM, offensive avionics system (OAS), and cruise missiles checkout continued to be funded by this project.

2. FY 1980 Program: Development of hardware and SRAM/cruise missile/carrier aircraft checkout and support equipment continues. Any modifications required by the uniqueness of the cruise missile selected for production will be incorporated into a final ESTS configuration. Funding shortfalls in FY 1979, not made up in FY 1979 Supplemental Budget, had to be moved into FY 1980. This resulted in a program slip of approximately six months for the full capability. Development efforts were prioritized to concentrate on ALCM, the missile interface unit (MIU), and SRAM in that order.

3. FY 1981 Planned Program: Development required for production deliveries in FY 1981 will be completed to meet the scheduled initial alert capability date of September 1981 and an initial operational capability (IOC) of December 1982. The FY 1981 program was expanded to include items not completed in FY 1980. The efforts will include development of the remaining ALCM test package sets (TPS), then working with SRAM TPS and MIU requirements. Any delays resulting from slippage of an Air Launched Cruise Missile (ALCM) production decision scheduled for the third quarter of FY 1980 will also have to be made up in this year.

4. FY 1982 Planned Program: This is the last year of the ESTS project. Development is scheduled to be completed. Modifications and/or additions to this test set may be required when future generations of cruise missiles are introduced into the Air Force inventory.

5. Program to Completion: TBD.

6. Milestones:

	Date
A. Critical Design Review (CDR)	Oct 77
B. First Set Fabricated	Oct 77

Project: #2570
Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: Electronic System Test Set (ESTS)
Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

C.	System Software CDR	May 78
D.	Planned Production Start	Jan 80
E.	Initial Alert Capability	Sep 81
F.	Initial Operational Capability (IOC)	Dec 82

7. Resources: ($ in thousands)[1/]

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs[1/]
Total for Project #2570	21,500*	13,500	23,400	1,900		62,300

1/ Does not include SRAM or ALCM contributory efforts. *Includes amounts in the FY 1979 Supplemental Budget.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2570	Electronic System Test Set (ESTS)	1,999	32,000*	13,500	5,000		52,499

Funds were increased in the FY 1981 request to assure test equipment would meet schedule and testing scope requirements; to make up for funding not received in FY 1979 Supplemental Budget; to compensate for increases due to changes in Air Launched Cruise Missile configuration and subsystems; and adjust for increases in operational and support command requirements for test package sets (TPS).

Project: #2571 — Title: B-52 Aircraft Modernization Program
Program Element: #11113F — Title: B-52 Squadrons
DOD Mission Area: 113, Airborne Strike — Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The present B-52G/H aircraft systems were designed with technologies available in the early 1950s and are consequently experiencing decreasing effectiveness and increasing maintenance costs as they continue to age. The B-52 Aircraft Modernization Program focuses on two primary objectives. The first is the likely eventual transition of the B-52G/H force mission. This transition will require updates to keep the aircraft operationally effective. The second purpose is to ensure the force remains supportable through its predicted extended life into the next century. The shift of outyear mission requirements provided by Headquarters Strategic Air Command (HQ SAC) and future aircraft problem predictions provided by Headquarters Air Force Logistics Command (HQ AFLC) have been incorporated into the definition and scope of this program. The project will coordinate planning, definition, integration, and eventual flight testing of the overall aircraft modernization.

The B-52 Aircraft Modernization Program (AMP) (formerly Avionics Update - Phase Two) does

The B-52 Aircraft Modernization Program (AMP) represents a systems approach to follow-on B-52 modernization. AMP is aimed at the eventual transition of the B-52 force
mission. A complete aircraft and mission requirement evaluation was done in FY 1980 and a full scale engineering and development (FSED) contract is scheduled for the second quarter of FY 1981. Thus far the following items are considered minimum requirements for this program: radar power supplies, integrated pilot/copilot heading displays, autopilot update, update of electrical power system, and an improved environmental control system. Crew task loading studies would be initiated to determine the feasibility of a reduced crew configuration. This project will incorporate any related life extension/modernization projects identified in the Life Extension Study carried out in FY 1978.

Defensive avionics systems under development in other program elements will be phased with these actions to provide a total, integrated approach in B-52G/H modernization efforts.

RELATED ACTIVITIES: The program will receive benefits from the completed Low Life Cycle Cost Avionics (PE 63705F), the Electronically Agile Radar (EAR) (PE 63241F), the Standard Precision Navigator (SPN/GEANS) (PE 64201F), and other similar Research and Development (R&D) efforts in Air Force Systems Command (AFSC), and contractor internal research and development (IR&D) efforts. The program will meet the total offensive avionics update requirement as stated in

Project: #2571 Title: B-52 Aircraft Modernization Program
Program Element: #11113F Title: B-52 Squadrons
DOD Mission Area: 113, Airborne Strike Budget Activity: Strategic Programs, #3

Strategic Air Command (SAC) Required Operational Capability (ROC) 6-75. All missile development programs will be integrated with other offensive and defensive avionics update projects.

WORK PERFORMED BY: The avionics study which initially identified avionics subsystems for incorporation into this program was accomplished by Boeing Military Airplane Company (BMAC). The B-52 Offensive Avionics System (OAS) development program has been assigned to BMAC on a sole source basis. Initial design and definition tasks under the Aircraft Modernization Program (AMP) has also been given to BMAC. There are 80 potential subcontractors on the B-52 AMP. The list of subcontractors will not be firm until after source selection which is scheduled for FY 1980.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Low Life Cycle Cost Avionics (LLCCA) Study was completed in FY 1976 and FY 1977. FY 1978 work concentrated on the OAS program.

In 1979, the package began with trade studies, system definition, and initial system design. Efforts identified in the Life Extension Study which require development or prototyping were initiated under the AMP tasking if they related to the major headings of offensive avionics, offensive and defensive avionics integration, crew reduction, or reliability, maintainability, and supportability problems.

2. FY 1980 Program: BMAC was put on contract early in FY 1980 to evaluate operational requirements, logistical support problems, alternative B-52 missions, and to recommend alternative modification options depending on selected B-52 outyear missions. Each option will also include recommended subcontractor requirements. The options will be presented to Air Force and OSD agencies for review. The selected option will then be put into competitive source selection with BMAC and Air Force Systems Command making tentative subcontractor selections. After selections are approved, the program will begin full scale engineering and development (FSED) in early FY 1981. Crew task loading studies would be initiated to determine the feasibility of a reduced crew configuration. Programs identified in the FY 1978 Life Extension Study would also be included. The scope of this project meets Strategic Air Command (SAC) requirements for the B-52 force.

3. FY 1981 Planned Program: An FSED contract is planned for the second quarter of FY 1981. The remainder of the year will be used to issue procurement requests for RDT&E items in preparation for system integration and software development. Basic software development and interface with the OAS software package will begin in the Systems Integration Laboratory and Test Facility (SILTF). Crew configuration will be evaluated to determine if crew composition/location should be changed.

4. FY 1982 Planned Program: During the year, updated subsystems will be received for checkout and integration in the SILTF. These subsystems and the associated software will be packaged for flight test aircraft modification during the later part of this year.

Project: #2571
Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: B-52 Aircraft Modernization Program
Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

5. Program to Completion: Current planning shows that by FY 1983 or 1984 a completely integrated, updated modification package could be ready for a production decision.

6. Milestones:

		Date
A.	Definition/Trade Studies	FY 1979-1980
B.	FSED Contract	Jan 81
C.	Prototyping Initiation	FY 1982
D.	Production Decision - Total Package	FY 1983-1984
E.	First Aircraft - In/Out	FY 1985

7. Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimated	FY 1981 Estimated	FY 1982 Estimated	Additional to Completion	Total Estimated Costs
Total for Project #2571	2,200	2,400	6,200	10,100	62,700	83,600

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2571	B-52 Avionics Update - Phase Two		11,500	7,400	8,900	Cont	N/A

Funding for this project has been significantly reduced in concert with the decision not to continue to protect an option for maintaining the B-52G/H capability to

Project: #2601
Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: Strategic Radar/EAR
Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Electronically Agile Radar (EAR) is a nuclear hardened multimode radar with the capability to simultaneously perform air-to-air, air-to-ground terrain following and avoidance and precise doppler velocity measurement functions. Installation, integration, and flight testing on a B-52 was completed in FY 1980.

The EAR has been judged as too sophisticated and expensive for the less stressful penetration and/or standoff cruise missile carriage missions now envisioned for the B-52 force.

However, a radar update/replacement is still required to support B-52G/H outyear missions. This project represents a restructuring of the entire B-52G/H radar update effort. It will now concentrate on meeting new mission requirements of the Strategic Air Command and the Air Force Logistics Command.

RELATED ACTIVITIES: The technology for this advanced radar system is based on several efforts: The Forward Looking Advanced Multimode Radar (FLAMR) effort under PE 63203F; the Multi-Mode Radar (MMR) performed by the Navy and the Reliable Advanced Solid State Radar (RASSR) of the Advanced Avionics Project 63203F; the advanced development Electronically Agile Radar effort PE 63241F; and the Low Life Cycle Cost Avionics (LLCCA) program PE 63705F.

WORK PERFORMED BY: The Aeronautical System Division, Wright-Patterson Air Force Base, an organization of Air Force Systems Command, will manage the project. Westinghouse Electric Corporation, Baltimore, MD, was the research and development contractor for the EAR radar. The integration flight test will be accomplished at Wichita, KS, by the Boeing Military Airplane Company (BMAC). It is assumed that at least four radar contractors will be competing for this project.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Low life cycle studies under PE 63705F confirmed the cost-effectiveness of an EAR like radar to fulfill the requirements of SAC penetrating bomber mission requirements. EAR 63241 tests were begun to verify the EAR design.

In 1979, the EAR/B-52 flight tests continued. Built-in Test (BIT)/fault isolation tests were accomplished. The weapon system interface trade study was begun to establish cost, schedule and risk of full scale development for an EAR/B-52 modification program.

2. FY 1980 Program: In FY 1980, Project 2601 completed the flight tests of the EAR on a B-52 and flight test aircraft demodification was initiated. The remaining funds were used to carry out an analysis to define radar alternatives that better match the revised mission objectives of the B-52.

3. FY 1981 Planned Program: During FY 1981, identification, procurement, initial fabrication and laboratory testing of the selected radar system will begin. Software development and test for all radar modes will also be initiated.

Project: #2601 — Title: Strategic Radar
Program Element: #11113F — Title: B-52 Squadrons
DOD Mission Area: 113, Airborne Strike — Budget Activity: Strategic Programs, #3

Because aircraft avionics systems revolve around the radar system, a concentrated effort will be made this year to move out on this project.

4. FY 1982 Planned Program: The initial hardware parts will be received during this year in order to begin system fabrication, System Integration Laboratory and Test Facility (SILTF) integration, and the build-up of the software package. Test aircraft modification could begin near the end of this year.

5. Program to Completion: Project 2601 will complete the engineering development, flight test, evaluation and qualification of an improved radar for the B-52 weapon system.

6. Milestones:

		Date
A.	SAC ROC 6-75 Approved	Dec 76 (EAR)
B.	Initiation of Engineering	Oct 79 (EAR)
C.	Completion of Advanced Development (PE 63241/ PE 11113F)	Jan 80 (EAR)
D.	Delivery of RDT&E Model	Oct 81
E.	Start Flight Testing	Jan 83
F.	Complete Flight Testing	Mar 84

7. Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Total for Project #2601		1,500	17,900	21,200	23,000	63,600

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2601	Electronically Agile Radar (EAR)			3,000	17,900	44,200	65,100

Project 2601 funding has been reduced to reflect a change in the radar system requirement.

Project: #2632 — Title: OAS/CMI WST Modification
Program Element: #11113F — Title: B-52 Squadrons
DOD Mission Area: 113, Airborne Strike — Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Offensive Avionics System (OAS)/Cruise Missile Integration (CMI) Weapon System Trainer (WST) modification project upgrades and modifies the WST baseline configuration to include the OAS and Air Launched Cruise Missile (ALCM) capabilities. Each modification to an aircraft which changes the crew compartment configuration brings with it the obligation to update and to fund modification to the respective aircraft aircrew trainers. This project fulfills that obligation. The program consists of software and controls and displays.

RELATED ACTIVITIES: The WST development and acquisition programs for the B-52G/H aircraft.

WORK PERFORMED BY: The Aeronautical System Division, Wright-Patterson Air Force Base, Ohio, an organization of Air Force Systems Command, will manage the project. Development and modification will be incorporated with the ongoing WST prgram.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable.

2. FY 1980 Program: Hardware modification of the offensive station of the WST was begun. Software modifications based on data from the OAS and ALCM were also initiated. Acquisition of controls and indicators was begun. Efforts are also underway to incorporate the OAS and ALCM data into the WST baseline before WST production is begun.

3. FY 1981 Planned Program: Development of the alterations necessary to incorporate the features of the OAS and ALCM into the WST continues.

4. FY 1982 Planned Program: The necessary development to provide OAS and ALCM capabilities to WST will be completed.

5. Program to Completion: Not applicable.

6. Milestones: None.

7. Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Total for Project #2632		5,699	7,157	700		13,756

Project: #2632
Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: OAS/CMI WST Modification
Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2632	OAS/CMI WST Modification			3,900	2,100	700	6,700

The project has increased over previous budget estimates due to the fact the WST program schedule has undergone some slippage. In addition previous budget estimates were based on the program manager's estimates whereas the values above are based on final contract bids.

Project: #2692 Title: Autopilot
Program Element: #11113F Title: B-52 Squadrons
DOD Mission Area: 113, Airborne Strike Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The basic B-52 autopilot technology dates back to World War II. In the early 1960's, its functions were expanded to include the Low Level (LL) and Aerial Refueling (AR) modes. The Mean Time Between Failure (MTBF) for the existing system is about 15 hours. The age of the autopilot has made it extremely difficult and costly to maintain. The autopilot has been plagued with unscheduled pitch up/down on LL and AR modes, roll wallow, erratic aerial refueling operation, and yaw oscillations. Of particular concern are the extremely narrow safety margins in the LL and AR modes. The project will provide autopilot updates which will improve reliability, maintainability, and safety to an acceptable level by providing new line replaceable units (LRU) combining the functions of several existing units that are high failure items and containing a model pitch channel with appropriate comparators. Also a redundant pitch force transducer and a second altitude source will be included.

The B-52D has an additional requirement to incorporate an Attitude Heading Reference System (AHRS) to replace the current N-1 compass system. The AHRS will provide a heading and second attitude input to the autopilot. The AHRS is a part of the B-52 Offensive Avionics System (OAS) project on the B-52G/H.

Due to commonality of B-52 systems, results of this project can be applied not only to the B-52D but also to the B-52G/H. The B-52D problem is more severe and it is therefore scheduled for modification in FY 1982.

RELATED ACTIVITIES: Outputs from this project will be used to support a B-52D Class IV modification. These outputs can also be incorporated in the B-52 Aircraft Modernization Program (Project 2571) to provide for the eventual upgrade of all B-52G/H autopilots.

WORK PERFORMED BY: The B-52 System Manager at Oklahoma City Air Logistics Center (OCALC), a subdivision of the Air Force Logistics Command (AFLC), will manage this development project.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable.

2. FY 1980 Program: Not applicable.

3. FY 1981 Planned Program: Begin design, fabrication, integration, and prototyping of an autopilot system which has force wide application and which can be integrated with AHRS and aircraft data bus systems.

4. FY 1982 Planned Program: The project will terminate this year. The B-52D version will begin thorough flight testing to ensure the system is flight worthy and all safety of flight evaluations are completed. Data for the B-52G/ will be transferred to other related projects.

Project: #2692
Program Element: #11113F
DOD Mission Area: 113, Airborne Strike

Title: Autopilot
Title: B-52 Squadrons
Budget Activity: Strategic Programs, #3

5. Program to Completion: Not applicable.

6. Milestones:

		Date
A.	Definition/Trade Studies/Contractor Selection	FY 1981
B.	Flight Testing	FY 1982
C.	B-52D Modification Start	FY 1982

7. Resources ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Total for Project #2692			12,500	13,800		26,300

8. Comparison with FY 1980 Budget Data: Not applicable, this is a new project.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #11118F
DoD Mission Area: Airborne Strike, #113

Title: SRAM/Longer Life Motor Development/SAMIT
Budget Activity: Strategic Program #3

Resources (Project Listing): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7,816	8,200	0	0	0	48,800

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Short Range Attack Missile (SRAM) Longer Life Motor Development Program is the full scale engineering development (FSED) of a replacement rocket motor for the SRAM-A missile. The motor is designed to have a longer shelf life than the original SRAM-A motor and will be used to retrofit the SRAM (AGM-69A) fleet as age-out occurs and replaces operational assets used in the SRAM motor surveillance program. The goal of the program is to develop and qualify a replacement for the current rocket propellant with less age-sensitive propellant. The new rocket motor will have the same size, thrust, hot and cold temperatures and performance characteristics as the original SRAM-A motor. The SRAM-A missile equipped with a new longer life rocket motor will continue to be employed by Strategic Air Command as a primary strike/defense suppression weapon against soft to medium hard targets by the penetrating bomber force. FB-111 and B-52G/H aircraft use the SRAM-A as standard armament in a mix with nuclear gravity weapons to provide increased flexibility of targeting and to present a spectrum of threats significantly different from ballistic re-entry vehicle attacks. The requirement for the FB-111 SRAM Airborne Mission Trainer (SAMIT) is driven by a recent adverse trend in FB-111A/SRAM Follow-On Test and Evaluation (FOT&E) results, the primary cause of which is sub-optimum aircrew - SRAM weapon system management/programming procedures. This deficiency is traceable to inadequate inflight SRAM training due to restrictions imposed by live SRAM carriage as well as the reduced FB-111A flying hour program. FB-111A/SAMIT will improve aircrew proficiency by providing for more and better SRAM inflight training.

BASIS FOR FY 1981 RDT&E REQUEST: Not Applicable.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #11118F
DoD Mission Area: Airborne Strike, #113

Title: SRAM/Longer Life Motor Development/SAMIT
Budget Activity: Strategic Program #3

DETAILED BACKGROUND AND DESCRIPTION: The AGM-69A Short Range Attack Missile (SRAM A) is a supersonic, inertially guided air-to-surface missile with a two pulse solid propellant rocket motor, flight control section, and a nuclear warhead. The missile is launched from outside the point defensive environment, is capable of penetrating sophisticated defenses, and is effective against soft to medium hard targets. SRAM A is currently carried by the B-52 and FB-111A aircraft. The existing AGM-69A motor has a design life specification of five years and an estimated minimum service life of approximately nine years based upon recently completed motor surveillance testing. A new SRAM rocket motor possessing a more chemically stable propellant and consequently a longer service life (ten years) is being developed to replace SRAM A motors when age-out occurs. SAMIT will allow SRAM training without any of the restrictions imposed by actual missile carriage.

RELATED ACTIVITIES: The SRAM longer life motor technology is similar to rocket propellant technology under development for Army Patriot and Air Force Maverick and Sidewinder missile systems.

WORK PERFORMED BY: The Strategic Systems Program Office at the Aeronautical Systems Division, Wright-Patterson AFB, OH, is the responsible organiztion for the SRAM motor development and SAMIT. Industry contractors are: Missile Prime Contractor - Boeing Aerospace Company, Seattle, WA; Rocket Motor - Thiokol Chemical Corporation, Brigham City, UT.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The longer life motor full scale engineering development contract was awarded in June 1976. Component development, including propellant characterization was completed by end FY 1977. A propellant liner interface compatibility problem was discovered in September 1977 forcing a halt to motor development pending resolution of the problem. A solution was achieved in June 1978 and fabrication of development motors was re-initiated. The overall impact of the propellant-liner compatibility problem was to delay completion of the longer life motor development effort from April 1979 to January 1981 (21 months) and increase total program cost by $10 million. Build-up, dissection and test of the 22 development motors used to refine specifications was completed. The motor critical design review was conducted and fabrication of the 39 qualification motors was initiated. Development began on the FB-111A/SRAM Airborne Mission Trainer.

2. FY 1980 Planned Program: Buildup and test of the 39 qualification motors will be completed as well as the Physical and Functional Configuration audits. Development will continue on SAMIT.

Program Element: #11118F
DoD Mission Area: Airborne Strike, #113

Title: SRAM/Longer Life Motor Development/SAMIT
Budget Activity: Stategic Progams #3

3. FY 1981 Planned Program: Not Applicable.

4. FY 1982 Planned Program: Not Applicable.

5. Program to Completion: Not Applicable.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 80 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	12,200	5,900	8,200	1,800	0	46,700

FY 1980 budget request included RDT&E funding of $1.8 million in FY 1981. This requirement will now be accomplished in FY 1980 and taken care of by internal reprogramming actions using FY 1980 funds.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #11142F
DOD Mission Area: Airborne Strike, #113

Title: KC-135 Squadrons
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,600	15,000	23,600	27,300		
2214	Improved Aerial Refueling Systems	500	1,000	1,200	TBD	Continuing	N/A
2469	KC-135 Re-engining	7,100	10,000	15,000	22,000	15,000	69,200
2391	Avionics Modernization	1,000	2,500	2,600	2,900	Continuing	N/A
2425	KC-135 Winglets		1,000	4,800	2,400	TBD	TBD
2584	Electro Magnetic Pulse Study (EMP)		500				

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The main objective of this program element is to assess recent improvements in aircraft systems and equipment in order to apply selected improvements to the aerial refueling tanker force, where it makes sense to do so. Increasing demand for aerial refueling support necessitates that present and future tanker aircraft possess up-to-date systems in order to increase their capabilities in support of a rapidly growing and diverse range of air refueling requirements.

BASIS FOR FY 1981 RDT&E REQUEST: The KC-135 Improved Aerial Refueling System project supports full scale engineering development of selected improvements to the KC-135A aerial refueling system. The KC-135 Re-engining project finances government support and test center costs for the first article KC-135A re-engined configuration. The KC-135 Avionics Modernization project supports completion of feasibility study of a cost effective two man flight deck tanker operation and planning for integration of selected system into the KC-135A. The KC-135A Winglets project supports full scale engineering design and fabrication of a KC-135 Winglet configuration designed to optimize fuel savings. The EMP studies project is principally directed toward EC-135 aircraft and will identify the aircraft avionics subsystems which are sensitive to the effect of electromagnetic pulse (EMP) and identify proposed solutions to counter the effects of EMP. Results will be applied to the KC-135 fleet where appropriate.

OTHER APPROPRIATION FUNDS:	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
KC-135 Re-Engining					
Procurement (3010)	5,000	44,500	1,500	None	51,000
Installation(3400)			3,000		3,000

Program Element: #11142F Title: KC-135 Squadrons

DOD Mission Area: Airborne Strike, #113 Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The KC-135 design is based on 1950s technology. The first aircraft was delivered to the Air Force in 1957. The KC-135 is equipped with low power-obsolete turbojet engines characterized by adverse environmental noise, high fuel consumption, deterioration due to age, and increasing maintenance costs. These characteristics restrict operations, limit operational use to less than optimal performance, and place an increasing burden on O&S funds.

The proposed re-engined configuration incorporates new engines, nacelles and pylons plus modifies the horizontal stabilizer and landing gear of the KC-135 aircraft. The resulting performance improvements will allow the KC-135 to take off in shorter distances with maximum fuel loads, and nearly eliminates the adverse environmental noise impact of the KC-135. Fuel consumption will be reduced by 25% resulting in potential savings of over 100,000,000 gallons annually. Operational payoffs will include the ability to increase fuel offload available by approximately 150%, depending on the range flown. Other projects under this element are designed to improve performance of antiquated systems such as the air refueling boom and avionics. In addition, winglets offer a low cost, low risk means for further reducing fuel consumption.

The winning engine configuration - the CFM-56 (1-B-1) - was selected after a comprehensive two-year technical and cost evaluation by the Air Force. It will provide significantly increased fuel offload capability and reduction in fuel consumption, as well as superior emission and noise performance. It meets all USAF emission goals. This engine, derived from the B-1 aircraft engine, thus contains long range reliability and maintainability design features.

RELATED ACTIVITIES: The selected CFM-56 engine is currently being prototyped on commercial aircraft: the Boeing 707/DC-8. This activity will benefit the KC-135 re-engining effort. Potential spinoffs from these commercial programs include the development of nacelles and pylons and engine performance verification.

WORK PERFORMED BY: The KC-135 re-engining program is managed by the Aeronautical Systems Division of the Air Force Systems Command, located at Wright-Patterson AFB OH. The Prime Contractor is the Boeing Company, Wichita, KS. The engine manufacturer is the CFM Company, a partnership between General Electric of the United States and Snecma of France. The CFM-56 engine will be assembled at the CFM plant near Cincinnati, Ohio.

Program Element: #11142F
DOD Mission Area: Airborne Strike, #113

Title: KC-135 Squadrons
Budget Activity: Strategic Programs, #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Improved Aerial Refueling System (IARS) trade study was initiated to determine KC-135 systems improvement requirements. On re-engining, source selection on the engine candidates was begun. Definitive production prices and developmental data were evaluated in preparation for a selection decision in FY 80. The test aircraft began modification to a feasibility demonstration configuration in the Avionics Modernization project. The Winglets joint NASA/USAF effort was begun to develop and test the technology base winglets program. Fuel savings of 4 - 6% were demonstrated.

2. FY 1980 Program: Analysis of IARS trade study results leading to initial full scale engineering development (FSED) of selected improvements to the KC-135 aerial refueling system will be accomplished. KC-135 Re-engining source selection decision has been completed in January 1980. Preliminary design has begun and fabrication materials for the certification vehicle will be purchased. Under the Avionics Modernization project cost effective KC-135 cockpit designed to eliminate the navigator will be established. Simulation hardware will be procured and installed. Cockpit designs will be tested. Operational hardware will be procured, integrated and tested. Detail design for fabrication and installation of winglet sets on KC-135A will begin. The Electromagnetic Pulse Study (EMP) to identify the sensitive avionics subsystems affected by EMP was undertaken.

3. FY 1981 Planned Program: IARS will continue the full scale engineering development and testing of selected improvements. Re-engining will encompass the fabrication and initial installation of new engines on the KC-135 first production article. The Avionics Modernization project will integrate design criteria and system performance specifications. Final reports will be prepared. Full scale engineering planning will begin. Winglets detail design and kit fabrication will be completed.

4. FY 1982 Planned Program: Improved Aerial Refueling systems full scale engineering development and flight testing of selected improvements will be completed. Re-engining installation and integration will continue to completion in the fourth quarter of FY 82. Avionics Modernization will include completion of full scale engineering development of selected cost-effective system configurations. Winglets installation will be completed and ground and flight testing of the prototype KC-135 configuration will be accomplished.

5. Program to Completion: Improved Aerial Refueling Systems (IARS) production of improved systems will begin. Fund requirements are yet to be determined (TBD). Re-engine certification testing will be completed. Necessary flight test and residual Research & Development (R&D) will be accomplished. Avionics modernization production of improved systems will begin. (Funds TBD) The winglets project will begin production of optimized units for the KC-135A. (Funds TBD)

Program Element: #11142F
DOD Mission Area: Airborne Strike, #113

Title: KC-135 Squadrons
Budget Activity: Strategic Programs, #3

6. MILESTONES: Not Applicable

7. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1978 Actual	FY1979 Estimate	FY80 Estimate	FY81 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,800	10,500	11,000	28,400	Continuing	Not Applicable
2214	Improved Aerial Refueling Systems	900	500	1,000	1,200	Continuing	Not Applicable
2469	KC-135 Re-engining	2,500	9,000	6,000	20,000	3,000	41,600
2391	Avionics Modernization	400	1,000	2,500	2,600	Continuing	Not Applicable
2425	KC-135 Winglets			1,000	4,600	2,000	7,600
2584	EMP Study			500			500

8. Comparison with FY 1980 Budget Data: The only changes in this FY 1981 summary are in the FY 1980 and FY 1981 estimates for KC-135 re-engining. In FY 1980, per Congressional action, $4.0M was added to accelerate the program toward production. In FY 1981 $5.0M is reduced from the Research and Development account to be placed into procurement to accomodate production of the first re-engined aircraft. Total approved re-engine program costs for the first re-engined aircraft now reflects non-recurring costs for a follow-on production program. In addition, Project 2425 is increased by $0.2 million to cover DOD escalation impact.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #11212F
Title: Titan Squadrons
DOD Mission Area: Land Based Strike, #111
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	800	1,300	900	300		923,100
Command, Control, Communications Integration	800	1,300	900	300		3,300

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides improvements to the Titan II Intercontinental Ballistic Missile (ICBM) force to enhance its contribution to strategic deterrence. These improvements are the integration of new Command, Control, and Communications (C^3) equipment into Titan II Launch Control Centers (LCCs).

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds to continue design and testing of the accommodation hardware which is needed to install and integrate the new C^3 equipment. The new C^3 system will provide the ICBM force with improved command and control compatible with all Single Integrated Operational Plan (SIOP) forces.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Procurement (3020)		4,100	9,700	10,100	2,300	875,300

Program Element: #11212F
DOD Mission Area: Land Based Strike, #111

Title: Titan Squadrons
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Titan II Intercontinental Ballistic Missile (ICBM) achieved full operational capability (54 missiles) in December 1963. Flight testing was terminated in May 1969. The Universal Space Guidance Set Class IV modification deployment was started in April 1978 and was completed in December 1979.

The objective of the on-going program is to develop improvements for the Titan II which will maintain this force as a strong and viable deterrent. The current improvement is the integrated installation of three new Command, Control, and Communications (C^3) systems into Titan II Launch Control Centers: Air Force Satellite Communications System (AFSATCOM), 616A (Survivable Low Frequency Communication System), and Strategic Air Command Digital Network (SACDIN). AFSATCOM and 616A will be independently installed first, followed by full integration with SACDIN on a schedule compatible with SACDIN deliveries.

RELATED ACTIVITIES: 616A is being procured under PE 33131F. PE 33601F provides for development and procurement of AFSATCOM hardware, except for the hardened Ultra High Frequency antenna. SACDIN is being developed and procured under PE 11316F. The communications equipment will be delivered as Government Furnished Equipment to the C^3 Integration Program. These C^3 systems will also be installed in the Minuteman Missile Weapon System with development funds in Minuteman Squadrons, PE 11213F. Duplication is avoided by assigning C^3 Integration for all ICBM Launch Control Centers to the Ballistic Missile Office.

WORK PERFORMED BY: The responsible Air Force agency is the Air Force Systems Command's Ballistic Missile Office (BMO), Norton Air Force Base, CA. The principal contractor is the Martin-Marietta Company, Denver, CO.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishemtns: The C^3 Integration Program was initiated in October 1978.
2. FY 1980 Program: Design of the AFSATCOM and 616A accommodation hardware will be completed.
3. FY 1981 Planned Program: Testing will be completed for AFSATCOM and 616A accommodation hardware, and designs for SACDIN integration will be initiated. AFSATCOM and 616A assembly and checkout will begin.
4. FY 1982 Planned Program: Design and testing of the SACDIN accommodations will be completed. The major part of the AFSATCOM and 616A installation will be completed.
5. Program to Completion: Installation and integration of the three C^3 systems will be completed in FY 1985.
6. Milestones: Not Applicable.
7. Resources: Not Applicable.
8. Comparison with FY 1980 Budget Data: Not applicable, no change.

FY 1981 PDT&E DESCRIPTIVE SUMMARY

Program Element: #11213F
DOD Mission Area: Land Based Strike, #111

Title: Minuteman Squadrons
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	50,300	35,300	48,300	40,000	26,400	3,968,900
MK 12*	22,000					145,400
Guidance Improvement	2,500					150,500
Command, Control, Communications Integration	5,600	14,100	19,900	17,300	4,300	61,200
Airborne Launch Control System Phase III	5,000	10,000	21,300	18,900	1,700	56,900
Radar Signal Processor	2,100	4,100				6,200
Program Support	13,100	7,100	7,100	3,800	20,400	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The program provides improvements and modifications to the Minuteman Intercontinental Ballistic Missile force to enhance its contribution to strategic deterrence. Improvements and modifications include integration of new Command, Control, and Communications (C^3) equipment into Minuteman launch control centers and enhancement of the Airborne Launch Control System (ALCS) capability.

Program Element: #11213F
DOD Mission Area: Land Based Strike, #111

Title: Minuteman Squadrons
Budget Activity: Strategic Programs, #3

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds to continue design and testing of the accommodation hardware which is needed to install and integrate the new Command, Control, and Communications (C^3) equipment and to complete Airborne Launch Control System (ALCS) Phase III equipment design and initiate ground testing. The new C^3 systems will provide the Intercontinental Ballistic Missile (ICBM) force with improved command and control compatible with all Single Integrated Operational Plan (SIOP) forces. ALCS Phase III will provide missile sortie status reporting and remote retargeting capability to ALCS aircraft.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Procurement (3020)	68,700	105,200	130,900	89,000	44,900	8,819,800*

Department of Energy costs

*Includes initial spares

Program Element: #11213F
DOD Mission Area: Land Based Strike, #111

Title: Minuteman Squadrons
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Minuteman weapon system was initially conceived in the late 1950s and was developed to provide a rapid reaction Intercontinental Ballistic Missile (ICBM) that would be storable for long periods of time in underground Launch Facilities (LFs) to provide survivability. Deployment was subsequently authorized, and Minuteman has become a prime nuclear deterrent force of the United States for over 15 years. Minuteman II and III are three-stage solid propellant ballistic missiles which are guided to their targets by all-inertial guidance and control systems. The missiles are deployed in hardened and dispersed underground silos which are unattended, but constantly monitored by an electronic system manned by two officers located in underground Launch Control Facilities. There is one Launch Control Facility for each ten missiles. The missiles can also be launched by the Airborne Launch Control System (ALCS) aircraft at least one of which is airborne at all times. The Minuteman III uses the same rocket motors for the first and second stages as Minuteman II, but a higher performance third stage and a post-boost vehicle consisting of a post-boost propulsion system, the missile guidance set, and the MK 12 Reentry System. With the improved third stage and the post-boost propulsion system, the Minuteman III missile can deliver multiple independently targetable reentry vehicles (MIRVs) and their penetration aids to multiple targets. The present force structure of 450 Minuteman II and 550 Minuteman III missiles was achieved in July 1975. The survivability of the Minuteman force was enhanced by the Upgrade Silo Program which provides improved blast and shock, radiation, and electromagnetic pulse protection to Minuteman LFs. Modification of all LFs will have been completed in January 1980.

The objective of the on-going program is to improve the Minuteman Weapon System to ensure it remains a strong and viable deterrent. The program includes development of improvements enhancing command and control and force effectiveness. The silo-based Minuteman system is highly survivable today due to the hardness improvements of the Upgrade Silo Program and will remain survivable against projected threat into the 1980s. The current program includes three basic development tasks: MK 12A; Command, Control, and Communications (C^3) Integration; and ALCS Phase III. Programmatic support for these development tasks (e.g., Systems Engineering/Technical Direction support, collateral testing and analyses, travel, etc.) are provided at the program level. This summary addresses the overall program and includes total funding for the development tasks and program support. The direct development tasks are described in two separate descriptive summaries: C^3 Integration and ALCS Phase III. Development of the MK 12A was completed in FY 1979 and deployment is on-going in FY 1980.

RELATED ACTIVITIES: Advanced Ballistic Reentry Systems (ABRES), PE 63311F, is a Department of Defense program. ABRES develops reentry system technology having potential application to Minuteman. The new strategic missile program, M-X, PE 64312, is developing system and guidance technology for future ICBM systems. The Minuteman program supports guidance technology as an outgrowth of the Missile Performance Measurement System (MPMS). Duplication is avoided by assigning all of these programs and Minuteman development activities to a single organizational entity, the Ballistic Missile Office. Relative to the C^3 Integration Program, the three communications systems are each being developed and procured by their respective program elements and the equipment will be delivered to the C^3 Integration Program as Government Furnished Equipment (as described in the project section) for integration into the Minuteman System. These communications systems will also be installed in the Titan II Missile Weapon System, with Development

funds in Titan Squadrons, PE 11212F. Duplication is avoided by assigning Command, Control, and Communications (C^3) Integration for all ICBM Launch Control Centers to the Ballistic Missile Office.

WORK PERFORMED BY: The responsible Air Force agency is the Air Force Systems Command's Ballistic Missile Office, Norton Air Force Base, CA. The principal contractors and their responsibilities are: TRW Systems, San Bernardino, CA - system engineering and technical direction; the Boeing Company, Seattle WA - assembly and checkout, missile interstages, and system testing; Rockwell International, Autonetics Division, Anaheim, CA - guidance and control; Thiokol Corporation, Wasatch Division, Brigham City, UT - Minuteman III Stage I and III motors; Aerojet Solid Propulsion Company, Sacramento, CA - Minuteman III Stage II motors; General Electric Company, Philadelphia PA - MK 12 and 12A Reentry Systems: GTE Sylvania, Incorporated - Needham Heights, MA - ground electronics; and Bell Aerospace Corporation, Buffalo, NY - Propulsion System Rocket Engine.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Minuteman II R&D flight program was concluded in February 1968. Ninety percent of the 51 launches were successful. Five hundred (500) Minuteman IIs were deployed with Minuteman Is, making a total 1,000-missile force. The first R&D flight of Minuteman III was conducted in August 1968. Through July 1971, a total of 25 Minuteman III flights were conducted, of which 19 were successful. Initial Operational Capability (IOC) for Minuteman III was achieved in June 1970. Continued deployment of Minuteman III resulted in a force mix of 450 Minuteman II and 550 Minuteman III missiles by the end of July 1975. Nineteen Minuteman III Special Test Missiles and 15 Production Verification Missiles have been successfully launched subsequent to the IOC. Design and development of modifications to protect Minuteman III missiles from the effects of nuclear dust and debris were completed and incorporated into the operational force. Development of silo improvements for increased blast, shock, and electromagnetic pulse hardness was completed. Design, development, and test of Minuteman III Command Data Buffer remote retargeting capability for Wings III, V, VI, and Squadron 20 were completed. A formal demonstration of Command Data Buffer system operation was successfully conducted in November 1972, and deployment was completed. Development of the Missile Performance Measurement System (MPMS) was completed in FY 1977. The MPMS is an airborne instrumentation system which provides improved performance data on the Missile Guidance System. The MK 12A and Guidance Improvement Programs were started in FY 1975. Through FY 1979, there have been ten MK 12A flight tests and nine Guidance Improvement test flights. Development of the MK 12A is complete and deployment is beginning. Deployment of the new software developed in the Guidance Improvement Program was completed in September 1978. The Force Modernization Program to improve silo hardness was initiated at Wing IV (Whiteman AFB, MO) in May 1978 and was completed at Wing I (Malmstrom AFB, MT) in February 1979. The Airborne Launch Control System (ALCS) Phase III; Command, Control, and Communications (C^3) Integration; and Radar Signal Processor (RSP) programs were initiated in October 1978.

Program Element: #11213F
DOD Mission Area: Land Based Strike, #111

Title: Minuteman Squadrons
Budget Activity: Strategic Programs, #3

2. FY 1980 Planned Program: Deployment of the MK 12A is beginning. Force Modernization will be completed at Wing IV (Whiteman AFB, MO) in January 1980, completing this program. Airborne Launch Control System (ALCS) Phase III design will continue. Within Command, Control and Communications (C^3) Integration, design of the accommodation hardware will be completed for integration of the Air Force Satellite Communications (AFSATCOM) system and Survivable Low Frequency Communication System (616A). Testing and data analysis for the Radar Signal Processor (RSP) program will be completed and the decision to proceed with processor procurement and operational deployment will be made.

3. FY 1981 Planned Program: Deployment of the MK 12A will continue. Integration tests of the ALCS Phase III modification will be performed. C^3 Integration testing for the 616A and AFSATCOM accommodations will be completed and assembly and checkout will begin; designs for the Strategic Air Command Digital Network (SACDIN) integration will be initiated.

4. FY 1982 Planned Program: Deployment of the MK 12A will continue. Testing of ALCS Phase III will be completed and procurement for the aircraft modifications will begin. The major part of the AFSATCOM and 516A installation will be completed and design and testing of the SACDIN accommodations will be completed.

5. Program to Completion: Deployment of the MK 12A will be completed in FY 1983. ALCS Phase III installation will be completed in FY 1984. Installation and integration of the three C^3 Systems will be completed in FY 1985.

6. Milestones:

		Date
A.	Completed Deployment of 550 Minuteman IIIs	Jul 1975
B.	Completed Deployment of Improved Guidance	Sep 1978
C.	Completed Development of MK 12A	Jul 1979
D.	Complete Deployment of Upgrade Silo	Jan 1980
E.	MK 12A Initial Operational Capability	
F.	MK 12A Full Operational Capability	1983

7. Resources: Not applicable.

Program Element: #11213F
Dod Missile Area: Land Based Strike, #111

Title: Minuteman Squadrons
Budget Activity: Strategic Programs, #3

8. Comparison with FY 1980 Budget Data:

TITLE	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	56,462	53,300	30,300	27,000	21,200	3,920,600
MK12A	19,635	22,000				145,400
Guidance Improvement	20,915	2,500				150,500
Command, Control, Communciations Integration		5,600	14,100	19,900	21,200	60,800
Airborne Launch Control System Phase III		5,000	5,000	CONT	CONT	TBD
Radar Signal Processor		2,100	4,100			6,200
Program Support	15,912	16,100	7,100	7,100		Not Applicable

The RDT&E funding line for Airborne Launch Control System Phase III has been added from FY 1981 through program completion (this information was not available for the FY 1980 submission) and adjusted to reflect the $5.0 million added by the Appropriations Bill for FY 1980 RDT&E. Funding for Program Support has been added from FY 1982 through completion to more accurately reflect this continuing effort (based on the programs currently approved within this Program Element, Program Support is expected to be required through FY 1985). Minor adjustments to the FY 1982 and out-year estimates have been made due to new escalation rates.

Project: # N/A
Program Element: #11213F
DOD Mission Area: Land Based Strike, #111

Title: Command, Control, and Communications Integration
Title: Minuteman Squadrons
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND DESCRIPTION: Three Command, Control and Communications (C^3) systems will be incorporated into the Minuteman Launch Control Centers. These are the 616A Survivable Low Frequency Communication System, the Air Force Satellite Communication (AFSATCOM) system and the Strategic Air Command Digital Network (SACDIN). The 616A will improve survivable low frequency communications for receipt of emergency action messages. AFSATCOM will provide a two-way ultra-high frequency (UHF) communication capability for Launch Control Centers to receive and transmit via satellite to higher authority. SACDIN will provide replacement equipment for the existing 465L system which uses dedicated land lines for high speed encrypted two-way traffic. In addition, the SACDIN User Terminal Element will serve as the functional integrating unit for processing all record traffic including receiving emergency action messages and providing a common output for the missile crew operator. The C^3 Integration program will integrate and install these systems into the Launch Control Centers. The C^3 Integration program will insure proper installation of these systems and will reduce cooling air/power requirements in the Launch Control Center, eliminate duplicate emergency action message processing, and ensure C^3 system operability during time urgent situations. The program started in FY 1979 with initial design work on the 616A system and AFSATCOM. The Minimum Essential Emergency Communications Network (MEECN) Message Processing System (MMPS) was previously envisioned as a separate system which could reduce transmission time over low frequencies. It has now been determined that this function can best be incorporated into the other systems, so MMPS is no longer part of this program.

RELATED ACTIVITIES: 616A is being procured under PE 33131F. PE 33601F provides for development and procurement of AFSATCOM hardware, except for the hardened UHF antenna. SACDIN is being developed and procured under PE 11316F. Integration and installation into the Titan II missile system is funded in PE 11212F. Duplication is avoided by assigning the integration and installation of these systems into all ICBM Launch Control Centers to the Ballistic Missile Office.

WORK PERFORMED BY: The responsible Air Force agency is the Air Force System Command's Ballistic Missile Office, Norton Air Force Base, CA. The principal contractors and their responsibilities are: TRW Systems, San Bernardino, CA - system engineering and technical direction; the Boeing Company, Seattle, WA - C^3 systems installation and integration; and GTE Sylvania, Incorporated, Needham Heights, MA - C^3 installation and integration.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The C^3 Integration Program was initiated in October 1978.

2. FY 1980 Program: Design of the AFSATCOM System and 616A accommodation hardware will be completed.

3. FY 1981 Planned Program: Testing will be completed for AFSATCOM and 616A accommodation hardware, and designs

Project # N/A

Program Element: #11213F

DOD Mission Area: Land Based Strike, #111

Title: Command, Control and Communications Integration

Title: Minuteman Squadrons

Budget Activity: Strategic Programs, #3

for Strategic Air Command Digital Network (SACDIN) integration will be initiated. AFSATCOM and 616A assembly and checkout will begin.

4. FY 1982 Planned Program: Design and testing of the SACDIN accommodations will be completed. The major part of the AFSATCOM and 616A installation will be completed.

5. Program to Completion: Installation and integration of the three Command, Control, and Communications (C^3) systems into Minuteman Launch Control Centers will be completed in FY 1985.

6. Milestones:

	Date
A. Development Start	Oct 78
B. Complete C^3 Integration Development	1983
C. Complete C^3 Installation	*(1984) 1985

*Date presented in FY 1980 Descriptive Summaries

EXPLANATION OF MILESTONE CHANGES:

The completion date for this program was refined after more accurate delivery schedules for the three new communications systems were determined.

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDT&E Funds	5,600	14,100	19,900	17,300	4,300	61,200
Missile Procurement Funds		13,800	41,300	54,900	44,900	154,900

Project # N/A
Program Element: #11313F
DSB Mission Area: Land Based Strike, #111

Title: Command, Control and Communications Integration
Title: Minuteman Squadrons
Budget Activity: Strategic Programs, #3

9. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
RDT&E Funds		5,600	14,100	19,900	21,200	60,800

Minor adjustments have been made to the FY 1982 and 1983 estimates due to new escalation rates.

Project: # N/A
Program Element: #11213F
DOD Mission Area: Land Based Strike, #111

Title: Airborne Launch Control System (ALCS) Phase III
Title: Minuteman Squadrons
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Airborne Launch Control System (ALCS) Phase III started in FY 1979. It will provide to a portion of the ALCS aircraft the capabilities to receive sortie status via a data link directly from the Minuteman silos and remotely retarget missiles in a similar manner to the Command Data Buffer capability available in the missile Launch Control Centers. This capability will provide a highly survivable launch platform for status and retargeting. This will improve force effectiveness by allowing retargeting of remaining missiles to highest priority targets. This program was scheduled to start in FY 1978, but due to cost growth was redefined for a less costly approach and scheduled for a new start in FY 1979. The new, more austere program will provide these new capabilities to 9 EC-135 aircraft for interoperability with 200 Minuteman III missiles.

RELATED ACTIVITIES: Modifications to EC 135 aircraft to accept ALCS Phase III hardware are being accomplished in PE 11142.

WORK PERFORMED BY: The responsible Air Force agency is the Air Force Systems Command's Ballistic Missile Office, Norton AFB, CA. The principal contractors and their responsibilities are: TRW Systems, San Bernardino, CA - system engineering and technical direction; The Boeing Company, Seattle, WA - ALCS upgrade development and integration.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: ALCS Phase III development was initiated in October 1978. Preliminary system requirements analyses culminated in a system design review in June 1979.

2. FY 1980 Program: Equipment design and ground software definition will continue. Modifications for EC-135 aircraft will be defined.

3. FY 1981 Planned Program: Integration testing will be performed.

4. FY 1982 Planned Program: Final performance testing will be conducted with the first modified aircraft.

5. Program to Completion: The first modified aircraft will be on line in early 1983 and deployment will be completed in FY 1984.

6. Milestones:

		Date
A.	Development Start	Oct 1978
B.	First Aircraft Modified	1983
C.	Deployment Complete	1984

Project: # N/A
Program Element: #11213F
DOD Mission Area: Land Based Strike, #111

Title: Airborne Launch Control System (ALCS) Phase III
Title: Minuteman Squadrons
Budget Activity: Strategic Programs, #3

7. Resources:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDT&E Funds	5,000	10,000	21,300	18,900	1,700	56,900
Missile Procurement: Funds		3,600	1,900			5,500

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
RDT&E Funds		5,000	5,000	CONT	CONT	TBD

The RDT&E funding line for ALCS Phase III has been added from FY 1981 through program completion (this information was not available for the FY 1980 submission) and adjusted to reflect the $5.0 million added by the Appropriations Bill for FY 1980 RDT&E.

Budget Activity: Strategic Programs, #3
Program Element: #11213F, Minuteman Squadrons

Test and Evaluation Data

1. Development Test and Evaluation: The major Minuteman III production decision preceded establishment of the current DOD Test and Evaluation policy. However, missile design validation and adequacy of missile modifications were demonstrated by flight testing prior to deployment. The Minuteman III flight test development program consisted of three parts: the R&D program which began in August 1968 and was completed in July 1970, the follow-on or Special Test Missile (STM) Program which began in September 1970 and was completed in August 1979, and the Production Verification Missile Program which began in May 1972 and is continuing. The R&D program consisted of 25 launches for the development and design verification of the missile. Two of the 25 missiles were launched by Strategic Air Command (SAC) crews, the remainder by contractor personnel. The program was in two phases, with the second phase demonstrating the operational configuration.

	No. of Launches	Successes	% of Success
Phase I	15	11	73
Phase II	10	8	80
Total	25	19	76

The STM Program consisted of 21 missiles and had two purposes. The first was to demonstrate the system performance at extremes of range and reentry angles beyond those essential to operational requirements. The second purpose was to test system modification. The last STM flight test was conducted in August 1979. The Production Verification Missile (PVM) Program consists of 19 missiles. This program verifies modifications and improvements incorporated into operational hardware, investigates problems revealed in operational use, and validates continued production hardware performance. There have been 17 launches to date. Two more PVMs are approved for launch after October 1979.

The dust hardness improvement effort has been completed. The dust modifications were flight tested on STMs and were accepted for service use in October 1972.

Testing of the Wing V Upgrade Silo/Command Data Buffer system was successfully completed at a formal demonstration of system operations conducted in November 1972. Procedure development and performance verification were completed in February 1973. Crew training and procedure development were completed in June 1973. All testing and verification were accomplished using operational design and prototype production hardware typical of that deployed at Wing V and Wing III. Testing for Wing VI and Squadron 20 began in June 1973 and was completed in March 1976. Testing for Wing IV Upgrade Silo began in FY 1976 and was completed in August 1978.

The first demonstration launch from a facility modified with Upgrade Silo/Command Data Buffer was accomplished in June 1973. Initial Operational Capability for Upgrade Silo and Command Data Buffer was achieved in June 1973. All maintainability and reliability requirements for Command Data Buffer have been met or exceeded in operational use.

Silo modifications for Electromagnetic Pulse (EMP) protection are verified by testing the modified silos with large EMP simulators. Testing of all Launcher Equipment Room modifications for all wings was completed in November 1975.

2. Operational Test and Evaluation: The Operational Test and Evaluation flight testing for Minuteman III is conducted by the Strategic Air Command (SAC) at the Western Test Range and consists of two phases. The first phase, Demonstration and Shakedown Operations (DASO), had four objectives: (a) test the total weapon system (hardware, software, personnel, technical data) under operationally realistic conditions to assess mission capability; (b) ensure weapon system stability by identifying remaining deficiencies from R&D and acting to resolve them; (c) refine operating and maintenance procedures; and (d) verify that the weapon system is logistically supportable. The DASO program has been completed. There were six launches in the program, all objectives were met, and no problems remain. The weapon system was approved for service use on 19 June 1970.

The second phase, Operational Test, is a continuing program that provides SAC with weapon system reliability, accuracy, and penetration aids performance under representative operational conditions throughout the life of the system. This data is used in turn to derive planning factors for the Single Integrated Operational Plan. The missiles are randomly selected from the operational alert force to statistically represent the force configuration, removed from the Launch Facilities by SAC operational maintenance crews, and launched by SAC operational missile combat crews. Participating personnel are from the unit supplying the missile, and the technical data is the same as that used to maintain the missile on strategic alert. All subsystems are tested. There have been 70 Operational Test launches as of September 1979. Reliability and maintainability requirements have been exceeded by the deployed force.

Type	No. Launches	Launch Successes	% Success
Demonstration and Shakedown Operations (DASO)	6	6	100
Operational Test (OT)	70	64	91

Several Operational Test and Evaluation (OT&E) efforts not involving flight tests are planned in conjunction with Minuteman programs during FY 1980-84. Initial Operational Test and Evaluation (IOT&E) of the Command Control Communications (C^3) integration elements is planned in phases. The IOT&E of the 616A modification to the Survivable Low Frequency Communications System were completed in FY 1978-79. Later phases will involve IOT&E of Air Force Satellite Communication System (AFSATCOM) and SAC Digital Information Network (SACDIN) integration and terminals. These IOT&E phases will be combined to the extent made by possible by AFSATCOM and SACDIN hardware availability. IOT&E of the Airborne Launch Control System Phase III is planned for FY 1981-82. IOT&E of the Radar Signal Processor integration with Minuteman launch site security systems will be conducted during FY 1981. A Qualification Operational Test and Evaluation (QOT&E) of the Minuteman Extended Survivable Power (MESP-lithium batteries) project will be completed in conjunction with Air Force Systems Command-conducted production acceptance testing during FY 1980.

These Operational Test and Evaluations are being managed and conducted by Strategic Air Command personnel possessing extensive operational experience. The test teams will also include representatives from the Air Force Logistics Command and Air Training Command. The Air Force Test and Evaluation Center will monitor these OT&Es and provide assistance as required. Air Force Test and Evaluation Center will approve the operational test and evaluation test plans and review and comment on the OT&E final reports.

3. System Characteristics:*

	Current Estimate	Demonstrated Performance
Countdown and Flight Reliability		
In-Commission Rate		
Accuracy		
Range		
Payload (variable for mission)	Two or three MK12 Reentry Vehicles, up to Chaff Clouds	
Warhead Yield, MK12		
Warhead Yield, MK12A	MK12A IOC in	

* Additional listings of Goals or Thresholds are not applicable for the Minuteman III as it is a mature weapon system, and the basic design goal for the MK 12A reentry vehicle was the yield which has been certified by the Department of Energy.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #11312F
Title: Post Attack Command and Control System (E-4)
DoD Mission Area: Strategic Command and Control #131
Budget Activity: Strategic Programs #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	26,000	24,500	8,100	7,200	Continuing	N/A
2211	Block I	26,000	24,500	7,100	3,200		365,000
2212	Future Blocks			1,000	4,000	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The overall objective of the E-4 Program is to develop and acquire the E-4B system to support the National Emergency Airborne Command Post and the Strategic Air Command Airborne Command Post missions. The E-4 provides significant improvements in capability, survivability, and reliability for the command and control of strategic forces in the pre, trans, and post attack phases of a general war. The E-4 provides advanced command, control and communications equipment, nuclear hardening, larger floor space and battle-staff and improved aircraft performance.

BASIS FOR FY 1981 RDT&E REQUEST: Includes funds for Contractor Support Services for the first E4B, test-bed aircraft, and the completion of the demodification engineering for the E-4A to E-4B retrofit. Initiates the necessary studies and analysis to provide the basis for the logical, structured growth of the E-4B necessary to maintain compatibility with other existing and evolving elements of the Worldwide Military Command and Control System.

OTHER APPROPRIATION FUNDS:

	FY 1979 & Prior	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
Aircraft Procurement	106,900	121,100	144,663	156,600	751,629 1/	1,280,892 1/
(Quantity-New)					(2)	(2)
(Quantity-Retrofit)		(1)	(1)	(1)		(3)
O&M (Modification Installation)			7,000	7,000	7,000	21,000
Military Construction	19,700					19,700

1/ Includes funding for production of E-4B five and six, initial spares, and other aircraft modifications.

Program Element: #11312F
Title: Post Attack Command and Control System (E-4)
DoD Mission Area: Strategic Command and Control #131
Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: Strategic deterrent credibility depends in part on the existence of a reliable and survivable command and control system. The EC-135 airborne command posts formerly used by the National Command Authority (the President or his appropriate successor) and currently used by the Strategic Air Command are considered inadequate due to their limited communications capability, lack of nuclear hardening, insufficient floor space to house the requisite battle staff, and limited capacity for necessary enhancements. In December 1971, the Worldwide Military Command and Control System (WWMCCS) Council, chaired by the Deputy Secretary of Defense, approved the Advanced Airborne Command Post Program to replace selected EC-135 Airborne Command Posts with larger and more capable 747 aircraft. Initiation and guidance for Block I of the E-4 program was received in a Deputy Secretary of Defense memorandum dated 19 January 1973. The E-4 advanced command, control and communications system will provide greatly improved survivability and reliabily through nuclear hardening, mobility, and communications connectivity and will permit more rapid and selective responses to general war provocations.

The E-4 program is structured under a building block concept with defined capabilities, costs, and schedules associated with each major block. Block I included the development of the E-4B which was completed in December 1979 with the delivery of the first E-4B to the Air Force. Future blocks will encompass enhancements to the current E-4B baseline. These enhancements are necessary to maintain the E-4B as a viable command and control system taking advantage of stateofthe-art technology and maintaining compatibility with other existing and evolving elements of the WWMCCS.

RELATED ACTIVITIES: Strategic Air Command Communications, Program Element (PE) 11316F; Air Force Satellite Communication Program, PE 33601F; System Survivability, PE 64711F; Electromagnetic Radiation Test Facilities, PE 64747F; National Emergency Airborne Command Post (NEACP), PE 32015F; Air Force Support to Minimum Essential Emergency Communications Network, PE 33131F; the Defense Support Program, PE 12431F; Advanced Computer Technology, PE 63728F; and WWMCCS Automated Data Processing/E-4, PE 32010F.

WORK PERFORMED BY: The Air Force Systems Command, Electronic Systems Division, L. G. Hanscom AFB, MA., has responsibilities for the program. The Boeing Company, Seattle, WA., was the prime contractor for the development of the E-4B. The retrofit/production phase of the E-4 Program is currently in source selection with contract award anticipated March 1980. Two contractors, the Boeing Company, Seattle, WA., and Rockwell International, Los Angeles, CA., have submitted proposals for the retrofit/production phase.

Program Element: #11312F
DoD Mission Area: Strategic Command and Control #131

Title: Post Attack Command and Control System (E-4)
Budget Activity: Strategic Programs #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Studies in the early 1970s investigated numerous alternatives and performed equipment and functional tradeoffs to assist in defining the Advanced Airborne Command Post program. Congress authorized four aircraft and appropriated funds for three (two production aircraft and one test bed) aircraft in FY 1973 and one production aircraft in FY 1974. Subsequent to the FY 1973 Appropriations Bill, the Department of Defense performed an in-depth review of the E-4 program. Based on this review, the Deputy Secretary of Defense approved initiation of the Block I program in January 1973. Aircraft number 1 and 2 were ordered from Boeing in 3rd quarter FY 1973, and the contract for transfer of the EC-135 equipment was awarded to E-Systems, Incorporated in 4th quarter FY 1973. The Air Force accepted aircraft number 1 in 1st quarter FY 1974. This aircraft was delivered to the E-Systems facility in Greenville, TX, where it was modified and configured with existing EC-135 command, control and communications (C^3) equipment. The option with Boeing for aircraft number 3 was also exercised in 1st quarter FY 1974. The Air Force accepted aircraft 2 in 2nd quarter FY 1974. Number 2 aircraft was flown to Kirtland Air Force Base, NM where it underwent low level electromagnetic pulse (EMP) testing. After completion of the EMP testing it was delivered to E-Systems for modification and EC-135 equipment transfer. The contract award for aircraft number 4 was made in 2nd quarter FY 1974. C^3 development contract was awarded in 3rd quarter FY 1974 followed by initiation of the C^3 design and fabrication. E-Systems option for number 3 aircraft was also exercised in 3rd quarter FY 1974. Aircraft number 3 was accepted by the Air Force in 2nd quarter FY 1975, was delivered to E-Systems for modification and EC-135 C^3 equipment transfer. The Development Test and Evaluation (DT&E) and the Initial Operational Test and Evaluation (IOT&E) of aircraft number 1 was completed in 2nd quarter FY 1975. Aircraft number 2 entered the operational inventory in 4th quarter FY 1975, and aircraft number 3 in the 1st quarter FY 1976. In the 1st quarter FY 1976 the Air Force also accepted aircraft number 4, the E-4B test bed aircraft. This aircraft was modified with the 1200 Kilovolt-Ampere (KVA) electrical power system that had been certified by the Federal Aviation Administration in FY 19TQ. Critical Design Review for the advanced C^3 package was completed in the 1st quarter FY 1977. Development and System Integration Laboratory testing of the advanced C^3 package and modification of the E-4B test bed aircraft to incorporate the C^3 equipment continued during FY 1977. Integration of the developed C^3 equipment on the test bed aircraft was completed in FY 1978. DT&E of the E-4B, including both ground tests and flight tests, was completed by December 1978 and IOT&E was conducted during the 2nd quarter FY 1979. The E-4B then underwent electromagnetic pulse (EMP) testing at Kirtland AFB, NM, and was returned to the Boeing Company for aircraft refurbishment.

2. FY 1980 Program: Refurbishment of the E-4B test bed aircraft will be completed and flight tests will be conducted to verify system performance of new equipment and correction of deficiencies identified during DT&E and IOT&E. The first E-4B will be delivered to the Air Force to support the operational mission. The Defense System Acquisition Review Council (DSARC) Milestone III decision for the retrofit of the three E-4A aircraft and the production of two E-4B aircraft will be made during the 2nd quarter FY 1980. The contract for the retrofit of the first E-4A will be awarded and demodification engineering for the retrofit of the three E-4A aircraft to the E-4B configuration will be initiated.

Program Element: #11312F Title: Post Attack Command and Control System (E-4)
DoD Mission Area: Strategic Command and Control #131 Budget Activity: Strategic Programs #3

3. FY 1981 Planned Program: Completes the demodification engineering started in FY 1980 and effectively completes the development for Block I. Provides Contractor Support Services for the first E-4B and support the program office and MITRE for the completion of the development phase. Initiates the necessary studies and analysis to provide the basis for the logical, structured growth of the E-4B necessary to maintain compatibility with existing and evolving elements of the Worldwide Military Command and Control System (WWMCCS). A program to install an Automated Data Processing (ADP) capability is initiated within Program Element 32010F as the first major enhancement to the E-4B. Retrofit of the second E-4A is initiated.

4. FY 1982 Planned Program: Continues the Contractor Support Service for the first E-4B. Initiates the RDT&E for incorporation of enhancements (Block II) to on-board communications systems. Continues a level of effort engineering task to maintain interoperability with existing
and evolving elements of the WWMCCS. Initiates the retrofit of the third E-4A.

5. Program to Completion: Future block development efforts will continue. An additional two E-4B aircraft will be acquired resulting in a total force structure of six E-4Bs.

6. Milestones:

		Date
A.	Contract Award (aircraft #1 & 2 mods)	Feb 73
B.	Equipment Transfer Contract Award	May 73
C.	Contract Award (aircraft #3)	Jul 73
D.	Contract Award (aircraft #4 test bed)	Dec 73
E.	Interim National Emergency Airborne Command Post Final Operational Capability (3 aircraft)	Sep 75
F.	Special Defense Systems Acquisition Review Council (DSARC)	Oct 75
G.	Development Test and Evaluation Complete	Dec 78
H.	Initial Operational Test and Evaluation Complete	Feb 79
I.	DSARC III Production Decision E-4A Retrofit and #5 and #6	Feb 80
J.	Initial Operational Capability, E-4B	Jan 80
K.	Award of Competitive Contract for First Retrofit with Options in Future Years	Mar 80
L.	Initiate Retrofit of Second E-4A to E-4B	Oct 80
M.	Initiate Retrofit of Third E-4A to E-4B	Oct 81
N.	Initiate Production of E-4B #5	Oct 83
O.	Initiate Production of E-4B #6	Oct 84
P.	Full Operational Capability (six E-4Bs)	Mar 88
Q.	Future Block Program	Continuing

Program Element: #11312F Title: Post Attack Command and Control System (E-4)
DoD Mission Area: Strategic Command and Control #131 Budget Activity: Strategic Programs #3

7. Comparison with FY 1980 Budget Data:

FY 1980 Resource Listing ($ in thousands):

Project Number	TITLE	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
	RDT&E (3600): TOTAL FOR PROGRAM ELEMENT	61,026	32,000	25,500	8,900	Continuing	N/A
2211	Block I	61,026	32,000	24,500	3,900	0	365,400
2212	Future Blocks			1,000	5,000	Continuing	N/A
	Aircraft Procurement (3010):		10,000	128,700	139,400	154,200	529,200

The fiscal year 1979 decrease of $6.0 million in RDT&E resulted from over-estimating the 1979 requirement. The reduction of $1.0 million of RDT&E funds in fiscal year 1980 is due to Congressional action denying funds for any Future Block effort. The fiscal year 1981 RDT&E increase of $3.2 million for Block I is due to the delayed transfer of engineering responsibility from Air Force Systems Command to the Air Force Logistics Command. The fiscal year 1980 decrease in procurement funding results from delaying the buy of initial spares by one year. The procurement funding increase in total estimated cost is due to reinstatement of E-4B aircraft #5 and #6 in this year's budget.

Project: #2211 Title: E-4 Block I
Program Element: #11312F Title: Post Attack Command and Control System
DoD Mission Area: Strategic Command and Control #131 Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: Strategic deterrent credibility depends in part on the existence of a reliable and survivable command and control system. The EC-135 airborne command posts formerly used by the National Command Authority (NCA) (the President or his appropriate successor) and now used by the Strategic Air Command (SAC) are inadequate due to their limited communications capability, lack of nuclear hardening, insufficient floor space to house the requisite battle staff, and limited capacity for necessary enhancements. In December 1971, the Worldwide Military Command and Control System (WWMCCS) Council, chaired by the Deputy Secretary of Defense, approved the Advanced Airborne Command Post Program to replace selected EC-135 Airborne Command Posts with larger and more capable 747 aircraft. Initiation and guidance for Block I of the E-4 program was received in a Deputy Secretary of Defense memorandum dated 19 January 1973.

The overall objective of the program is to provide the NCA and SAC with a highly survivable command and control system that will operate reliably during all phases of a general war. The E4 will include an advanced command control and communicatons (C^3) package and improved capabilities such as a greatly increased floor-space, a larger battle staff, and significantly improved aircraft performance. The advanced C^3 package will provide greatly improved state-of-the-art communications which will permit more rapid and thorough analysis of a developing international crisis and will allow a more selective response to general war provocations.

RELATED ACTIVITIES: Strategic Air Command Communications Program Element 11316F; Air Force Satellite Communications Program, Program Element 33601F; System Survivability, Program Element 64711F; Electromagnetic Test Facilities, Program Element 64747F; National Emergency Airborne Command Post (NEACP), Program Element 32015F; Air Force Support to Minimum Essential Emergency Communications Network, Program Element 33132F; the Defense Support Program, Program Element 12431F; Advanced Computer Technology, Program Element 63728F; and WWMCCS Automated Data Processing/E4, Program Element 32010F.

WORK PERFORMED BY: The Air Force Systems Command, Electronics Systems Division, L.G. Hanscom AFB, MA; has responsibility for the program. The Boeing Company, Seattle, WA, was the prime contractor for the development of the E-4B. The retrofit/production phase of this program is currently in source selection with contract award anticipated in March 1980. Two contractors, the Boeing Company, Seattle, WA and Rockwell International, Los Angeles, CA have submitted proposals for this phase.

Project: #2211 Title: E-4 Block I
Program Element: #11312F Title: Post Attack Command and Control System
DoD Mission Area: Strategic Command and Control #131 Budget Activity: Strategic Programs #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: FY 1969, 1970, and 1971 studies investigated numerous alternatives and performed equipment and functional tradeoffs to assist in defining the Advanced Airborne Command Post program. Congress authorized four aircraft and appropriated funds for three (two production aircraft and one test bed) aircraft in FY 1973 and one production aircraft in FY 1974. Subsequent to the FY 1973 Appropriations Bill, the Department of Defense performed an in-depth reivew of the E-4 program. Based on this review, the Deputy Secretary of Defense approved initiation of the Block I program in January 1973. Aircraft number 1 and 2 were ordered from Boeing in 3rd quarter FY 1973, and the contract for transfer of the EC-135 equipment was awarded to E-Systems, Incorporated in 4th quarter FY 1973. The Air Force accepted aircraft number 1 in 1st quarter FY 1974. This aircraft was delivered to the E-Systems facility in Greenville, TX, where it was modified and configured with existing EC-135 command, control and communications (C^3) equipment. The option with Boeing for aircraft number 3 was also exercised in 1st quarter FY 1974. The Air Force accepted aircraft number 2 in 2nd quarter FY 1974. Number 2 aircraft was flown to Kirtland Air Force Base NM where it underwent low level electromagnetic pulse (EMP) testing. After completion of the EMP testing it was delivered to E-Systems for modification and EC-135 equipment transfer. The contract award for aircraft number 4 was made in 2nd quarter FY 1974. The Command, design and fabrication. E-Systems option for number 3 aircraft was also exercised in 3rd quarter FY 1974. Aircraft equipment transfer. The Development Test and Evaluation (DT&E) and the Initital Operational Test and Evaluation (IOT&E) of aircraft number 1 was completed in 2nd quarter FY 1975. Aircraft number 2 entered the operational inventory in 4th quarter FY 1975 and aircraft number 3 in the 1st quarter FY 1976. In the 1st quarter FY 1976 the Air Force also accepted aircraft number 4, the E-4B test bed power system that had been certified by the Federal Aviation Administration in FY 19TQ. Critical Design Review for the advanced C^3 package was completed in the 1st quarter FY 1977. Development and System Integration Laboratory testing of the advanced C^3 package and modification of the E-4B test bed aircraft to incorporate the C^3 equipment continued during FY 1977. Integration of the developed C^3 equipment on the test bed aircraft was completed in FY 1978. DT&E of the E-4B, including both ground tests and flight tests, was completed by December 1978 and IOT&E was conducted during the 2nd quarter FY 1979. The E-4B then underwent electromagnetic pulse (EMP) testing at Kirtland AFB, NM, and was returned to the Boeing Company for aircraft refurbishment.

2. FY 1980 Program: Refurbishment of the E-4B test bed aircraft will be completed and flight tests will be conducted to verify system performance of new equipment and correction of deficiencies identified during DT&E and IOT&E. The first E-4B will be delivered to the Air Force to support the operational mission. The Defense System Acquisition Review Council (DSARC) Milestone III decision for the retrofit of the three E-4A aircraft and the production of two E-4B aircraft will be made during the 2nd quarter FY 1980. The contract for the retrofit of the first E-4A will be awarded and demodification engineering for the retrofit of the three E-4A aircraft to the E-4B configuration will be initiated.

Project #2211 — Title: E-4 Block I
Program Element: #11312F — Title: Post Attack Command and Control System
DoD Mission Area: Strategic Command and Control #131 — Budget Activity: Strategic Programs #3

3. FY 1981 Planned Program: Completes the demodification engineering started in FY 1980 and effectively completes the development for Block I. Provides Contractor Support Service for the first E-4B and supports the program office at MITRE Corporation for the completion of the development phase. Initiates the retrofit of the second E-4A.

4. FY 1982 Planned Program: Continues the Contractor Support Service for the first E-4B. Initiates the retrofit of the third E-4A.

5. Program to Completion: An additional two E-4B aircraft will be acquired resulting in a total force structure of six E-4Bs.

6. Milestones:

		DATE
A.	Contract Award (aircraft #1 and 2 mods)	Feb 73
B.	Equipment Transfer Contract Award	May 73
C.	Contract Award (aircraft #3)	Jul 73
D.	Contract Award (aircraft #4 test bed)	Dec 73
E.	Interim National Emergency Airborne Command Post Final Operational Capability (3 aircraft)	Sep 75
F.	Special Defense Systems Acquisition Review Council (DSARC)	Oct 75
G.	Development Test and Evaluation Complete	Dec 78
H.	Initial Operational Test and Evaluation Complete	Feb 79
I.	DSARC III Production Decision E-4A Retrofit and # 5 and #6	Feb 80
J.	Initial Operational Capability, E-4B	Jan 80
K.	Award of Competitive Contract for First Retrofit with Options in Future Years	Mar 80
L.	Initiate Retrofit of Second E-4A to E-4B	Oct 80
M.	Initiate Retrofit of Third E-4A to E-4B	Oct 81
N.	Initiate Production of E-4B #5	Oct 83
O.	Initiate Production of E-4B #6	Oct 84
P.	Full Operational Capability (six E-4Bs)	Mar 88

Project #2211 — Title: E-4 Block I
Program Element: #11312 — Title: Post Attack Command and Control System
DoD Mission Area: Strategic Command and Control #131 — Budget Activity: Strategic Programs #3

7. Resources: ($ in thousands)

	FY 1979 & Prior	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E (3600):	330,200	24,500	7,100	3,200	0	365,000
Aircraft Procurement (3010):	106,900	116,700	143,700	158,300	751,600	1,272,700

8. Comparison with FY 1980 Budget Data:

FY 1980 Resource Listing ($ in thousands)

	FY 1978	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Cost
RDT&E (3600):	61,026	32,000	24,500	3,900	0	365,433
Aircraft Procurement (3010):	-	10,000	128,700	139,400	154,200	529,200

The fiscal year 1979 decrease of $6.0 million in RDT&E resulted from overestimating the 1979 requirement. The fiscal year 1981 increase of $3.2 million in RDT&E is required to provide Contractor Support Services for the first E-4B and results from the delayed transfer of engineering responsibility from the Air Force Systems Command to the Air Force Logistics Command. The procurement funding decrease in fiscal year 1980 results from a one year delay in acquisition of spares. The procurement funding increase in total estimated cost is due to reinstatement of E4B aircraft #5 and #6 in this year's budget.

Budget Activity: Strategic Programs, #3

Program Element: #11312F, Post Attack Command and Control System (E-4) Test and Evaluation Data

1. Development Test and Evaluation

a. Phase 1A - Modification of the first airframe with the interim Command Control and Communications (C^3) was completed in September 1974 by E-Systems, Greenville, TX. Development Test and Evaluation (DT&E) and Initial Operational Test and Evaluation (IOT&E) were completed in December 1974. Federal Aviation Administration (FAA) recertification of the aircraft was accomplished. The installed C^3 mission equipment was removed from the EC-135 National Emergency Airborne Command Post (NEACP) aircraft. DT&E of this equipment included electromagnetic interference and TEMPEST investigation as well as total system evaluation. The 2nd and 3rd aircraft were delivered for operational use after two months of acceptance testing.

b. Phase 1B - The E-4B DT&E program concentrated primarily on the integration and installation of the advanced C^3 package and subsequent system level testing of the operational aircraft. Testing of the Boeing 747 airframe with structural modifications (including in-flight refueling, antenna mountings, new aircraft generators) was also accomplished to maintain FAA certification. In addition, low level electromagnetic pulse (EMP) tests were conducted on the E-4A type airframe to assist in evaluation of later testing of the EMP hardened E-4B system. DT&E of the advanced C^3 package was initiated in early 1977 with the pretesting of selected components and subsystems by the prime contractor, the Boeing Company, Seattle, WA. Initial aircraft testing, both ground and airborne, was accomplished during the latter part of 1977 by the major subcontractor, E-Systems of Greenville, TX, after installation of equipment racks, wiring, fixtures, environmental control system, and selected mission equipment. The testing at E-Systems verified the aircraft modifications and substantiated the performance of selected mission subsystems.

c. Systems Level Test - The testbed aircraft was delivered to the Boeing Plant in January 1978 for installation of the Super High Frequency (SHF) satellite communications terminal, antenna radome, and the Very Low Frequency/Low Frequency (VLF/LF) communications subsystem. System level ground tests began in February 1978 and airborne tests of the system began in June 1978. Special test instrumentation, which was used to verify specification performance, was removed from the aircraft in September 1978 prior to starting the final operational verification of the total airborne system. DT&E was concluded on 17 December 1978 after completing a total of forty test flights. While some problems were discovered during this extensive DT&E, the problems were resolved and subsequent testing has verified that the E-4B performs in accordance with system specifications.

d. Phase 1C - No significant DT&E will be required during this phase; however, acceptance testing of all aircraft will be accomplished after installation of the advanced C^3 configuration.

2. Operational Test and Evaluation: The operational test and evaluation of the E-4 is being conducted in phases as appropriate for the various phases of the E-4 program. The testing phases with the test objectives and the results (if completed) are as follows:

Budget Activity: Strategic Programs, #3

Program Element: #11312F, Post Attack Command and Control System (E-4)

a. An initial operational test and evaluation (IOT&E) of the E-4A was conducted by Headquarters Command and the Organization of the Joint Chiefs of Staff (OJCS) on the first Phase 1A interim aircraft (aircraft #1) at Andrews AFB, Maryland, in December 1974. The primary objective of that IOT&E was to determine if the E-4A could effectively perform the National Emergency Airborne Command Post (NEACP) mission and be operated and maintained using existing assigned personnel, interim base facilities, and contractor logistics support. Upon completion of IOT&E, it was concluded that the E-4A system could perform the basic NEACP mission while being operated and maintained as planned.

b. IOT&E of the Phase 1B test bed E-4B aircraft, conducted by the Air Force Test and Evaluation Center (AFTEC), began in combination with development test and evaluation (DT&E) ground tests at E-Systems from September to December 1977. It continued from January through December 1978 as part of the combined DT&E and IOT&E at The Boeing Company in Seallte, WA. A 47-day separate IOT&E beginning 27 December 1978 at Offutt AFB, NE, followed the combined DT&E/ IOT&E. The separate IOT&E testing included 13 flights (125.7 hours) in the operational environment with deployments to Andrews AFB, MD, (the NEACP forward operating base) for ground alert evaluation and to Howard AFB, Canal Zone, for hot weather self-sustained ground alert evaluation. During this test period, the E-4B particiapted in both a Joint Chiefs of Staff (JCS) POLO HAT exercise and a SAC GIANT STAFF exercise. These exercises closely simulated the operational environment, and allowed a side-by-side comparison with currently operational aircraft, the E-4A and EC-135. During the separate IOT&E the aircraft was operated and maintained by Air Force personnel from the Strategic Air Command, Office of the Joint Chiefs of Staff, and Air Force Communications Service. The separate IOT&E was completed on 11 February 1979 with a test flight that delivered the aircraft to Kirtland AFB, New Mexico, for start of the system-level electromagnetic pulse (EMP) DT&E testing at the Air Force Weapons Laboratory (AFWL).

(1) The IOT&E test team was composed of personnel from the Air Force Test and Evaluation Center, Air Force Logistics Command, Air Force Systems Command, Air Training Command, Air Force Communications Service, Strategic Air Command, Office of Joint Chiefs of Staff, Air Force Security Service, and the School of Aerospace Medicine.

(2) The operational mission requirements of both the Strategic Air Command and the Office of Joint Chiefs of Staff/National Emergency Airborne Command Post served as the basis for the evaluation. Major objectives were to estimate operational effectiveness and suitability, and to identify deficiencies.

(3) As a result of the IOT&E, it was concluded that the E-4B aircraft will provide an improved command, control, and communications capability for the airborne command post missions of the Joint Chiefs of Staff and the Strategic Air Command. The test bed aircraft, as configured during IOT&E, demonstrated satisfactory operational effectiveness, but was deficient in reliability, maintainability, and availability.

Budget Activity: Strategic Programs, #3

Program Element: #11312F, Post Attack Command and Control System (E-4)

c. Operational deficiencies were discovered in certain subsystems during the IOT&E phase; however extensive efforts have been taken to correct these deficiencies. Appropriate fixes are being incorporated for the majority of these problems during the aircraft refurbishment phase, and resolution of any remaining problems is anticipated prior to aircraft delivery. In addition, several new subsystems are being installed during this same refurbishment period to attain the production configuration. The E-4B is scheduled for post-refurbishment testing during November-December 1979 to verify correction of deficiencies and to check out the final configuration.

d. A Follow-on Operational Test and Evaluation (FOT&E) for the E-4B will be conducted by the Air Force Test and Evaluation Center, the Strategic Air Command, and the Office of Joint Chiefs of Staff following aircraft delivery to the Air Force. The purpose of the FOT&E is to refine initial operational suitibility estimates, to evaluate system operational effectiveness, and to verify correction of all operational deficiencies identified during IOT&E.

Budget Activity: Strategic Programs, #3

Program Element: #11312F, Post Attack Command and Control System (E-4)

3. System Characteristics: The significant E-4B performance objectives and demonstrated performance are shown below.

	Objective	Demonstrated Performance
Operational		
Unrefuled Time on Station (hrs)	12	12*
Maximum Payload (lbs) (E-4B)	150,000	
Maximum Personnel Complement	94	94*
Maximum Gross Taxi Weight (lbs) (E-4B)	803,000	803,000
Maximum Take-off Thrust (lbs)	201,400	201,400
Technical		
Electrical Power (KVA)	1200	1200*
UHF SATCOM		
a. Bandwidth (KHz)	5	5*
b. Bit Error Rate/Bits Per Second (BER/BPS)	10^{-3}/75	10^{-3}/75*
SHF SATCOM (BER/BPS)	10^{-3}/75 10^{-6}/1200 10^{-5}/2400 10^{-3}/9600	10^{-3}/75* 10^{-6}/1200* 10^{-5}/2400* 10^{-3}/9600*
Command Radio Power (WATTS)	30	30*
Automatic Switching System Connections (Lines)	111	111*
CPE AUTODIN (BER/BPS)	10^{-5}/2400	10^{-5}/2400*
VLF/LF		
Power Output (KW)	200	200*

*Meets or exceeds contractural guarantees

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #11316F
DoD Mission Area: Strategic Communications #133

Title: SAC Communications - SACDIN
Budget Activity: Strategic Programs #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
1136	SAC Digital Network	14,000	17,000	23,100	28,800	2,900	114,500

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Strategic Air Command (SAC) Digital Network (SACDIN) Program will upgrade and modernize SAC's record data command and control communications system. The specific objectives are to (1) provide two-way, direct, secure data communications with enhanced survivability from the National Command Authorities and the Commander-in-Chief SAC to dispersed SAC missile crew commanders and aircraft wing commanders; (2) provide the capacity and flexibility to interface with other planned systems; (3) provide growth potential to support future record data requirements; and (4) replace obsolete hardware of the existing command and control data transmission subsystem.

BASIS FOR FY 1981 RDT&E REQUEST: Individual items of equipment will be integrated, and testing will be performed on the assembled racks. A functional prototype system will be tested to determine if all developmental objectives have been met. After completion of a program status review, a contract will be awarded for continuation of the development in areas of diagnostic software and external interface hardware and software.

OTHER APPROPRIATION FUNDS:

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
Procurement (3080) (Quantity)					160,400* (193)	160,400* (193)
Military Construction (3300)				200	200	400

*Includes initial spares

Project: #1136 Title: SAC Digital Network - SACDIN
Program Element: #11316F Title: SAC Communications
DoD Mission Area: Strategic Communications, #133 Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: The Strategic Air Command (SAC) Digital Network (SACDIN) Program includes the design, acquisition, and implementation of a record data communications system for the Commander-in-Chief SAC. The system will significantly improve current communications capabilities from both operational and maintenance standpoints. SACDIN will functionally replace the SAC Automated Total Information Network (SATIN) I and the Data Transmission Subsystem of SAC's existing record data command control system of the SAC Automated Command and Control System (SACCS). It will interface with the SACCS Data Display Subsystem. The SACDIN system will be acquired through an integration contractor, who will have overall contractual responsibility for the system. Maximum use will be made of off-the-shelf equipment. Modifications to hardware and new hardware/software procurement will be made only where operational requirements dictate. Minimum changes to present equipment will be made to meet the presently defined and validated operational requirements.

RELATED ACTIVITIES: Program Elements 11212F and 11213F will accomplish SACDIN integration into the TITAN and Minuteman Weapons Systems. Automatic Digital Network (AUTODIN) II (Program Element 33126F, Defense Communications System Long-Haul Communications) provides major network trunking support for SACDIN.

WORK PERFORMED BY: Electronic Systems Division, Hanscom AFB, MA; Air Force Weapons Laboratory for electromagnetic pulse criteria, analysis, and testing; Rome Air Development Center for reliability testing and Automatic Voice Network and AUTODIN II acceptance criteria; Air Force Test and Evaluation Center for Initial Operational Test and Evaluation, and International Telephone and Telegraph (ITT) Defense Communications Division, Nutley, NJ as prime contractor. The Air Force Communications Command will develop application software.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A SATIN IV contract was awarded to ITT on 15 March 1977 to upgrade the SACCS system; however, the House/Senate Defense Appropriations Conference deleted the SATIN IV Program in its review of the FY 1978 budget in August 1977. Congress agreed that a valid need existed for an improved SAC Communications System and encouraged the Air Force to restudy its needs and to resubmit to Congress a less expensive system with greater use of standard equipment and non-dedicated circuits. An Air Force conducted redefinition of effort was accomplished, and $1.999 million FY 1977 RDT&E funds were reprogrammed to continue the detailed redefinition to obtain cost, schedule and technical information from the contractor. The program redefinition, which met the concerns of Congress and satisfied the defined and validated communications requirements of SAC, was completed in January 1978. The January 1978 Air Force Systems Acquisition Review Council approved the restructured program and recommended reprogramming $8.5M of FY 78 funds. Congressional approval was obtained in June 1978. In FY 78 and FY 79, the System Design Review

was conducted and the contractor began the prototype development effort, including development of the processor. This processor will meet stringent security and environmental requirements of the Strategic Air Command (SAC) and will be the heart of the SACDIN terminal at nearly 200 SAC missile and aircraft locations. Other prototype hardware, primarily off-the-shelf, was also ordered during FY 79. Concurrent with the hardware efforts, the contractor initiated a top-down software design effort. Initial efforts were aimed at developing a software mechanism to ensure system security.

2. FY 1980 Program: During FY 80 the first articles of all hardware items will become available as the individual units are tested and meet the specified performance requirements on a "black box" level. During this period, the concurrent top-down software efforts will continue. The security control mechanism will be completed along with other software components. These individual components will be tested incrementally, forming a growing portion of the total SACDIN software.

3. FY 1981 Planned Program: The individual "black boxes" will be integrated and testing will be performed on the assembled racks to verify that the equipment meets the electromagnetic compatibility/electromagnetic security requirements while still providing the required operational performance. The software effort for the functional prototype will be largely completed and the software will be used in system level integration testing with hardware to ensure that the functional prototype has, in fact, reduced or eliminated the technical risks identified with the development program. Following a scheduled Air Force Systems Acquisition Review Council (AFSARC) review of program status, a contract will be exercised for the continued development and testing of the system with options for completion of development and production in FY 82 and FY 83, respectively.

4. FY 1982 Planned Program: In FY 82, the prototype system development, including the software, will be completed, as well as contractor conducted Development, Test, and Evaluation (DT&E). Field DT&E/Initial Operational Test and Evaluation (IOT&E) will begin. Preparations will be made for an Air Force Systems Acquisition Review Council, scheduled for Jan-Mar 83.

5. Program to Completion: IOT&E will be completed in FY 83 in an operational environment, and the production option will be exercised following an AFSARC III review.

6. Milestones:

a.	Program Redefinition Complete/AFSARC Approval	Jan 78
b.	Congress Approved Reprogramming	Jun 78
c.	Contract Date	Jul 78

Project: #1136
Program Element: #11316F
DoD Mission Area: Strategic Communications, #133

Title: SAC Digital Network - SACDIN
Title: SAC Communications
Budget Activity: Strategic Programs #3

d.	Restart Work	Aug 78
e.	Start Test and Evaluation	Dec 80
f.	Program Review (Secretary of the Air Force)	Mar 81
g.	Program Review (Secretary of the Air Force)	Dec 81
h.	Air Force Systems Acquisition Review Council III	*(Dec 82) Jan-Mar 83
i.	Production Decision/Contract Option Award	Mar 83
j.	Full Operational Capability	Jan 85

*Date presented in FY80 Descriptive Summary. A total of 90 days is reserved for this decision point, from test completion to start of production.

7. Resources: N/A

8. Comparison with FY 80 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
1136	SAC Digital Network	8,500	14,000	18,000	18,800	30,400	109,900
	Procurement (3080)					136,900	136,900
	Military Construction (3300)				200	2,100	2,300

Budget figures have increased because of inflation factors, and an increase of $12.4M in funds programmed for spares. Funds for site preparation were removed from the 3300 appropriation and will be transferred to the 3400 appropriation. A Congressional reduction of $1.0M in FY 1980 RDT&E funds will require some funding adjustments in FY 1981 and beyond.

Budget Activity: #3 Strategic Programs

Program Element: 11316F, Strategic Air Command (SAC) Communications (SACDIN)

Test and Evaluation Data

1. Development Test and Evaluation:

During the development phase, SACDIN subsystems will be tested to assure they meet their respective specifications. The testing will include response time, accuracy, human factors, etc. After the individual subsystems are tested, the subsystems will be assembled into a prototype of the SACDIN network. This prototype will be tested to the system specification to insure the accuracy, response, hardness, and security requirements are met and that the subsystems properly function together. Simulation will be used to create a representative network environment in which the prototype will be exercised during system tests. The DT&E testing period will last from approximately 4QFY79 to 2QFY82. International Telephone & Telegraph (ITT) Defense Communications Division, Nutley N.J., is the Prime Contractor.

The prototype will consist of the same hardware as production units (e.g., keyboards, printer, processors, etc.). In addition, the prototype will contain hardened equipment for the Intercontinental Ballistic Missile (ICBM) Launch Control Centers (LCCs) that is also the same as the production equipment. Computer program and hardware interfaces for systems presently in development and for systems that cannot be re-created in-plant will initially be tested by simulation. An example of these interfaces is the Air Force Satellite Communications (AFSATCOM) Single Integrated Operational Plan (SIOP) Terminal. After in-plant testing, SACDIN equipment will be installed at Offutt AFB and Vandenberg AFB and DT&E will be conducted using the actual SACDIN external interfaces. Reliability and Maintainability testing will be conducted both in-plant and on-site. All DT&E will be completed prior to the production decision. Acceptance testing and checkout will be conducted during production and deployment.

2. Operational Test and Evaluation: Initial operational test and evaluation (IOT&E) will be conducted by the Air Force Test and Evaluation Center (AFTEC) during Phases I and IIb of the acquisition. Phase I testing is scheduled for February 1981 through October 1981, and Phase IIb testing is scheduled for October 1982 through December 1982. Secretary of the Air Force for Acquisition and Logistics (SAFAL) progress reviews will be conducted at the start of Phase II (March 1981) (Phase II overlaps Phase I) and the conclusion of Phase I (December 1981). An Air Force Systems Acquisition Review Council (AFSARC) III review will be held at the end of Phase IIb (January-March 1983) prior to aproval to proceed with full-scale production and implementation.

a. Phase I IOT&E.

(1) Testing will be conducted in the contractor's plant (IBM, Gaithersburg MD) using the SACDIN functional prototype. The functional prototype will consist of hardware and software which will be used in the operational system. The purpose of Phase I is to demonstrate that identified risks have been reduced to acceptable levels. Therefore, only that amount of hardware and software necessary to allow testing of risk-associated functions will be produced in Phase I, and the system will not have the full functional capability planned for the operational environment.

(2) To provide an early estimate of the operational effectiveness and suitability of the implementation of the risk-associated functions, and to identify operational deficiencies early enough in the program that design changes can be made with minimum impact on cost and schedule, the IOT&E objectives will address system performance, system control, interoperability, survivability, human interfaces, safety, compatibility, and operational security to the extent allowable by the prototype configuration. There will be a total of 60 days of separate IOT&E (between February 1981 and October 1981) during which the AFTEC IOT&E test team will perform selected tests. The test team will consist of people from the Strategic Air Command (SAC), Air Force Communications Command (AFCC), Air Force Communications Computer Programming Center (AFCCPC), Air Force Logistics Command (AFLC), Electronic Security Command (ESC), and National Security Agency (NSA). In addition to this separate testing, the IOT&E test team will participate in development tests (October 1980 - October 1981) by operating the equipment during the contractor's tests, and by observing the tests themselves. These tests will provide the data necessary for the operational evaluation.

(3) Reliability, availability, maintainability, and logistics supportability have not been identified as risks. Therefore, in Phase I, there are no formal reliability or maintainability tests; there are no technical orders; there are no automated test equipments; there are only limited diagnostic programs; and the contractor is maintaining the equipment. All of these areas will be addressed in Phase IIb testing and completely evaluated at that time. However, in Phase I, the IOT&E test team will collect as much information as is available in these areas to assess the probable results of the contractor's design effort in each of these areas.

b. Phase IIb IOT&E.

(1) Testing will be accomplished at SAC operational locations (Offutt AFB and Vandenberg AFB). The equipment in the field will be interconnected with the functional prototype at IBM and the computer program development facility at the AFCCPC to form a network.

(2) The purpose of the Phase IIb IOT&E is to complete all remaining tests to provide an evaluation of the operational effectiveness and suitability of the SACDIN system for the AFSARC III.

(3) The IOT&E objectives will be the same as those in Phase I, plus more thorough evaluation of the reliability, availability, maintainability, and logistics supportability objectives. There are 60 days of separate IOT&E (October 1982 - December 1982) during which the AFTEC IOT&E test team will use the test configuration to run exercises simulating SAC operational communications requirements. Test team members will also participate in contractor-conducted tests, such as performing the maintenance during the formal maintainability demonstrations.

Budget Activity: #3 Strategic Programs

Program Element: 11316F, Strategic Air Command (SAC) Communications (SACDIN)

3. Systems Characteristics

CHARACTERISTIC	OBJECTIVE	DEMONSTRATED
Response time:		
Time to transmit Emergency Action Message (EAM)/Low Precedence Traffic	EAM - 15 Sec.(99.9% confidence) Low Precedence - 60 Sec. (70% conf.)	
Accuracy:		
Undetected Character Errors	$1:10^8$	
Availability:		
MM Path (7 Hrs/Yr)	.999195	
TITAN Path (14.5 Hrs/Yr)	.998347	
Maintainability:		
MTTR (Organizational)	15 min.	
MTBMc		
Missile Base Com Proc. (MBCP/FA)	1125 Hours	
Hard. User Terminal Element (UTE/FA)	2250 Hours	
Security:		
To the Executing Commanders	Multilevel Secure	
Traffic:		
Peak Load at Offutt Switch	11 M Characters/Hour	
Flexibility:	Manual Reconfiguration	
Hardness:		
For Hard Installation	Same as Basic Weapon System Req.	
Growth:		
Hardware & Software	Modular Design	

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 12311F

Title: NORAD Combat Operations Center (COC)/Space Defense Operations Center (SPADOC)

DoD Mission Area: Strategic Information Systems, # 134

Budget Activity: Strategic Programs, # 3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7,499	5,000	16,000	22,500	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops the Space Defense Command and Control System (SPADCCS) consisting of a Space Defense Operations Center (SPADOC) and the necessary communications systems. The SPADCCS is required to satisfy Presidential and Secretary of Defense (SecDef) Directives to improve, in a balanced manner, the space defense capabilities of the United States. The Air Force is aggressively improving and developing space defense elements including: Space Surveillance Systems, Satellite Surviability Systems and Anti-satellite (ASAT) systems. For these elements to be operationally employed in an integrated and coordinated manner, an effective command and control system is essential. This program will develop the SPADCCS in a phased approach to support the evolving space defense elements. The major development products of this program are the Prototype Mission Operations (PMOC) to support ASAT testing and limited operations and SPADOC Phase IV, the fully integrated space defense operations center.

BASIS FOR FY 1981 RDT&E REQUEST : The FY 1981 request will continue development of the ASAT PMOC. The system development, including the building of the hardware/software, will continue. This effort is essential for the PMOC to be available to support initial ASAT testing beginning in FY and the ASAT Limited Operataional Capability beginning in FY

During FY 1981 the SPADOC Phase IV procurement will begin. The source selection will be completed and the development contract awarded in late FY 1981. SPADOC Phase IV development must begin at that time to achieve an ASAT Initial Operational Capability in as directed by the SecDef.

OTHER APPROPRIATION FUNDS: Not applicable

Program Element: # 12311F

Title: NORAD Combat Operations Center (COC)/Space Defense Operations Center (SPADOC)

DoD Mission Area: Strategic Informaton Systems, # 134

Budget Activity: Strategic Programs, # 3

DETAILED BACKGROUND AND DESCRIPTION: Currently,

During both peace and conflict, United States (U.S.) military operations will require assessment of the situation in space and its impact on terrestrial forces, and the ability of the National Command Authorities (NCA) to respond rapidly to changes in that situation. Responses to a changing situation might include: increasing the Defense Condition, notifying satellite users and operators of impending attack, manuevering satellites, launching an anti-satellite (ASAT) or replacement satellite.

The Air Force is aggressively developing integrated space defense capabilities including space system survivability, space surveillance and attack warning, and ASAT systems. These systems require a fully integrated command and control (C^2) system to assure their useability in peacetime and stressed environments.

A program was inititated in FY 1978 for the phased development of the Space Defense Operations Center (SPADOC). Phase I was initiated 1 Oct 79 using existing North American Air Defense Command Combat Operations Center resources. In the future, a number of incremental improvements (such as foreign launch assessment upgrade and defensive countermeasures C^2) will be incorporated in ongoing SPADOC operations as they are available. A Protoype Mission Operations Center (PMOC) is being developed to support the development and operational testing of the Miniature Air-Launched ASAT. The PMOC will also provide the C^2 for the ASAT operations during the period of ASAT Limited Operational Capability (LOC). At the Initial Operational Capabililty (IOC) of the ASAT, SPADOC (Phase IV) will perform all ASAT C^2 and force management. When fully operational (SPADOC Phase IV IOC is planned for FY SPADOC will plan, coordinate, advise the NCA , and disseminate decisions/directives. Some typical SPADOC responsibilites include: continuously monitoring U.S. satellite and ground system status; providing satellite attack warning; reporting hostilities in space as they occur; monitoring satellite interference, verification data outputs; maintaining status of U.S. surveillance assets and their availability for tasking; notifying users of potential critical satellite support loss; providing notification to satellite command and control ground stations during hostilities/ disaster; recommending execution of replacement launch; maintaining status of Soviet satellites; planning, coordinating and directing U.S. antisatellite operations and providing strike assessment.

RELATED ACTIVITIES: This program is part of a single managed Space Defense Systems Program involving four functional areas: space survivability, space surveillance, anti-satellite, and command and control. Those program elements that are directly related are the following: Program Element (P.E.) 63428F, Space Surveillance Technology, P.E. 12424F, SPACETRACK; P.E. 63438F, Satellite Systems Survivability; P.E. 64406F, Space Defense System. The consoldated Space Operations Center (P.E. 35150) will interface with SPADOC to provide the link between SPADOC and the satellite operators for survivability and warning information.

Program Element: # 12311F
DoD Mission Area: Strategic Information Systems, # 134

Title: NORAD Combat Operations Center (COC)/Space Defense Operations Center (SPADOC)

WORK PERFORMED BY: Air Force Systems Command's Space Division in Los Angeles, CA, is responsible for overall management of the Space Defense Command and Control System development. The Prototype Mission Operations Center (PMOC) is being developed by Boeing, Seattle, WA, under contract to the miniature anti-satellite (ASAT) contractor (Vought). Current Space Defense Operations Center (SPADOC) contractors are: Martin Marietta Corporation, Denver, CO and System Development Corporation, Santa Monica, CA. The primary support contractors are Science Applications Incorporated, La Jolla, CA, Aerospace Corporation, Los Angeles, CA. and MITRE Corporation, Boston, MA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Improvements to the North American Air Defense Command Cheyenne Mountain Complex were accomplished during this period. An initial SPADOC capability was established at the direction of the Department of Defense (C^3I), using existing resources. Detailed system architecture and conceptual design studies were initiated in FY 1978 for the Space Defense Command and Control System addressing the following areas: (1) status data requirements and interfaces for United States satellite elements, (2) information requirements, flows and interfaces; (3) decision logic sequences and development of option planning; (4) system implementation options/ trade-offs and recommended configurational capabilities; (7) survivability and life cycle cost; (8) evolution of the system coupled with a roadmap of increasing capabilities and functions to support improved surveillance systems, satellite attack warning, anti-satellite targeting and and (9) a program implementation plan and specifications.

The system design requirements of the PMOC were established during FY 1979, including both miniature ASAT Development Test and Evaluation/Operational Test and Evaluation and Limited Operational Capability support requirements.

2. FY 1980 Program: The SPADOC Phase IV architecture will be refined and system specifications developed to begin procurement of the system. The PMOC design will be finalized and construction of the deliverable hardware and software will begin. Support to near-term SPADOC improvements (SPACETRACK and Satellite Attack Warning/Verification upgrades) will be provided.

3. FY 1981 Planned Program: PMOC hardware/software development and test will continue. The contract for SPADOC Phase IV will be awarded at the end of the year; detailed design efforts will begin. These efforts will address software modification requirements, displays, interfaces with existing systems, external/internal communications and long-lead hardware items. The foreign launch assessment satellite attack warning upgrade will be integrated into SPADOC operations.

Program Element # 12311F
DoD Mission Area: Strategic Information Systems, # 134

Title: NORAD Combat Operations Center (COC)/Space Defense Operations Center (SPADOC)
Budget Activity: Strategic Programs, #3

4. Planned FY 1982 Program: Prototype Mission Operations Center (PMOC) development will be completed with anti-satellite (ASAT) test preparations. Initial ASAT testing will involve captive miniature vehicle flights with PMOC support for flight data generation. The Space Defense Operations Center (SPADOC) Phase IV development will be fully underway. The detailed design will be firmed and early subsystem and component building and test will be performed. The command and contol (C^2) support for the defensive countermeasures demonstration will be integrated into the SPADOC operations.

5. Program to Completion: ASAT testing will be initiated in PMOC will support Development, Test and Evaluation during this period and will provide the command and control (C^2) during the ASAT limited operational capability period beginning in FY SPADOC Phase IV development and deployment will continue through FY 1983 and FY 1984. The initial operational capability (IOC) of SPADOC Phase IV is planned to be achieved by FY compatible with the IOC of the air-launched ASAT system.

6. Milestones: Not applicable

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additonal to Completion	Total Estimate Cost
TOTAL FOR PROGRAM ELEMENT	3,500	5,500	5,000	2,000	Continuing	Not applicable

The budget request for FY 81 of $15.9M is $13.9M higher than the $2.0M included in the FY 1980 Five Year Defense Program, (FYDP) as a result of a reorientation of the entire Space Defense Command and Control System (SPADCCS). The SPADCCS concept, as reflected in the FY 1980 FYDP was for study funds prior to selection of an ASAT concept baseline, including technical approach and schedule. In 1979, the Office of the Secretary of Defense (OSD) directed that in keeping with Presidential and OSD space defense direction, SPADCCS should be a highly integrated and capable system which will support all space defense systems including surveillance, satellite survivability and ASAT. This OSD direction resulted in a new phased development program which provides near term capabilities, and will support ASAT development testing and operations. This increased capabililty is reflected in the FY 1981 FYDP Research, Development, Test and Evaluation funding increase of $96.5M over the FY 1980 FYDP.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 12325F
DoD Mission Area: Strategic Air Defense # 122

Title: Joint Surveillance System (JSS)
Budget Activity: Strategic Programs # 3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number Title	FY 1979	FY 1980	FY 1981	FY 1982	Additional To Completion	Total Estimated Costs *
TOTAL FOR PROGRAM ELEMENT	8,500	8,600	9,700	1,300	900	48,200

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The requirement for JSS is to replace the existing Semi-Automatic Ground Environment (SAGE) and Back-up Interceptor Control (BUIC) air defense systems and to provide air surveillance and airspace sovereignty. The objective of this program is large cost avoidance in radar operation and operation center support through the elimination of redundancy in the civilian and military radar nets, and replacement of the SAGE/BUIC systems which are expensive to maintain and operate. The system will use radar data from a single net of Federal Aviation Administration (FAA) and USAF radars in the Continental United States and Alaska to input to FAA Air Route Traffic Control Centers and Air Force Region Operations Control Centers (ROCCs). Two ROCCs will be provided to Canada via Foreign Military Sales.

BASIS FOR FY 1981 RDT&E REQUEST: Software and hardware engineering, integration and inplant testing will continue on the Implementation Period contract awarded June 1979. Funds will also be applied to continuing program engineering support contracts.

OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Costs *
Other Procurement (3080)	36,951	71,538	1,914	2,154	2,885	127,542 **
(Quantity-ROCC)	(1)	(4)				(5)
(ROCC System Support Element)	(1)					(1)
Military Construction (3300)	6,200	23,200	0	0	0	37,800

* Totals include FY 78 & Prior Funding
** Includes spares

Project # 968H
Program Element: # 12325F
DoD Mission Area: Strategic Air Defense Support #122

Title: Joint Surveillance System (JSS)
Title: Joint Surveillance System (JSS)
Budget Activity: Strategic Program #3

DETAILED BACKGROUND AND DESCRIPTION: The requirement for the Joint Surveillance System (JSS) is to replace the Semi-Automatic Ground Environment/Back-up Interceptor Control (SAGE/BUIC) systems and to provide air surveillance and airspace sovereignty. The objective of this program is cost avoidance of over $100 million/year in radar operation and operation center support through the elimination of redundancy in the civilian and military radar nets, and replacement of SAGE/BUIC operations centers which are expensive to operate and maintain. The program will implement a system which uses radar data from a single radar net of Federal Aviation Administration (FAA) and Air Force radars in the Continental United States (CONUS) and Alaska as input to the FAA Air Route Traffic Control Centers and Air Force Region Operations Control Centers (ROCCs). JSS will provide four ROCCs in the CONUS and one in Alaska which will be equipped with modern off-the shelf computers, displays, and peripheral equipment to perform surveillance and air sovereignty operations. Canada will install a similar system with two ROCCs acquired through Foreign Military Sales. Although JSS is a low risk program utilizing mainly off-the-shelf components, a large amount of unique computer software development was undertaken. For this reason JSS production was preceded by a seventeen month Design Verification Period (DVP) to minimize any remaining risk. During DVP, the contractor performed the initial design and integration in critical software areas. After verification to insure the technical adequacy of the design, a contract was awarded in June 1979 for acquisition of the ROCC hardware/software during the Implementation Period. Thus, DVP allowed the Air Force to develop confidence that all critical areas have been examined prior to committing procurement funding.

RELATED ACTIVITIES: JSS is related to the SAGE/BUIC systems which it will replace. JSS is also related to the CONUS Over-the-Horizon (OTH-B), Alaskan Minimally Attended Radar Program (SEEK IGLOO PE 12411F), SEEK FROST (PE 12412F), and the E-3A programs. JSS will provide command and control of air defense forces for as long as it survives. The E-3A, as the more survivable element of air defense, will provide command and control during wartime. Coordination on all major activities is obtained from Tactical Air Command, Air Force Logistics Command, Alaskan Air Command, and the Air Force Communications Command. Coordination is also obtained from FAA on radar sensor portions of the program. Close coordination is maintained with Canada by having Canadian officers assigned to the Program Office.

WORK PERFORMED BY: Program management is provided by the Electronics System Division of the Air Force Systems Command. The prime contractor is Hughes Aircraft Corporation, Fullerton, CA. Support engineering is provided by American Institutes for Research, Bedford, MA; Computer Sciences Corporation, Bedford, MA; Input/Output Computer Sciences, Waltham, MA; Logicon Incorporated, Lexington, MA; MITRE Corporation, Bedford, MA; and the Defense Electromagnetic Compatibility Analysis Center, Annapolis, MD.

Project: # 968H
Program Element: # 12325F
DoD Mission Area: Strategic Air Defense #122

Title: Joint Surveillance System (JSS)
Title: Joint Surveillance System (JSS)
Budget Activity: Strategic Programs #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. FY 1979 and Prior Accomplishments: Funds were utilized for executing the Design Verification Period (DVP) contract awarded 17 October 1977. FY 1979 funds completed the seventeen month DVP contractual effort, commenced the Implementation Period (IP) contract awarded 29 June 1979, and continued Program Office contract engineering support.

2. FY 1980 Program: The IP contractual effort will be continued with contract option exercised 30 October 1979. Funding will be applied to that non-critical software effort remaining after DVP, and to hardware/software integration and testing. Program Office engineering support will continue.

3. FY 1981 Planned Program: The Implementation Period contract effort will continue. Software efforts, integration and testing will receive priority attention leading to the Initial Operational Capability of the first Region Operations Control Center (ROCC) in October 1981. Program Office engineering support will continue.

4. FY 1982 Planned Program: Test and integration activities for the remaining U.S. ROCCs will continue with emphasis placed on system testing.

5. Program to Completion: System deployment is scheduled to be completed in FY 1983.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11,200	8,500	8,600	9,600	2,200	48,100
968H	Joint Surveillance System	11,200	8,500	8,600	9,600	2,200	48,100

The FY 1981 funding for JSS was increased by 100 thousand dollars to reflect revised escalation indices.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element # 12421F
DoD Mission Area: Strategic Air Defense, # 122

Title: Surveillance Radar Stations/Sites
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING) ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		8,200	10,100	8,500	4,500	700	37,000
2433	SEEK IGLOO	8,200	10,100	8,500	4,500	700	37,000

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element supports the thirteen Alaskan Air Command (AAC) air surveillance radar sites. The RDT&E project, SEEK IGLOO, will enhance the surveillance and air space control capability of AAC and reduce support costs. SEEK IGLOO will develop a minimally attended radar, using current technology to replace the existing separate surveillance and height finder radars. The new radar will have integral height finding capability and improved performance in the presence of clutter, and will be maintained by significantly fewer personnel than are required today.

BASIS FOR FY 1981 RDT&E REQUEST: Provides funds for development test and evaluation of the preproduction prototype radar beginning at the contractor's plant and concluding at King Salmon AFS, Alaska. The request also includes funds for training maintenance personnel to support Initial Operational Test and Evaluation and for program office support.

OTHER APPROPRIATION FUNDS:

	FY 1982	Additional to Completion	Total Cost Estimate
Other Procurement (3080)	54,700	67,400	122,100*
(Quantity, including prototype retrofit)	(7)	(6)	
Military Construction (3300)	27,000	27,000	54,000

* Includes initial spares

Project #2433
Program Element #12411
DoD Mission Area: Strategic Air Defense #122

Title: SEEK IGLOO
Title: Surveillance Radar Stations/Sites
Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: Automation of the Alaskan Air Command and Control System is planned under the Joint Surveillance System (JSS) program. In addition, the Air Force had previously planned a program to improve surveillance radar clutter performance with a minor modification and an extensive military construction program to replace deficient support buildings at the radar sites. A study of alternative methods of radar improvement has shown that radar replacement with a new, minimally attended (no more than three radar technicans) radar and site equipment, using current technology, is the most cost effective means of providing the required capability. The new equipment will provide the required performance and significantly reduce maintenance costs. It will also greatly reduce the number of site personnel required, thereby reducing the military construction program (MCP). The reduced MCP and maintenance cost are expected to rapidly compensate for the investment in new equipment.

RELATED ACTIVITIES: The study of alternatives and definition of technical requirements were performed under Program Element (P.E.) 12325F Joint Surveillance System (JSS). The new radars are being designed to interface with the JSS equipment. Additional design contracts for the Unattended/Minimally Attended Radar Study were supported in P.E.63101F (Preliminary Design and Development). The SEEK IGLOO minimally attended radars could also be used to enhance the Distant Early Warning Line.

WORK PERFORMED BY: This effort is managed by the Electronics Systems Division, Hanscom AFB, MA. MITRE Corporation, Burlington, MA; Rome Air Develoment Center, Griffiss AFB, NY; and the Electromagnetic Compatibility Analysis Center, Annapolis, MD are supporting the effort. Design competition contracts were awarded to: General Electric Company, Syracuse, NY; ITT Gilfillan, Inc., Van Nuys, CA; and Westinghouse Electric Corp., Baltimore, MD. After evaluation of design proposals, a contract option to fabricate and test two preproduction prototypes was exercised in July 1979 with General Electric Co.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Program alternatives were studied and the minimally attended radar was selected for acquisition. A request for proposal for design, development and test was released and three six-month design competition contracts were awarded on 1 August 1978. The design competition was completed and General Electric Co. was selected in July 1979 to fabricate and test preproduction prototype radar equipment.

2. FY 1980 Planned Program: Prototype fabrication will be completed. Development Test and Evaluation (DT&E) will begin in the last quarter.

3. FY 1981 Planned Program: Continental United States (CONUS) DT&E will be completed including extensive reliability testing at the end of the year. Planning for Alaskan DT&E and Initial Operational Test and Evaluation (IOT&E) in Alaska will also be completed. Alaskan DT&E will follow completion of CONUS DT&E.

Project # 2433
Program Element: #12411F
DoD Mission Area: Strategic Air Defense #122

Title: SEEK IGLOO
Title: Surveillance Radar Stations/Sites
Budget Activity: Strategic Programs #3

4. FY 1982 Planned Program: Alaskan DT&E/IOT&E will be conducted at King Salmon AFS and results will be evaluated prior to a production decision planned for May 1982. The preproduction equipment will be refurbished to the production configuration and remain onsite as the first operational radar. The military construction program to consolidate, replace, and upgrade essential site support facilities such as composite buildings and prime power generators will begin.

5. Program to Completion: The first radar is planned to be operational in November 1982 and radar production and installation is planned for completion by September 1984.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 80 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		4,400	12,000	10,100	8,000	4,500	39,500
2433	SEEK IGLOO	4,400	12,000	10,100	8,000	4,500	39,500

Decreased RDT&E and other Procurement funds reflect results of competitive contract award (Jul 79) and rephase of production schedule to eliminate a production break.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #12412F
Title: DEW Radar Stations
DoD Mission Area: Strategic Air Defense, #122
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		2,470					2,470
2448	SEEK FROST	2,470					2,470

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element supports the 31 Distant Early Warning (DEW) Line radar stations. The DEW Line provides tactical warning of a bomber or cruise missile carrier penetrating the airspace of the North American Continent through a line from the northern Alaskan border to the east coast of Greenland. The warning provides the National Command Authorities with time for decision making and survival actions, permits the launch of offensive and command and control aircraft for survival and alerts the air defense network. The present DEW Line can be underflown by threat bombers because of numerous gaps at low altitude and marginal radar performance. Because of it's age, the existing system is increasingly difficult and costly to operate and maintain. The objective of project SEEK FROST is to eliminate the low altitude coverage deficiencies, provide modern radar performance and reduce operations and maintenance costs.

BASIS FOR FY 1981 RDT&E REQUEST: The DEW Line replacement program in FY 1980 was zero funded by Congress because of concern over the apparent lack of an overall tactical warning plan and an air defense modernization plan. These plans will be provided by DoD.

OTHER APPROPRIATIONS:

Other Procurement: Not Applicable

Project: #2448
Program Element (P.E.): 12412F
DoD Mission Area: Strategic Air Defense #122

Title: SEEK FROST
Title: DEW Radar Stations
Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: The present Distant Early Warning (DEW) Line has deficiencies in low altitude radar coverage and marginal radar performance; the over-twenty year old equipment is increasingly more costly ($62.8M estimated for FY 1980) to operate and maintain. When tests showed that an over-the-horizon radar would not provide reliable northern radar coverage, alternatives were examined and a ground based radar replacement for the DEW Line was selected as the most cost effective approach to provide tactical warning of an airborne attack from the North. Detailed design studies of unattended/minimally attended radars and unattended radar sites led to a selection of a mix of thirteen minimally attended radars (developed in P.E. 12411F, Surveillance Radar Stations/Sites) and fifty-seven unattended gap filler radars to provide the most cost effective solution to DEW Line improvement. The selection of this mix of radars greatly simplified the design, and thus lowered the cost and risk, of unattended radar development. Maximum use will be made of existing DEW Line sites to minimize construction costs.

RELATED ACTIVITIES: Design study contracts for the unattended radar (part of the Unattended/Minimally Attended Radar Study) and totally unattended site were funded in P.E. 63101F (Preliminary Design and Development). The minimally attended radar developed under P.E. 12411F (Surveillance Radar Stations/Sites, Project SEEK IGLOO) is planned for use in SEEK FROST via an increase in production quantity. SEEK FROST radar coverage will be contiguous with the radar coverage provided by CONUS Over-the-Horizon Backscatter (OTH-B) radars in P.E. 63703F/12417F. The DEW Line is an integral part of North American Air Defense tactical warning systems with direct Canadian participation in operations and maintenance. The US-Canadian Government-to-Government Agreement precludes unilateral phaseout of the system.

WORK PERFORMED BY: This effort is managed by the Electronic Systems Division, Hanscom AFB, MA. MITRE Corporation, Burlington, MA; Rome Air Development Center, Griffiss AFB, NY; and the Electromagnetic Compatibility Analysis Center, Annapolis, MD are supporting the effort.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: An in-house study of alternatives to upgrade the DEW Line showed that a line of short range, unattended radar sites would provide the required radar coverage at the lowest life cycle cost. Five contractors completed conceptual design studies of unattended radars in FY 1977. The former Energy Research and Development Administration completed a study of unattended prime power sources for this program. Two contractors completed unattended radar site design studies in FY 1978. Based on these studies and the extensive development and acquisition program required, a mix of minimally attended long range radars, and simplified short range gap filler radars was selected as the most cost effective and timely means of DEW Line improvement. A joint US/Canada Air Defense Study commissioned by the Secretary of Defense and Canadian Minister of National Defence was completed in FY 1979. The study addressed tactical warning and air defense requirements and alternative solutions from a North American perspective. Of the many study findings, the following two are relevant to the problem of northern tactical warning.

Project #2448
Program Element # 12412F
DoD Mission Area: Strategic Air Defense #122

Title: SEEK FROST
Title: DEW Radar Stations
Budget Activity: Strategic Programs #3

First, "modernization of existing ground radars will be required to maintain existing capability and can be justified on an economic basis." Second,"if a long range, all altitude coverage system is desired as soon as possible..., then procurement of the Over-the-Horizon Backscatter radar and gap filler radars at the Distant Early Warning (DEW) Line should be started now."

2. FY 1980 Program: The DEW Line replacement program in FY 1980 has been zero funded by Congress. Program emphasis will be limited to providing a response to Congress regarding concerns for an overall tactical warning plan and air defense modernization plan.

3. FY 1981 Planned Program: Plan to implement a program consistent with the tactical warning and air defense plans.

4. FY 1982 Planned Program: Prepare and issue request for proposal for a modernized DEW Line and evaluate competitive design and system integration proposals.

5. Program to Completion: Award competitive design contracts and evaluate proposals to select a single contractor for further effort. Select one contractor to fabricate pre-production hardware and system integration equipment for test. Test pre-production prototype to confirm technical performance and operational suitability. Fabricate and install an integrated system to provide a final operational capability.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMEMT		1,000	5,000	5,000	11,000	26,000	48,000
2448	SEEK FROST	1,000	5,000	5,000	11,000	26,000	48,000

Program funding has significantly decreased. The Air Force did not fund the program due to Congressional concern for an overall tactical warning plan and air defense modernization plan. The Air Force will submit an FY 82 Budget Request after responding to Congressional concern and evaluating program alternatives.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 12423F
DoD Mission Area: Strategic Surveillance and Warning, # 132

Title: Ballistic Missile Early Warning System Modernization
Budget Activity: Strategic Programs, # 3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number Title	1979 Actual	1980 Estimate	1981 Estimate	1982 Estimate	Additional Cost to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	5,000	0	9,100	14,500	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Ballistic Missile Early Warning System is being modernized to protect the missile early warning mission capability from degradation in the developing Multiple Independently Targeted Reentry Vehicle environment, to provide an attack assessment capability, to prevent system availabililty problems, and to reduce increasing maintenance costs. The radars and software are being upgraded for the tactical warning function. Better warning and attack characterization is required to support the National Command Authorities in management of the strategic forces during pre-attack, trans-attack and post-attack periods to include escalation control, orderly and controlled termination and management of the strategic reserve force.

BASIS FOR FY 1981 RDT&E REQUEST: Procurement will be initiated for the Thule, Greenland (Site I) radar and software for tank resolution and discrimination. Computer replacement of the 20 year old hardware will be continued.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Other Procurement (3080) (Quantity) Not applicable	7.0	0	44.0	21.4	0	76.8
O&M (3400)	0	8.2	3.3	3.1	0	14.6

Program Element: #12423F
DoD Mission Area: Strategic Surveillance and Warning. # 132

Title: Ballistic Missile Early Warning System Modernization
Budget Activity: Strategic Forces, # 3

DETAILED BACKGROUND AND DESCRIPTION: The Ballistic Missile Early Warning System (BMEWS) represents the 1950s radar technology. Three factors have combined to make the BMEWS upgrade program a necessity. These are: declining supportability/availability of the aging system; the introduction of the Multiple Independently Targeted Reentry Vehicle threat; and, requirements to support National Command Authorities (NCA) retaliatory decision options. The Air Force (AF) upgrade program supports validated Joint Chiefs of Staff (JCS) Requirements Memo of 26 June 1978 and AF requirements and consists of four phases: Tactical Operations Room (TOR) replacement; computer replacement; ultra-high frequency radar upgrades at Site I (Thule, Greenland), Site III (Fylingdales, England),and Site II (Clear, Alaska); and the L-Band tracking radar modifications. The first phase does not involve any RDT&E, and is not part of this request. The radar improvements were studied under the Warning Information Correlation (WIC) program and in the AF Warning System Study, which judged them to be feasible and necessary to provide the NCA required attack assessment data. Sites I and II detection radars resolution cell will be reduced from Software will be developed to make use of the increased traffic handling and accuracy of the radars.

RELATED ACTIVITIES: The program is related to all strategic offensive and surveillance activities. BMEWS is the key ground-based element of the Worldwide Military Command and Control System (WWMCCS). Other coordination of activities is obtained from North American Air Defense Command (NORAD), Strategic Air Command, and the JCS. Procurement funds for the TOR, computers, and radars are programmed under Program Element (P.E.) 12423F. The AF WWMCCS Program (P.E. 63735F) and the WIC Program (P.E. 63429F) are providing system architecture for Air Force missile warning network of which BMEWS is a key element.

WORK PERFORMED BY: Electronic Systems Division, Bedford, MA, in conjunction with NORAD, Strategic Air Command, JCS, and other Air Force Systems Command laboratories and divisions. The original prime contractor was RCA/Missile and Surface Radar Division, Moorestown, NJ. Contractor teams interested in this program are Federal Electric Corporation (ITT), Paramus, NJ; RCA, Government Systems Division, Moorestown, NJ; Burroughs Corporation, McLean, VA; General Electric, Syracuse, NY; IBM Federal Systems, Gaithersburg, MD; Science Applications Incorporated, Huntsville, AL; KAPPA Systems Inc, Colorado Springs, CO; Control Development Corporation, Los Angeles, CA; Raytheon Company, Equipment Development Laboratories, Wayland, MA; Digital Equipment Corporation, Merrimac, NH; Sperry Univac, Washington, DC; GTE, Sylvania Western Division, Mountain View, CA; Systems Development Corporation, Santa Monica, CA; Systems Consultants Incorporated, Washington, DC; Hughes Aircraft Company, Radars Systems Group, El Segundo, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Continued installation of Site I, II, and III TOR consoles and development of preliminary specifications for the computer upgrades.

Program Element: # 12423F
DoD Mission Area: Strategic Surveillance & Warning, # 132

Title: Ballistic Missile Early Warning System Modernization
Budget Activity: Strategic Programs, # 3

2. FY 1980 Program: Continued installation of Tactical Operating Room consoles and source selection for the replacement of IBM 7090 computers at all sites.

3. FY 1981 Program: Complete system design and initiate procurement of upgraded radars at Thule, Greenland. Continue replacement of IBM 7090 computers at all sites.

4. FY 1982 Planned Program: Complete replacement of IBM 7090 computers. Initiate upgrade of tracker radars at Fylingdales, England for tactical warning.

5. Program to Completion: Upgrade of Site II (Ultra High Frequency) and all tracking radars to L-Band is planned past FY 82. The L-Band upgrade is required for attack assessment which discriminates reentry vehicles destined for targets other than Minuteman wings and is commensurate with Joint Chiefs of Staff requirements.

6. Milestones: Not applicable

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data:

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimate Costs
5,000	9,000[1]/	5,550[2]/	Continuing	Not Applicable	

1/ The Congressional Appropriation conferees agreed to the deletion of $9,000,000 requested for Ballistic Missile Early Warning Sytem (BMEWS) improvements. This action delays BMEWS improvements pending an Office of Secretary of Defense Missile Warning Master Plan. The Defense Department is expeditiously evaluating and developing an overall Missile Warning Plan considering various options including the life cycle cost of each.

The conferees appreciate the age and problems of the computer at Thule, Greenland and, with the prior approval of the Congress, the Defense Department may acquire equipment or spare parts required to keep the current BMEWS operational until decisions on a replacement can be made. This item should in no way influence the decision on BMEWS.

2/ Original estimate was based on preliminary contractor input. Subsequent analyses and Department of Defense revised procurement strategy resulted in increase shown.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 12424F
DoD Mission Area: Space Defense, # 123

Title: SPACETRACK
Budget Activity: Strategic Programs, # 3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,111	6,200	6,700	6,700	Continuing	Not Applicable
0002	Ground Based Sensors	4,300	3,400	5,500	4,500	Continuing	Not Applicable
2295	Ground-Based Electro-Optical Deep Space Surveillance System (GEODSS)	3,811	2,800	1,200	2,200	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program incorporates near and far term operational systems into SPACETRACK in support of Satellite Attack Warning and Verification, rapid alerting for

opment efforts are to support the deployment and transition of: (1) a five site Global GEODSS system that will detect and track satellites at altitudes from 3000 nautical miles (nm) to 22,000nm; (2) Pacific Radars (Altair-Kwajalein, GPS-10

rapid calibration of all SPACETRACK radars using the Navy Transit satellites; (4) the Defense Advanced Research Projects Agency Maui Optical Site and HAYSTACK Space Object Identification facilities to SPACETRACK for operational uses; (5) and extended range capability for selected SPACETRACK radars.

These Research and Devel-

BASIS FOR FY 1981 RDT&E REQUEST: The five site GEODSS system started in FY 1977 will be continued. RDT&E funding for GEODSS is for software development, system/site engineering support and Initial Operational Test and Evaluation. SPACETRACK improvements will be continued with existing sensors for an improved calibration capability and for transition of the HAYSTACK radar imagery capability to SPACETRACK for tactical assessment of satellite mission. Design, system engineering, environmental surveys and software development will be continued for the ALTAIR/GPS-10 radars.

Program Element: # 12424F
DoD Mission Area: Space Defense, # 123

Title: SPACETRACK
Budget Activity: Strategic Programs, # 3

OTHER APPROPRIATION FUNDS:

PROCUREMENT: (3080)*	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimate Costs
Ground-Based Electro-Optical Deep Space Surveillance System (GEODSS)						
Funds	10,600	1,201	1,200	1,500	Continuing	Not applicable
Quantities	(1)				(2)	(5)
Ground-Based Sensors						
Funds	4,046	0	4,954	8,200	Continuing	Not applicable
Quantities						
Military Contruction (3300)						
GEODSS	0	5,800	1,150	0	Continuing	Not applicable

* Does not include initial spares; Procurement is for projects with Research and Development activity only.

Program Element: # 12424F
DoD Mission Area: Space Defense, # 123

Title: SPACETRACK
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: This program incorporates near-term operational improvements into SPACETRACK in support of Satellite Attack Warning and Verification, rapid alerting for _

This program will also support the far-term deployment of a space-based surveillance system being developed under Program Element (PE) 63428F, Space Surveillance Technology.

This PE funds activities that will correct the above deficiencies within the geographical limitation of ground based systems. These activities will: (1) provide a five site global Ground Based Electro-Optical Deep Space Surveillance (GEODSS) capability that will detect and track satellites from 3,000nm to 22,000nm; (2) provide near real-time calibration of all SPACETRACK radars (using the Navy Transit satellites) and range extension for selected radars and transition of the Defense Advanced Research Projects Agency, Maui Optical Tracking and Identification Facility (MOTIF) Tactical Mission Assessment facility to SPACETRACK for operational use; (3) provide radar systems (ALTAIR, GPS-10) to provide

RELATED ACTIVITIES: The baseline and technology for the GEODSS system and SPACETRACK calibration, extended range and radar imagery capabilities were developed and demonstrated under PE 63428F, Space Surveillance Technology. This program element is integrated with those programs that comprise the Space Defense System Program: PE 63438F, Satellite Systems Survivability; PE 12311F, North American Air Defense Command Combat Operations Center; PE 64406F, Space Defense System; PE 12450, Space Defense Operations and PE 63428F, Space Surveillance Technology.

WORK PERFORMED BY: Program management is primarily provided by the Electronic Systems Division, Hanscom AFB, MA. The MOTIF Transition management is provided by the Space Division, Los Angeles, CA. The GEODSS contractor is TRW, Los Angeles, CA. AVCO Everett Research Laboratories, Everett, MA supports MOTIF. General Systems Engineering support is provided by MITRE Corporation, Bedford, MA and MIT/Lincoln Laboratories, Bedford, MA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The requirements for were reviewed resulting in the network design. Design/performance definitions were developed for the Southwest Pacific radars and operational tests and evaluation were conducted on the ALTAIR radar.

The GEODSS development was initiated and is continuing. Site surveys for sites 4 and 5 design studies of a relocatable GEODSS site were conducted in FY 1979. An existing SPACETRACK radar was modified and tested in 1979 to operationally evaluate the improved accuracy through calibration using the Navy Transit Satellite. This technique was developed under PE 63428F, Space Surveillance Technology.

Program Element: # 12424F
DoD Mission Area: Space Defense, # 125

Title: SPACETRACK
Budget Activity: Strategic Programs, #3

2. FY 1980 Planned Program: During FY 1980 Ground-based Electro-Deep Space Surveillance (GEODSS) development will continue. Software development will be conducted and charge-coupled devices will be examined for improving system performance and long-term supportability. Design changes will be considered to modify the fourth and fifth GEODSS site to a relocatable configuration to reduce the difficulty with foreign siting.

3. FY 1981 Planned Program: One GEODSS site will undergo Initial Operational Test and Evaluation in this period and Development of a relocatable site is planned and deployment of the remaining sites will continue. The ground-based sensors project will continue with initiation of HAYSTACK transition.

4. FY 1982 Planned Program: The GEODSS deployment will continue with the Development of charge-coupled devices for GEODSS will continue. The ground-based sensors project will continue.

5. Program to Completion: Final Operational Capability of the GEODSS system is planned for (contingent upon obtaining foreign sites for deployment and funding for fifth site procurement). Continuing improvements to the SPACETRACK system will be made to support space defense requirements for warning and defensive countermeasures/anti-satellite operations.

6. MILESTONES: Not applicable

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
TOTAL FOR PROGRAM ELEMENT	6,948	6,900	6,200	2,700	Continuing	Not applicable
GEODSS	4,100	2,600	2,800	400		9,900
Ground-based sensors 1/	2,848	4,300	3,400	2,300	Continuing	Not applicable

An increase in FY 1981 RDT&E funding of $3.9 million (M) ($6.7M vice 2.7M) is shown. This increased funding supports GEODSS changes (relocatable-designs, software development and charge-coupled devices focal plane development) and SPACETRACK upgrades (range extension, coherent data processing modification, sensor integration and anti-satellite support efforts). In addition, the program project breakout was changed to consolidate new programs directly in support of the Space Defense Program and separate them from the GEODSS program which is well into development and deployment.

1/ A new project is established in FY 1981 which combines all previous ground-based sensor projects, except GEODSS, into a single project 0002.

Project: # 0002 Title: Ground-based Sensors
Program Element: # 12424F Title: SPACETRACK
DoD Mission Area: Space Defense, # 123 Budget Activity: Strategic Programs, # 3

DETAILED BACKGROUND: The current SPACETRACK network of sensors was evolved to support relatively benign requirements such as peacetime space object cataloging. Significant new demands are being placed on the SPACETRACK system to support new national space defense policies. Space surveillance for warning/verification/defensive countering of attacks against United States (U.S.) satellites, and targeting/strike assessment of attacks by U.S. anti-satellite systems require major increases in timeliness, accuracy and quality of data collection and processing. This project develops, integrates and tests modifications to existing sensors to extend the range capability, improve the accuracy and enhance early orbit coverage of the SPACETRACK system. Specifically, this project will modify selected SPACETRACK radars to extend their range capability to 22,000 nautical miles, provide near real-time calibration (using Navy Transit satellites and improve the space object identification (SOI) capability with enhanced radar imaging. It will also incorporate the ALTAIR (Kwajalein) and GPS-10

RELATED ACTIVITIES: The technologies for the SPACETRACK upgrades were developed and demonstrated under Program Element (PE) 63428F, Space Surveillance Technology. This project is closely integrated with all the programs which comprise the Space Defense Systems Program. This is a new project breakout which clearly separates upgrades to ground-based elements of SPACETRACK from the Ground-based Electro-Optics Deep Space Surveillance System which is currently being procured and deployed under this P.E.

WORK PERFORMED BY: Program management and sytems engineering are provided by the Electronic Systems Division, Hanscom AFB, MA, and the Air Force Space Division, Los Angeles, CA. General systems engineering and development of SPACETRACK upgrade techniques is performed by MITRE Corporation, Bedford, MA, and Lincoln Lab, Bedford, MA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The requirements for SPACETRACK range extension, accuracy improvement, early orbit coverage and SOI upgrades were definitized. A network design was established and technologies to support the upgrade were demonstrated (under PE 63438F, Space Surveillance Technology). The Defense Advanced Research Projects Agency MAUI Optical Facility was transitioned to operational SPACETRACK use in FY 1979.

2. FY 1980 Program: The Army ALTAIR radar at Kwajalein will be modified (hardware and software) to improve both its high altitude (detection/tracking) and low altitude (imaging) performance. Engineering details for the SPACETRACK sensor upgrades (improved orbital determination and SOI data) will be defined.

3. FY 1981 Planned Program: Modification to existing SPACETRACK radars (for range extension, coherent processing and calibration) will be inititated. The ALTAIR radar will achieve [illegible] as part of the SPACETRACK system and the Lincoln Lab HAYSTACK Radar will continue its transition to operational use.

Project: #0002
Program Element: #12424F
DoD Mission Area: Space Defense, #123

Title: Ground-Based Sensors
Title: SPACETRACK
Budget Activity: Strategic Programs, #3

4. FY 1982 Planned Program: The SPACETRACK coherent processing, calibration and range extension modifications will continue. Data processing improvements (for improved orbital determination and Space Object Identification (SOI)) will be made to support satellite attack/strike assessment.

5. Program to Completion: Continuing modifications to the SPACETRACK system will be required as other Space Defense System elements (anti-satellite operations, defensive countermeasures and attack warning/verification) evolve and mature.

6. Milestones: Not applicable.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		6,948	6,900	6,200	2,700	Continuing	N/A
0002	Ground-Based Sensors[1]	2,848	4,300	3,400	2,300	Continuing	N/A

An increase in project RDT&E funding for FY 1981 of $3.2M ($5.5M vice $2.3M) is planned. This increased funding is required to implement SPACETRACK upgrades (range extension, early coverage, calibration, and SOI) needed to support the Space Defense System Program requirements identified in the network design studies.

[1] A new project is established in FY 1981 which combines all previous Ground-Based Sensor Projects, except Ground-Based Electro-Optical Deep Space Surveillance, into a single project, 0002.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 12431F
DoD Mission Area:

Title: Defense Support Program
Budget Activity: Strategic Programs, # 3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		30,550	31,000	72,900	135,300	Continuing	Not applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Defense Support Program (DSP) is the key element of the Worldwide Military Command and Control System [illegible]etwork. The system's current deployment consists of satellites in [illegible] orbit and two dedicated ground readout stations to perform surveillance of the Eastern and Western Hemispheres and provide near-real time [illegible] against the United States. A secondary mission is to obtain

BASIS FOR FY 1981 RDT&E REQUEST: Funds are included for continuing the development of payload modifications for compatibility with Shuttle/Titan 34D Inertial Upper Stage. This is the peak funding year for satellite # 14 design. This year will complete design of Mobile Ground Terminals and (contingent upon securing FY 80 funds and Congressional approval) development of a satellite status capability for the Simplified Processing Station. A new start for this year is the design and development of user interface so the ground based users can receive and process Mobile Ground Terminal data.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Procurement (3020) (Quantity)	123,400 (3 retrofit)	103,862 (1 retrofit)	51,931	192,280 (1 New)	Continuing	Not applicable
Procurement (3080)* (Quantity)	17,258	26,574	90,132 (3 MGT's)	10,733	Continuing	Not applicable

* Includes initial spares

Program Element: #12431F
DoD Mission Area: _____

Title: Defense Support Program
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Defense Support Program (DSP) was developed as an outgrowth of the and other related developments. DSP satellites contain infrared sensors, The system is operational and provides near real-time

to the National Command Authorities (NCA) and other designated users. The system also provides these more specific data: In addition, DSP is replacing the satellite program and provides data on The system's current deployment consists of

Two dedicated ground stations, one overseas and one within the Continental United States (CONUS), receive, process, and transmit The Simplified Processing Station provides a backup capability to the current ground stations to enhance mission data survivability and increase the probability that data will be available. It is currently deployed in the CONUS, but can be moved overseas in about a two week period. The Joint Chiefs of Staff have designated the Aerospace Defense Command, Strategic Air Command, National Military Command System, Atlantic Command, Pacific Command, European Command, as users of DSP data. Evolutionary satellite improvements are intended to prolong the useful life of each satellite, make the satellite more survivable in environments, increase the viewing area of each satellite, and increase the accuracy of data provided on to more precisely define the for the NCA decision-making process. Modifications under development will ensure that the DSP payloads are compatible with Shuttle/Titan 34D/Inertial Upper Stage (IUS) capabilities. The Mobile Ground Terminals will provide DSP data survivability by developing a truck mounted data processing and communication capability that will

RELATED ACTIVITIES: Programs were predecessor programs. Program were prior program designators. is developing the technology for a possible successor program. Appropriate procurement phas. , with the follow-on DSP program is being addressed in program planning. Defense Satellite Communications System (P.E. 33110F) provides primary communications routing for DSP overseas data. Space Boosters (P.E. 35119F) provides launch support. Space Vehicle Subsystems Advanced Development (P.E. 63401F) is developing technology for improved satellite stabilization techniques. The National Emergency Airborne Command Post (P.E. 32015F) and Post-Attack Command and Control System (P.E. 11312F) are potential users of DSP data. DSP is the key element of the Worldwide Military Command and Control Systems (WWMCCS) Network and is related to the other elements of the network (WWMCCS Architecture P.E. 63735F). After transition to the Space Shuttle, Space Launch Support (P.E. 35171F) will provide IUSs and Space Shuttle flights for DSP missions. DSP Communications (P.E. 12447F) provides operations and maintenance for the DSP Ground Communication Network.

Program Element: # 12431F
DoD Mission Area:

Title: Defense Support Program (DSP)
Budget Activity: Strategic Programs, # 3

WORK PERFORMED BY: Commander-in-Chief, Aerospace Defense Command, maintains operational control of Defense Support Program (DSP) for the Joint Chiefs of Staff. Strategic Air Command and the Air Force Communications Command have become the system operators and maintainers of the DSP ground stations. Air Force Systems Command's Space Division, Los Angeles, CA, has overall development and procurement management responsibility. The Air Force Logistics Command provides engineering and logistics support. Air Force Weapons Laboratory, Kirtland AFB, NM, will provide facility support. The Air Force Test and Evaluation Center, Kirtland AFB, NM participates in test and evaluation of selected system segments. TRW, Redondo Beach, CA is the prime contractor for the spacecraft and satellite integration. Aerojet Electro Systems Company, Azusa, CA, is the prime contractor for the infrared sensor. Ford Aerospace and Communications Corporation, Western Development Laboratories, Palo Alto, CA, is the prime contractor for the Data Acquisition and Communications segments. The Martin Company, Denver, CO, builds the Titan IIIC booster. The Department of Energy (Sandia Corporation) has responsibility for the IBM Thousand Oaks, CA is the prime contractor for all software efforts as well the prime contractor on the Simplified Processing Station. Technology Corporation is the prime contractor for the Ground Communications Network. The Aerospace Corporation, Inglewood, CA, furnishes general systems engineering/integration for the DSP System Program Office.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Significant accomplishments to date include procurement of 13 satellites and 12 Titan IIIC boosters, construction of two data processing facilities, and provision of user displays, software, communications and a training facility (also used for software development and mission data analysis), completion of Research and Development (R&D) for modifications to satellites 10-12 to improve survivability in a environment and to provide data survivability, completion of R&D for an improved focal plane for satellite 13 and completion of development of hardware and software for the Simplified Processing Station. Development initiated in FY 1976, continues on an improved sensor to provide increased viewing area and more accurate In June 1976, a software package was delivered which enables the system to Development of modifications for satellite retrofit to improve survivability in environment was initiated. R&D support for DSP augmentation was completed. Ground station modifications for compatibility with a satellite anti-jam command capability were completed. Satellite Tracking Set Training Equipment was delivered.

Program Element: # 12431F
DoD Mission Area:

Title: Defense Support Program
Budget Activity: Strategic Programs, # 3

Critical Design Review was conducted in June 1978 on a new sensor which is to provide more accurate data sensors and two of these with improved infrared sensor continued. Funding ensuring TITAN 34D/Shuttle Inertial Upper Stage (IUS) compatibility continued. In December 1978 the prototype Simplified Processing Station (SPS) was shipped to for Initial Operational Test and Evaluation. The testing was completed in June 1979. A satellite calibration experiment was performed to determine infrared sensor responsivity.

2. FY 1980 Planned Program: Expenditures include the continuation of the DSP satellite compatibility development with the Shuttle/TITAN 34D IUS. This development is necessary to ensure that the DSP satellites are compatible with the IUS interfaces and support the program transition to a Shuttle launch capability. The development efforts will be applied to insure that the system design will in corporate launch and recovery loads, safety requirements, interface compatibility and contamination protection. The current plan for DSP satellite launches is as follows: one more TITAN IIIC launch; two TITAN 34D/IUS launches: and all subsequent launches on Shuttle/IUS. The development of the sensor structural test model will be continuing. The purpose of this model is to verify the sensor loads compatibility with each of these launch vehicles. Work will be completed on the improved spacecraft data transmision capability development. This development will increase the reliability of the high-power data transmission to the ground so DSP data can be received in a small antenna. The Link II satellite status development for the SPS will be completed. This capability will allow the SPS personnel to monitor the health and status of the satellite in its role of improving DSP data survivability. The design of the next new satellite will begin. Extensive new design of the spacecraft will be required to incorporate new sensors, survivability features and because many components used in previous satellites are no longer available because of obsolescence. Funds were requested to start Mobile Ground Terminals (MGTs). They were deleted by the Appropriations Conference on the basis that they were premature pending completion of the Office of the Secretary of Defense study on systems. After submission of the study an attempt will be made to obtain the FY 1980 design funds and Congressional approval to proceed. The purpose of the MGT is to provide DSP data by mobilizing and proliferating the data processing and communication functions. The FY 1981 MGT program schedule depends on starting the design in FY 1980. Orbital operations data analysis, survivability and satellite improvement studies will continue.

3. FY 1981 Planned Program: A major part of the FY 1981 funds will be applied to continuing development of the payload TITAN 34D/IUS compatibility and the design of the next new group of satellites. This is the peak year for the satellite design. The current plan is to procure four new satellites of this design, one each of the following years; FY 1982, FY 1983, FY 1984, and FY 1986. The purpose of these satellites is to replace operational satellites that have

worn out and can no longer accomplish the mission. The Mobile Ground Terminal (MGT) design will be completed with a Critical Design Review. Based on a successful review, a production option for the procurement of the three MGTs will be exercised. The design and development of user interfaces for the ground based users to receive MGT data will begin. The purpose of this capability is to ensure that each can receive and process Defense Support Program data from all sources and keep common data at each command center for as long as possible. No attempt will be made to have elaborate association/correlation schemes. Funding is planned for the development of a direct line-of-sight Ultra High Frequency communication capability from the Simplified Processing Station to an Airborne Command Post. This capability will provide an emergency method for the airborne user to obtain Defense Support Program data. Studies on survivability, orbital data and system improvements will continue.

4. FY 1982 Planned Program: Plans include continuing Shuttle/Titan 34D/Inertial Upper Stage (IUS) compatibility; however, at a lower funding rate than in the previous years. The design of the future satellite will be completed. The MGT user interface design and development will be completed. Prototype development for a MGT that will be compatible with the follow-on Defense Support Program system will begin. Continued studies on system survivability, performance improvements, and orbital data analysis are planned.

5. Program to Completion: This is a continuing program. RDT&E funding will support continuing satellite/system development in support of Department of Defense requirements. Primary emphasis will be directed toward eliminating or minimizing operational employment deficiencies, the use of the Space Shuttle and/or Titan 34D/IUS in lieu of the Titan IIIC, the development of the MGT capability and the adequacy of the ground station data processing capability.

6. Milestones:

	Date
D. Delivery of Satellite #5	Mar 73
F. Delivery of Satellite #6	Jul 73
G. Delivery of Dual Satellite Software	Feb 74
H. Delivery of Satellite #8	May 74
I. Delivery of Satellite #7	Oct 74
J. Delivery of Satellite #9	Mar 75
K. Software Logic complete	Jun 76
L.	
M.	
N. Delivery of Simplified Processing Station (SPS)	Dec 78
O.	

Program Element: # 12431F
DoD Mission Area:

Title: Defense Support Program
Budget Activity: Strategic Programs, # 3

P.	Deliver Simplified Processing Station Link Status Capability	4Q CY 80
Q.	Retrofit of Titan 34D/Inertial Upper Stage (IUS) Compatible Satellite Complete	3Q CY 81
R.	Retrofit of IUS Compatible Satellite Complete	1Q CY 82
S.	Initial Operational Capability of Mobile Ground Terminals	4Q CY 83
T.	Satellite Launches	As required

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title (If Applicable)	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
		28,745	32,300	44,400	53,200	Continuing	Not applicable

FY 1979 actual was lower than FY 1979 estimate because of the deferral of satellite 14 procurement from FY 1981 to FY 82, this deferred the need to start the design from FY 79 to FY 80.

FY 1980 estimate is lower because the Appropriations Conference deleted $13,400 requested for the start of the Mobile Ground Terminal design.

In the FY 1981 estimate, funding requirements for satellite 14 design increased to account for most of the program growth. Inflation accounted for a portion of the FY 1981 estimate increase over last year's estimate.

Budget Activity: Strategic Programs, #3
Program Element: # 12431F

Test and Evaluation Data

1. Development Test and Evaluation: The Defense Support Program (DSP) has been designed, developed, tested and deployed as an operational system in the early 1970's. The system is a classified space program consisting of ground control and readout stations that receive data from satellites, process the data, and present information to the National Command Authorities and military commanders for decision making purposes. Development Test and and Evaluation/Initial Operational (DT&E/IOT&E) on the prototype Simplified Processing Station (SPS) was completed in 1978. The testing indicated that the SPS met most of its specifications and it was recommended that Initial Operational Test and Evaluation (IOT&E) be accomplished. All discrepancies and deficiencies uncovered to date have been resolved or are planned to be resolved jointly by Aerospace Defense Command and Air Force Systems Command (AFSC). Maintainability and reliability testing of the system was conducted by the system operator. There is a continuing effort to upgrade the satellites and ground facilities for improved system performance and survivability. Development Test and Evaluation will be accomplished for each of these improvements.

2. Operational Test and Evaluation:

(a) Combined DT&E and IOT&E was performed on the DSP prototype SPS from 26 August 1978 to 6 November 1978 at Vandenberg Air Force Base, CA. This combined test was then followed by dedicated IOT&E from 16 April 1979 to 18 June 1979 at The HQ Space Division was responsibile for DT&E while the Air Force Test and Evaluation Center, assisted by personnel from the Aerospace Defense Command (operating for DSP), managed and conducted IOT&E.

(b) IOT&E was conducted using simulated and "real world" events with prototype SPS hardware and software. The objectives were to evaluate the system's performance and to estimate the reliability, availability, and maintainability of an opoerationally deployed system. The October 1979 IOT&E report identified three major deficiencies which would prevent the SPS from being operationally effective. These were: (1) The operational requirement dictated no more than during the test period. (2)

(3) Excessive computer-generated message error rate - Mission messages were periodically rejected at the data distribution center because of parity error. As a result, mission messages were lost.

(c) Additionally, IOT&E revealed that the operational availability was percent versus the required percent.

(d) All major deficiencies are to be corrected by the SPS contractor, International Business Machines, before

the start of follow-on test and evaluation which is tentatively scheduled for a 30 day period in January 1980. The FOT&E will be performed in two phases at the permanent SPS location in _(near the IOT&E location). The first phase will be conducted by Air Force Test and Evaluation Center to verify correction of IOT&E deficiencies and to further refine reliability, availability and maintainability estimates. The second phase will be conducted by the Aerospace Defense Command to develop operations and maintenance techniques, doctrine, and training for the system. Follow-on Test & Evaluation results will be used to support decisions concerning the deployment of the prototype Simplified Processing Station as an operational system.

3. System Characteristics:

Characterstics	Objectives	Demonstrated
For the current operational system		

Budget Activity: Strategic Programs, # 3

Program Element: # 12341F

For the Simplified Processing Station

Objectives	Demonstrated
	Development Test & Evaluation (DT&E), about for simulated scenario during Initial Operational Test & Evaluation (IOT&E)
	DT&E, during IOT&E
	DT&E, IOT&E
	DT&E, IOT&E
	during IOT&E
	per week during IOT&E
	DT&E, IOT&E
	DT&E only

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 12450F
DoD Mission Area: Space Defense, # 123

Title: Space Defense Operations
Budget Activity: Strategic Programs, # 3

RESOURCES (Project Listing): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		0	0	14,508	26,142	91,200	131,800

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is the companion program to the anti-satellite (ASAT) development effort funded under Program Element 64406F and provides for operational deployment of the production ASAT capability. This requires the production of ASAT interceptors, modification of aircraft and the procurement of special handling and test equipment. In addition, RDT&E funding is required for development of training aids and manuals, transition of test software to operational formats, support of Initial Operational Test & Evaluation efforts, design of operational support equipment and purchase of Limited Operational Capability ASAT interceptors.

BASIS FOR FY 1981 RDT&E REQUEST: Design of operational support equipment will begin in as well as the development of training aids and preliminary technical manuals. Joint Space Division/Air Force Test and Evaluation Center planning for Initial Operational Test and Evaluation efforts will be initiated.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Military Construction	0	0	0	2,000	18,000	20,000

Program Element: # 12450F
DoD Mission Area: Space Defense, # 123

Title: Space Defense Operations
Budget Area: Strategic Programs, # 3

DETAILED BACKGROUND AND DESCRIPTION: Baseline planning for the initial Air Force non-nuclear anti-satellite (ASAT) capability envisions deployment of modified F-15 air-defense interceptors at stateside bases. These F-15's will serve jointly as air-defense interceptors and ASAT carrier aircraft. Preliminary planning calls for procurement of Miniature Air-Launched anit-satellite (ASAT) missiles to support operational deployment. Prior to Initial Operational Capability (IOC), special support and test equipment unique to the ASAT mission must be designed and developed. Training programs and technical publications to prepare the operating command to assume responsibility for the weapon system will be developed. A combined development test and evaluation and Initial Operational Test and Evaluation (IOT&E) effort is planned and will require engineering and technical support from the development agency and contractors. Subsequent to completion of the IOT&E efforts, a Limited Operational Capability (LOC) will exist. This LOC will be supported by contractor personnel and will provide some capability to negate Soviet satellites (on extended timelines) prior to IOC. LOC ASAT missiles will be procured with RDT&E resources since some may be used to continue IOT&E testing if development tests results dictate. As development test results are available, minor changes in ASAT design may be required. RDT&E funding in this Program Element (P.E.) will support design modifications to configure the ASAT to an operational configuration. Finally, ASAT computer software modifications dictated by flight test results, will be funded within this P.E.

RELATED ACTIVITIES: This program supports Space Defense Systems, P.E. 64406F and other P.E.'s in the Space Defense Program; P.E. 63428F, Space Surveillance Technology; P.E. 63438F, Satellite Survivability; P.E. 12424F, SPACETRACK; 12311F; North American Air Defense Command Combat Operations Center.

WORK PERFORMED BY: This program is managed by Air Force System Command's Space Divison, formerly Space and Missile Systems Organization, Los Angeles, CA. Primary contractors are Vought Corporation, Grand Prairie, TX and Boeing Aerospace Corporation, Seattle, WA. Aerospace Corporation, El Segundo, CA provides technical support. Aircraft and modifications will be contracted to McDonnell Douglas Aircraft Corporation, St. Louis, MO.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable

2. FY 1980 Program: Not applicable

3. FY 1981 Planned Program: Design of support equipment unique to the ASAT mission will be initiated. This includes equipment to verify ASAT/carrier aircraft interfaces to checkout ASAT missile status and to condition the Much of this equipment must be available to support LOC capability in Planning to support the cooperative development test and evaluation/IOT&E effort will begin and require exhaustive test planning to insure maximum results are achieved from a minimum number of high-cost tests.

Program Element: # 12450F
DoD Mission Area: Space Defense, # 123

Title: Space Defense Operations
Budget Activity: Strategic Programs, #3

4. FY 1982 Planned Program: Initiatives begun in FY 1981 will continue. The will be procured. Efforts in support of training, test and mission support will accelerate.

5. Program to Completion: RDT&E support will continue through 1987. Procurement of the remaining LOC assets will occur in while mission support efforts will peak in FY 1983 and FY 1984. In FY 1984, pre-production configuration changes will be funded.

6. Milestones: See Program and fiscal year descriptions

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data: Not applicable

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #32010F Title: Worldwide Military Command and Control System Automated Data Processing/E-4 (WWMCCS ADP/E-4)

DoD Mission Area: Strategic Information Systems, #134 Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT			3,400		0	3,400

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The goal of the E-4 program is to provide a flexible, highly survivable command center responsive to the needs of both the National Command Authorities and Commander-in-Chief, Strategic Air Command (CINCSAC). Automated Data Processing (ADP) is required for realization of this goal. It will provide an on-board data processing capability that will allow the airborne command post aircraft to operate independently of ground based computers should they become non-operational during any phase of general war. The system will consist of a central processor, mass storage devices, input/output devices, and communications system interfaces.

BASIS FOR FY 1981 RDT&E REQUEST: Includes funds for engineering, prototyping and testing of the ADP system and its interfaces to on-board communications systems.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Aircraft Procurement (3010)			3,800		10,100 1/	13,900 2/
Quantity			1		3	4

1/ ADP for E-4B aircraft #5 and #6 is funded in Program Element 11312F

2/ Includes initial spares

Program Element: #32010F Title: Worldwide Military Command and Control System Automated Data Processing/E-4 (WWMCCS ADP/E-4)

DoD Mission Area: Strategic Information Systems, #134 Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: To accommodate requirements for increased operational capabilities over the lifetime of the system, the E-4 program was structured under a "Block" development concept. Block I provided for acquisition of six commonly configured 747 aircraft with an improved command, control and communication (C^3) subsystem, increased aircraft/system survivability, and an ability to accommodate a larger battle staff. At the inception of the program, on-board Automated Data Processing (ADP) was an integral part of the C^3 subsystem. However due to lack of definition of ADP requirements, problems associated with the development of the advanced C^3 subsystem and high initial cost estimates, ADP was deferred to fiscal year 1980 when the C^3 development was scheduled for completion. The fiscal year 1980 request was denied by the Congress; however, wording associated with that denial of funds allowed continuation of software development and stated that future budget requests would be analyzed to assure the E-4 ADP system is austere and low cost.

The E-4 equipped with an advanced C^3 subsystem is the first step in providing the National Command Authorities (NCA) and Commander-in-Chief, Strategic Air Command (SAC) with a survivable command and control system that would provide a credible means of monitoring the worldwide situation, formulating responses to warning and threat assessment, and prosecuting the Single Integrated Operations Plan (SIOP). The next logical step is to incorporate an ADP capability on the E-4 to aid the battle staff in execution of their responsibilities.

Battle staff responsibilities, include the tasks of effectively monitoring, executing, recovering and reconstituting the SIOP committed strategic forces consisting of bombers, Intercontinental Ballistic Missiles (ICBMs), Submarine Launched Ballistic Missiles (SLBM's), tankers and reconaissance vehicles. A data processing capability on-board the E-4 is absolutely essential to support the following priority characteristics of the nuclear posture of the United States: (a) provide the NCA timely information to support decision making during all phases of a general war; (b) provide a credible means to execute the SIOP; and (c) accomplish the complex force management tasks of monitoring, executing, recovering and reconstituting the SIOP committed strategic forces.

The ADP system installed on SAC's EC-135 airborne command posts will be used as the core system for the E-4 application. Some additional equipment will be required to accommodate the total SIOP data base and increased size of the battle staff. In addition, the E-4 ADP system will be hardened against electromagnetic pulse effects and will include an interface to on-board communications system for automatic update of the data base. The ADP system will consist of a minicomputer with approximately 160 thousand words of main memory, approximately 100 million bits of mass storage, visual display terminals, printers, magnetic tape storage system, and appropriate interfaces to existing on-board communications systems. Mission software will be developed by SAC and the Defense Communications Agency's Command and Control Technical Center.

Program Element: #32010F Title: Worldwide Military Command and Control System Automated Data Processing/E-4 (WWMCCS ADP/E-4)

DoD Mission Area: Strategic Information Systems, #134 Budget Activity: Strategic Programs, #3

RELATED ACTIVITIES: The Post Attack Command and Control System (PACCS), Program Element 11312F; provides funding for development and acquisition of the E-4 and also includes funds to equip E-4 aircraft #5 and #6 with ADP as part of the production effort. WWMCCS ADP-Strategic Air Command , Program Element 11310, provides funding for in-house development of software to support E-4 ADP.

WORK PERFORMED BY: The Air Force Logistics Command, Oklahoma City Air Logistics Center, Tinker Air Force Base, OK is responsible for acquisition, and integration of the hardware on the E-4 aircraft. The Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA will provide technical support. Mission software is being developed by the Strategic Air Command, Offutt AFB, NE and the Defense Communications Agency, Command and Control Technical Center, Washington, D. C. A contract for hardware acquisition will not be awarded until fiscal year 1981.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The E-4 Software Feasibility Project was completed by the Strategic Air Command. Objectives of this project were: (a) define and document the users airborne requirements; (b) develop and demonstrate a software package from a subset of these requirements; (c) provide a mission software baseline adaptable to any airborne ADP system; and (d) provide the technical basis for future acquisition activities.

2. FY 1980 Program: Although funding for this program was denied for fiscal year 1980, wording associated with that denial allowed continuation of software development. Development of software will be continued to ensure availability of mission software commensurate with hardware acquisition and installation of an ADP capability on the first E-4B. In-house planning activity, within the Air Force Logistics Command, will continue towards a contract award in early fiscal year 1981 for acquisition and installation of ADP equipment on the E-4B.

3. FY 1981 Planned Program: A contract will be awarded for acquisition, installation, and test of an ADP system on the first E-4B. Development and documentation of mission software will be completed.

4. FY 1982 Planned Program: No funds requested. The planned E-4A to E-4B retrofit program and the operational requirement to support the National Emergency Airborne Command Post mission with a minimum of two operational E-4 aircraft preclude depot level modification during 1982-1983.

Program Element: #32010F Title: Worldwide Military Command and Control System Automated Data Processing/E-4 (WWMCCS ADP/E-4)

DoD Mission Area: Strategic Information Systems, #134 Budget Activity: Strategic Programs, #3

5. Program to Completion: The ADP System will be installed in three E-4B aircraft (upon completion of retrofit) as a separate aircraft modification. The ADP system for E-4B aircraft #5 and #6 will be installed concurrently with other equipment during production of those aircraft.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
FY 1980 Resource Listing ($ in thousands)						
TOTAL FOR PROGRAM ELEMENT			800	3,000	27,300	31,100

Total RDT&E costs have been reduced by $27.7 million due to program redefinition. Procurement funds in the amount of $13.9 million have been added for acquisition of ADP hardware for four (4) E-4B aircraft.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element # 33131F Title: Minimum Essential Emergency Communications Network (MEECN)
DoD Mission Area: Strategic Command and Control #131 Budget Activity: Strategic Programs #3

RESOURCES (PROJECT LISTING): ($ IN THOUSANDS)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Total for Program Element		7,300	8,500	13,500	26,900	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The MEECN is a composite of designated Worldwide Military Command and Control System assets that provide the highest possible assurance that the National Command Authorities can deliver

Current developments and acquisitions in this program element will eliminate deficiencies in those portions of the MEECN very-low-frequency/low-frequency (VLF/LF) system that are supported by the Air Force.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds to complete the development of an airborne VLF/LF antenna for EC-135 and E-4 airborne command posts. This antenna will permit reception of signals in the transverse-electric (horizontally polarized) mode. Development of a higher power (100 kilowatt) VLF/LF transmitter for the EC-135 will be continued, and work will begin on a diversity reception system for the EC-135 and E-4 which will automatically combine messages received through separate antennas with repetitions of those messages to produce optimum composite messages.

OTHER APPROPRIATION FUNDS:

Procurement (3080)	39,464	12,550	-	3,929	Continuing	Not Applicable
(Quantity)	(142)	(25)				

Program Element: # 33131F Title: Minimum Essential Emergency Communications Network (MEECN)
DoD Mission Area: Strategic Command and Control #131 Budget Activity: Strategic Programs #3

DETAILED BACKGROUND AND DESCRIPTION: The Air Force portion of the MEECN effort is a continuing program to develop and install improvements to Air Force elements supporting the MEECN. Improvements are based upon validated requirements of the Strategic Air Command (SAC) and the other Single Integrated Operational Plan Commanders-in-Chief, the Defense Communications Agency, and priorities of the Joint Chiefs of Staff. The primary current emphasis is on improvements to the very-low-frequency/low-frequency (VLF/LF) system. The VLF/LF system consists of transmitters on the EC-135 and E-4 airborne command posts and at two fixed locations at Silver Creek, NE and Hawes, CA. Receivers are located at SAC wing command posts, intercontinental ballistic missile launch control centers, northern radio relay sites (Green Pine stations), as well as at the transmit facilities. The VLF/LF system has attributes useful in strategic communications including significant penetration of seawater, low ambient atmospheric propagation losses, and good performance (relative to higher frequency bands) in a nuclear environment.

RELATED ACTIVITIES: This program is coordinated with work by the Defense Communications Agency (DCA), Navy, and Army in complementary portions of the MEECN Program Element (PE) 33131. Modifications to EC-135 and E-4 airborne command posts resulting from the developmental work in this program element are programmed in PE 11142F, KC-135 Squadrons, and in PE 11312F, Post Attack Command and Control System. Demodulators, which are procured in FY79 and FY80, are installed in TITAN II and Minuteman launch control centers with funds programmed in PE 11212F, TITAN II Squadrons, and PE 11213F, Minuteman Squadrons.

WORK PERFORMED BY: Electronic Systems Division, Hanscom Air Force Base, MA, has management responsibility for the Air Force Research Development Test & Evaluation (RDT&E) for MEECN. The contractors are Westinghouse Electric Corporation Defense and Electric Systems Center, Baltimore, MD (616A modulator/demodulator and 100-kilowatt transmitter); Analytical Systems Engineering Corporation, Burlington, MA (system engineering); and Collins Radio, Dallas, TX (subcontractor to Boeing for the E-4 200-kilowatt transmitter).

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Development of 616A modulator/demodulators was completed in August 1978 and a production contract was awarded in November, 1978. The Hawes, CA, fixed transmitter site was modified and turned over to SAC in April, 1979, and deliveries of modification kits began for the remaining facilities. A 200-kilowatt transmitter and 616A modulator/demodulator system were installed in the E-4B aircraft by the Boeing Company. Two feasibility models of 100-kilowatt transmitters were fabricated and tested at ground installations with the development of higher power transmitters for the EC-135 airborne command post aircraft the ultimate objective. Source selection activities took place in FY 1979 for full-scale development of these transmitters. Airborne tests of propagation of the transverse-electric mode of VLF/LF signals were conducted in 1976-1978 and revealed that further jam resistance and range improvements are possible using antennas oriented to receive the horizontal components of signals transmitted

by the aircraft trailing wire antennas. In FY 1979, an acquisition package was prepared for development and production of the required antennas, and studies were conducted to evaluate alternatives for automatic combination of horizontally and vertically polarized signals. This diversity combination technique will produce automatically constructed composite messages from the two polarized input signals. Through automatic combination of repetitions of messges, as well, an added dimension of time diversity will also be achieved. Draft specifications for the MEECN Message Processing Mode (a Navy development program) were reviewed.

2. FY 1980 Program: A contract was awarded to Westinghouse Electric Corporation for development of the 100-kilowatt transmitter for the EC-135 airborne command post aircraft in October 1979. This development will improve connectivity with ground and airborne elements of the Air Force, Navy, and Army supporting the MEECN. A contract for development of the transverse-electric antenna and associated electronics will be awarded during the year. Funds are also programmed to support demonstration of an advanced high-frequency/very-high-frequency network (HF/VHF) to support MEECN and day-to-day communications.

3. FY 1981 Planned Program: Funds are requested to complete development of the transverse-electric antenna system and to continue development of the 100-kilowatt transmitter. Analyses will be conducted and preparations will be made for development of the automatic polarization and time diversity combination system described above.

4. FY 1982 Planned Program: In FY 1982, the MEECN program activity will be stepped up to include efforts in three separate areas. Development will be completed during the year for the 100-kilowatt high power transmitter for the EC-135. However, a new contract will be awarded for development of the automatic polarization and time diversity reception system. This system will utilize signals from the existing antenna as well as from the horizontally polarized antenna being developed in FY 1980 and FY 1981. In addition, a feasibility demonstration of a compact very-low-frequency/low-frequency (VLF/LF) receiver for bomber communications will be conducted.

5. Program to Completion: This is a continuing program which must assure successful communications to strategic forces as the threat to such communications evolves. Interference cancellation data collection and modelling will be conducted to reduce noise in the received signals leading ultimately to a full-duplex capability with the VLF/LF system. A new HF/VHF radio will be developed for Air Force airborne and ground installations based upon the results of a requirement analysis and the concept demonstration program being conducted.

6. Milestones:

	Activity	Date 1/
616A Modulator/Demodulator	Development Contract Complete	Mar 75
	Pre-production Contract Award	Mar 76
	Preliminary Design Review	Oct 76
	Critical Design Review	Feb 77

	Testing Complete		Aug 78
	Production Contract Award		Nov 78
	Initial Operational Capability	*(4QFY79)	Jan 81
	Full Operational Capability		FY1982
200 Kilowatt Transmitter (E-4)	Development Complete		FY19TQ
	E-4 Initial Operational Test and Evaluation Complete	*(2QFY79)	Feb 79
100 Kilowatt Transmitter (EC-135)	Development Contract Award	*(Jun 79)	Oct 79
	Critical Design Review		Jun 80
	Development Complete	*(FY81)	Sep 81
	Production Decision 2/	*(1QFY82)	Jan 82
Transverse Electric Antenna	Development Contract Award	*(3QFY79)	Jun 80
	Critical Design Review		Nov 80
	Development Complete	*(FY80)	Oct 81
	Production Decision 2/	*(1QFY82)	Nov 81
Polarization and Time Diversity Combiner	Development Contract Award	*(3QFY79)	Jun 82
	Complete Design Review		Jan 83
	Development Complete	*(FY81)	Mar 84
	Production Decision 2/	*(1QFY82)	May 84

*Dates presented in the FY 1980 Descriptive Summary

1/ Initial Operational Capability for 616A modulator/demodulator redesignated January, 1981, to coincide with organic logistic support capability. Development milestones delayed because of unavailability of FY 1979 supplemental funds ($9.6 million of supplemental funds were assumed in the FY 1980 budget request).

2/ Acquisition funds for aircraft modification programmed in Program Elements 11142F and 11312F (see RELATED ACTIVITIES)

Program Element: #33131F Title: Minimum Essential Emergency Communications Network (MEECN)
DoD Mission Area: Strategic Command and Control #131 Budget Activity: Strategic Program #3

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: ($ IN THOUSANDS)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	10,420	17,200	8,500	5,500	Continuing	N/A

The FY 1980 budget request was based upon approval of a request for FY 1979 supplemental funds. This request was still under consideration at the time of the budget submission. The supplemental funds requested ($9.6 million) were not approved; consequently, many of the milestones occur later in the FY 1981 budget request and the funding estimates have been realigned accordingly.

Budget Activity: Strategic Programs, #3

Program Element: 33131F - Minimum Essential Emergency Communications Network (MEECN)

Test and Evaluation Data

1. Development Test and Evaluation: The Air Force Support to MEECN Program (616A) is a continuing program involving development of several Very Low Frequency/Low Frequency (VLF/LF) communications system improvements. These include a Transverse Electric (TE) mode receive antenna, a higher power transmitter (100 kilowatt), and an automatic diversity combiner to develop optimum messages by combining those received via the Transverse Magnetic (TM) mode with those receive via the TE mode. A contract was awarded in October 1979 to the Westinghouse Electric Company for the 100 kilowatt transmitter; contracts for the other two development activities have not yet been awarded. Details of the DT&E have yet to be planned, but the overall development period extends from October 1979 until March 1984.

2. Operational Test and Evaluation: Details of the OT&E have not yet been planned for the development programs described above; SAC will perform the IOT&E with AFTEC monitoring the testing.

3. Systems Characteristics:

a. Transverse Electric (TE) Antenna

Characteristics	Objective[1]/	Demonstrated
Sensitivity		
Frequency Range		
Size		
Noise Rejection		
Survivability/Vulnerability		
Duty Cycle		
Mean-Time-Between-Failure		
Weight		

1/ Source-Selection Sensitive--RFP in preparation.

b. 100 Kilowatt Transmitter

Characteristics	Objectives	Demonstrated
Power Output	100 KW	
Frequency Range	27-60 kHz	
Automatic Tuning	Within 10 Seconds	
Weight	2200 lbs (1600 is a goal)	
Mean-Time-Between-Failure	4050 Hours	
Mean-Time-Between-Maintenance-Actions	>425 Hours	
Broadband Noise & Spurious Output	-120db in 200 Hz segments beyond ± 5 KHZ from the carrier	

c. Diversity Combiner

Characteristics are not yet defined in detail.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #33601F Title: Air Force Satellite Communications System (AFSATCOM)
DoD Mission Area: Strategic Communications, #133 Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	Total for Program Element	19,711	19,200	61,400	63,400	Continuing	N/A
2487	AFSATCOM/Transponder Terminals	15,511	10,000	26,500	17,300		
	Single Channel Transponders (SCT)	4,200	9,200	12,700	7,600	Continuing	N/A
	Strategic Satellite System (SSS) New Satellite and Terminal		-	22,200	38,500	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops, procures and installs the ground, airborne and satellite communications equipments needed to satisfy critical needs of the National Command Authorities and the military Commanders-in-Chief for reliable, worldwide communications for command and control of the Single Integrated Operational Plan and other designated forces.

BASIS FOR FY 1981 RDT&E REQUEST: Includes funds for development of AFSATCOM consolidated ground terminals remoting and message routing subsystems; hardware and software maintenance tools; operational monitoring aids; single channel transponders and associated Emergency Action Message transmission subsystems; full scale development of the upgrade to Launch Control Center Terminals for improved performance in a nuclear environment; concept definition and initial work on a new satellite (called Strategic Forces Communications Satellite) and associated terminals; and improvements to airborne command post connectivity to Nuclear Weapon Storage (NWS) sites. The new satellite is a part of the Strategic Satellite System (SSS).

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Missile Procurement (3020)	56	200	13,464	0	Continuing	N/A
Quantities (Single Channel Transponders)	-	-	(4)			
Other Procurement (3080)	28,185	35,647	27,288	14,140	Continuing	N/A
Quantities (Ground Terminals)	(30)	(110)	(48)	(20)		

Program Element: #33601F Title: Air Force Satellite Communications System (AFSATCOM)
DoD Mission Area: Strategic Communications, #133 Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Air Force Satellite Communications (AFSATCOM) System program is a satellite based Ultra High Frequency communications system that provides command and control communications to the National Command Authorities, the Joint Chiefs of Staff, the military Commanders-in-Chief (CINCS), the nuclear and supportive forces and selected high priority users. The wartime mission of the AFSATCOM system is to disseminate Emergency Action Messages, to provide conferencing communications to the CINC's from their worldwide locations, to direct the forces, report status and terminate hostilities. In peacetime the system is used during training exercises, contingency operations, crisis management, search and rescue, and for relay of reconnaissance information and missile testing data. The AFSATCOM system terminals are being installed in B-52's and FB-111's, in Minuteman and Titan launch control centers and in airborne and ground command posts, tankers, reconnaissance aircraft, and ground cruise missile launch centers. The space segment consists of multi-channel transponders on the Satellite Data System (SDS) and Fleet Satellite Communications System and classified host spacecraft. Single channel transponders are being developed for improved assurance of transmitting the Emergency Action Messages to the forces and will be deployed on several host spacecraft including the Defense Satellite Communication System, the SDS and potentially the Global Positioning System (GPS). To achieve the survivable, two way, worldwide communications needed to provide command and control communications through crisis management and all phases of nuclear war, improvements to the Air Force Satellite Communications System are needed. These required improvements are higher availability of service, increased capacity to serve the growing terminal population, and improved electromagnetic and physical survivability. Many alternatives were considered including upgrading the multichannel transponders on the Satellite Data System, deploying only single channel transponders, new satellites with substantially upgraded communications, adaptive high frequency radio and Meteor Burst Communications. The alternative selected at the Defense System Acquisition Review Council in January 1979 consists of new satellites at 110,000 miles, single channel transponders on selected host spacecraft, and integration of higher frequencies, more robust modulation, higher power signal amplification and communications security into existing AFSATCOM terminals. These improvements for electromagnetic and physical survivability are designed specifically to meet the threat projected for the 1985-2000 period. Other communications systems do not possess the high degree of survivability planned for the Strategic Satellite System.

RELATED ACTIVITIES: Approved Air Force users include the following program elements: 11113F, B-52; 11142F, EC- and RC-135; 11115F, FB-111; 11312F, E-4; 27222F, KC-10A; 11212F, Titan; and 11213F, Minuteman Launch Control Centers. The Minuteman, 11213F, and Titan, 11212F, Intercontinental Ballistic Missile programs will integrate AFSATCOM terminals and improvements into the launch control facilities. Additional users include the Navy TACAMO Program and Nuclear Weapons Storage Sites. Program Element 63431F, Advanced Space Communications, develops and demonstrates technology to increase the reliability and survivability of space communications. This technology is transferred to the AFSATCOM Program for operational development. Program Element 35165F, NAVSTAR Global Positioning System (GPS), and Program Element 33110F, Defense Satellite Communications System (DSCS), are potential host spacecraft for AFSATCOM transponders. The Satellite Data System, Program Element 35158F, and Program Element 33109N, the Navy Fleet Satellite Communications System are the major satellite systems hosting AFSATCOM communications equipments.

Program Element: #33601F Title: Air Force Satellite Communications System (AFSATCOM)
DoD Mission Area: Strategic Communications, #133 Budget Activity: Strategic Programs, #3

WORK PERFORMED BY: The AFSATCOM System is managed by the Space Division, Los Angeles, CA. Support facilities include the Camp Parks, CA, satellite test facility; a ground terminal test facility at Verona, NY; and aircraft assigned to Strategic Air Command and to Aeronautical Systems Division, Wright-Patterson Air Force Base, OH. The AFSATCOM transponders on the Satellite Data System are built by Hughes Aircraft Company, EL Segundo, CA and on the Fleet Satellite Communications System by TRW INC, Redondo Beach, CA. The AFSATCOM terminal development/production is managed by the Electronics Systems Division, Hanscom AFB, MA. Terminal development was conducted by the Collins Telecommunications Products Division of Rockwell International, Cedar Rapids, IA, and terminal production by the Collins Communications Systems Division of Rockwell International, Newport Beach, CA. AFSATCOM modems are produced by LINK-A-BIT Corp, San Diego CA. Transponder development is conducted by General Electric, Valley Forge, PA, for Defense Satellite Communications System (DSCS III) program, and by Rockwell International Corporation, Satellite Systems Division, Seal Beach, CA. for the Global Positioning System. Federal Contract Research Center support is provided by the Aerospace Corporation, Los Angeles, CA, MITRE Corporation, Bedford, MA and Lincoln Laboratory, Lexington, MA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: AFSATCOM Initial Operational Test and Evaluation was completed in October 1975 using a host transponder in polar orbit and pre-production terminals. A terminal production decision was received on 30 June 1976 and delivery of airborne and command post terminals began in July 1978. satellites were launched successfully in Fleet Satellite Communications System satellites were launched successfully in February 1978, May 1979 and January 1980. Interfaces between AFSATCOM and other command and control systems were developed to assure interconnectivity, and the consolidated ground terminal effort was initiated to reduce the number of major ground terminals required for the system. Terminals were installed in B-52, FB-111, EC/RC135, and E-4B aircraft and selected ground command posts. Initial Operational Capability was achieved in May 1979. In April 1979 the Deputy Secretary of Defense approved the Defense System Acquisition Review Council decision to proceed with the concept validation and demonstration phase of the Strategic Satellite System dedicated space segment and associated terminals and to continue development of the single channel transponders and their associated terminal improvements.

2. FY 1980 PROGRAM: Continuing efforts include the multi-year ground terminal consolidation and remoting efforts, development of an encryption capability with the National Security Agency, the multi-year development of the Defense Satellite Communications System (DSCS) Phase Three Single Channel Transponder (SCT) and its message injection subsystem, and the multi-year development of the Global Positioning System (GPS) Phase III SCT. Both the DSCS and GPS SCTs increase the survivability, both electromagnetic and physical, of the Emergency Action Message (EAM) dissemination by improved anti-jam performance via The production of B-52, EC/RC-135, FB-111, launch control center, and command post terminals will continue in parallel with deployment activities. The DSCS III SCT injection subsystem will be tested with the SCT. Components to permit the terminals to use the modulation and faster frequency hopping employed by the SCT's will be developed.

Program Element: #33601F Title: Air Force Satellite Communications System (AFSATCOM)

DoD Mission Area: Strategic Communications, #133 Budget Activity: Strategic Programs, #3

3. FY 1981 PLANNED PROGRAM: The ground terminal consolidation program will continue. The development of the DSCS III Single Channel Transponder (SCT) message injection subsystem will be completed. Development of capabilities to inject Emergency Action Messages at Super High Frequency from airborne command posts and to improve connectivity from airborne command posts to the Nuclear Weapons Storage Sites in Europe is planned. The Global Positioning System (GPS III) SCT development, and development of the SHF receive capability for launch control center terminals sites will continue. After a complete review of the program approved by the Deputy Secretary of Defense in April 1979, the Strategic Satellite System (SSS) new spacecraft segment and its associated terminal development will be initiated with two or more contractors to insure competition and a thorough examination of the most promising designs. The SSS terminal development will focus upon adding Super High Frequency and Extremely High Frequency capabilities to command post terminals, and provide the modification to the AFSATCOM force element terminals to insure compatibility with the Ultra High Frequency capability already installed. The FB-111 and EC/RC-135 terminal production will be completed; B-52, command post and Intercontinental Ballistic Missile (ICBM) launch control center terminal production will be continue. The results of the Follow-on Operational Test and Evaluation effort will be documented, and essential system changes will be implemented.

4. FY 1982 PLANNED PROGRAM: The AFSATCOM ground terminal program will be completed. The Global Positioning System Single Channel Transponder development programs will continue. The development of the airborne injection subsystem and improvement to the European airborne command posts will continue. The SSS new spacecraft and terminal programs begin full scale development upon SSS Defense System Acquisition Review Council (DSARC) Milestone II approval. Installation of AFSATCOM terminals will continue in Launch Control Centers (LCC's), E-4's and KC-10's. Initial procurement of SHF upgrades to the Intercontinental Ballistic Missile LCC's will begin. Installation of terminals in B-52/H's will be completed.

5. PROGRAM TO COMPLETION: The AFSATCOM System is planned to evolve into an electromagnetically and physically survivable command and control capability -- the Strategic Satellite System. Development of the new space segment and higher frequency terminals, and minor modifications to existing terminals, are logically planned and based upon demonstrated technology wherever possible. Each evolutionary change will insure compatibility with already fielded equipments to insure operational continuity. This is a continuing program.

6. Milestones:

AFSATCOM SYSTEM	DATE	TRANSPONDERS	LAUNCH DATE
Development Start	Jan 73		
DT&E/IOT&E Complete	Oct 75		
Terminal Production Decision	Jul 76		
Terminal Production Start	Dec 76	FLTSATCOM (F-1)	Feb 78
First Terminal Delivery	Jul 78		

STRATEGIC SATELLITE SYSTEM	DATE
Technology Start	1971
Lincoln Exp. Satellites	Mar 76
Mission Element Need Statement	Jan 79
DSARC I	Jan 79
Concept Validation/	Jan 80 Mar 81

Program Element: #33601F
DoD Mission Area: Strategic Communications, #133

Title: Air Force Satellite Communications System (AFSATCOM)
Budget Activity: Strategic Programs, #3

Initial Operational Capability	May 79			DSARC II	*Feb 81	May 82
Final Operational Capability	1983	FLTSATCOM (F-2)	May 79			
		FLTSATCOM (F-3)	Jan 80			

Explanation of Milestone Changes
*Congress deleted FY80 funds for Concept Validation Phase slipping program about 14 months.

7. RESOURCES: Not applicable

8. COMPARISON WITH FY 1980 BUDGET DATA:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Total for Program Element	19,700	23,000*	70,600**	58,900***	Continuing	N/A

*Included 3,600 in FY79 Supplemental Request that was withdrawn.
**Included 51,400 that was deleted by HASC/SASC Joint Conference.
***Increased by new inflation factors

Program Element: #33601F
Budget Activity: Military Astronautics and Related Equipment, #4

Program Element: 33601F - Air Force Satellite Communications System

Test and Evaluation Data

1. Development Test and Evaluation (DT&E): The Air Force Satellite Communications System Terminals were developed by Collins Radio Company, Cedar Rapids, Iowa. The terminals are designed on the modular concept, with capabilities ranging from single channel to simultaneous multi-channel, multiple satellite communications. Increases in capability are achieved by exchanging or adding modules. DT&E was conducted in-plant and as part of initial operational testing. The DT&E demonstrated that the technical performance of the system supported its intended use and confirmed expected theoretical performance.

2. Operational Test and Evaluation: The Initial Operational Test and Evaluation (IOT&E) was combined with the Development Test and Evaluation (DT&E). The Air Force Test and Evaluation Agency (AFTEC) conducted the IOT&E. The combined test and evaluation program began on 1 February 1975. IOT&E was concluded on 30 September 1975; DT&E was extended to verify design fixes for identified equipment deficiencies.

a. The IOT&E objectives were accomplished in six categories or phases of tests, which included: (1) demonstrations of basic system/terminal functional capabilities; (2) performance tests; (3) network tests; (4) B-52, EC-135 network demonstrations; (5) logistic supportability tests, and (6) RC-135 special operability/compatibility tests. The first test category demonstrated basic operational capabilities and limitations of the system, terminals, and terminal subsystems. The second and third test categories together provided an estimate of effectiveness and suitability of actual AFSATCOM network operationel in an operational environment. The fourth test category served to verify that the results of the first three categories were applicable to two specific operational installations. The fifth test category evaluated and assessed logistics supportability under conditions approximating those anticipated when the AFSATCOM system becomes operational. The final test category evaluated special RC-135 limited test objectives. The initial period of the combined DT&E/IOT&E program emphasized technical testing. As the test program progressed, the emphasis shifted from technical to operational testing. Technical and operational tests were performed concurrently when such testing could be conducted on a noninterference basis. Airborne technical performance testing was configured to provide operational performance data which could be correlated with network test data. The IOT&E involved seven test sites (no ranges), six test aircraft, nine preproduction terminals, one satellite, and a satellite simulator. Airborne terminals were installed on operational and test aircraft. All four ground terminals were used in an operational configuration. Air Force personnel operated the terminals to provide realistic operator/terminal interface evaluations. Air Force operators were trained either formally or by on-the-job training. The number of operators per terminal during any one test was the same as that expected during operational conditions for that terminal configuration. Formally trained operators were supplied by the Strategic Air Command (SAC), Military Airlift Command (MAC), Air Force Communications Command (AFCC), Electronic Security Command (ESC), 9th Airborne Command and Control Squadron (ACCS), and 6th ACCS. Contractor personnel were present to perform maintenance.

b. The sixty seven deficiencies identified during initial operational test and evaluation (IOT&E) were prioritized by the using commands and provided to the System Program Office for resolution. Sixty five of these have been corrected and officially closed. The remaining two deficiencies are electromagnetic compatability (EMC) problems between the AFSATCOM terminals and other systems already on board the B-52 and RC-135 aircraft. These will be corrected by fixes incorporated into production hardware or the aircraft.

c. The final Air Force Satellite Communications (AFSATCOM) initial operational test and evaluation (IOT&E) report was published in December 1975.

d. On 1 July 1976, the Secretary of the Air Force/Installations and Logistics (SAF/IL) made a decision to proceed with production provided that fixes for the deficiencies identified during IOT&E were included in the production contract which was subsequently awarded to Rockwell International.

e. Follow-on operational test and evaluation (FOT&E) on the production terminals is scheduled to start in January 1980. Air Force Test and Evaluation Center (AFTEC) will conduct phases I and II of the FOT&E (verification of fixes for IOT&E deficiencies and wideband network performance). Strategic Air Command (SAC) will conduct, and AFTEC will monitor, phases III and IV (continued evaluation of operational effectiveness and suitability with continually increasing network complexity as more production terminals are fielded). According to the current schedule, phases I and II will end in Sep 81, and phases III and IV in Sep 82. All users will participate in the testing; SAC, Electronic Security Command, Air Force Communications Command etc. The terminals will be operated and maintained by the appropriate using agency personnel. The FOT&E will be accomplished using the Satellite Data System and Fleet Satellite Communications System (FLTSATCOM) operational satellites; production terminal equipments installed in B-52's, FB-111's and EC-135's and operational procedures developed by the using commands. The objectives are to evaluate performance in an operational environment and to verify reliability, maintainability and fixes to deficiencies, etc. The FOT&E will use operational assets when they are on normal training missions, to the extent practical.

3. (S) System Characteristics

Characteristics	Objectives	Demonstrated
Data rate (Words/Minute)	100	100
Error Rate		
Anti-Jam Protection (dbw)		
Mean time between failure (MTBF)	100 to 1000 hours depending on terminal configuration	Note 1

1. Demonstrated in reliability testing. Operational MTBF will be available after follow-on operational testing is completed.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #35158F
DoD Mission Area: Strategic Communications, #133

Title: Satellite Data System (SDS)
Budget Activity: Strategic Programs, #3

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
N/A	TOTAL FOR PROGRAM ELEMENT	23,130	36,300	45,300	27,900	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Satellite Data System (SDS) is a multi-payload, communications satellite which provides reliable and secure communications Operating in conjunction with the synchronous equatorial Fleet Satellite Communications satellites, the SDS completes the coverage required by the Air Force Satellite Communications (AFSATCOM) system for essential command and control communications to our nuclear capable forces. The SDS also provides a high speed link between Air Force Satellite Control Facility (AFSCF) remote tracking stations for command and control of national space assets and provides a nuclear event detection, identification, and location sensor.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for continuing the multi-year design and development efforts to improve the anti-jam capabilities of the AFSATCOM payload. Also included is the multi-year development necessary to produce a Space Shuttle optimized satellite. Sustaining engineering support is also required on a continuing basis.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Missile Procurement (3020)	37,900	100,223	93,823	40,023	Continuing	Not Applicable
Quantities		1	1			
Satellites						

Program Element: #35158F
DoD Mission Area: Strategic Communications, #133

Title: Satellite Data System (SDS)
Budget Activity: Strategic Programs, #3

DETAILED BACKGROUND AND DESCRIPTION: The Satellite Data System (SDS) provides critical, real-time command, control, and communications for Strategic Air Command Single Integrated Operational Plan (SIOP) and other nuclear capable forces. The SDS is an integral part of the Air Force Satellite Communications (AFSATCOM) system which also includes the Ultra High Frequency (UHF) communications capability on the geosynchronous equatorial Fleet Satellite Communications (FLTSATCOM) satellites, piggy-back transponders on selected host satellites, and airborne/ground radio terminals. As such, the SDS complements the FLTSATCOM satellite coverage by providing UHF polar coverage which the FLTSATCOM satellites cannot provide. SDS began an operational
Additionally, SDS supports the Air Force Satellite Control Facility (AFSCF) requirment for reliable, two-way high data rate, S-band communications between AFSCF remote tracking stations.

The direct benefits of SDS will be reliable and secure direct communications which will result in greatly improved command and control of our nuclear capable forces, elimination of the dependence on some of the vulnerable AFSCF communications

RELATED ACTIVITIES: The space segment of the FLTSATCOM will be developed, procured, and launched under the Navy's FLTSATCOM Program Element (PE), 33109N. The Air Force aircraft and ground UHF radio terminals required for operation with the FLTSATCOM and SDS satellites are funded within the AFSATCOM Program Element, 33601F. The AFSCF stations are funded under the AFSCF Program Element, 35110F. Space Shuttle flights for all Air Force satellites (except Special Activities), including those for SDS, are provided by the Space Launch Support Program, PF 35171F.

WORK PERFORMED BY: Air Force Systems Command's Space Division, Los Angeles, CA, is responsible for the SDS. The prime contractor is Hughes Aircraft Company, El Segundo, CA. General Systems Engineering and Integration is performed by the Aerospace Corporation, El Segundo, CA.

Program Element: #35158F
DoD Mission Area: Strategic Communications, #133

Title: Satellite Data System (SDS)
Budget Activity: Strategic Programs, #3

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The technology phase of the program was completed in FY 1971. This was followed by a contract definition phase in FY 1972 which established the system configuration. The system acquisition contractor was selected by competitive source selection and a system development contract was awarded in June 1972. The system Critical Design Review (CDR) was successfully completed in March 1974 with all critical specifications being met or exceeded. The structural model satellite testing was finished in May 1975. A qualification model satellite was built and tested to fully qualify the satellite prior to production. The first satellite (F-1) was launched on the second satellite (F-2) on All payloads were fully checked out on-orbit. Full operational capability was declared for all payloads in after successful on-orbit checkout.

Primary activities in FY 1979 included the initiation of design and development activities associated with improving the anti-jam capabilities of the AFSATCOM payload on the sixth (F-6) and subsequent satellites, the continuation of the multi-year development of a Space Shuttle optimized design on the sixth (F-6) and subsequent satellites, reliability improvement efforts, and sustaining engineering support.

2. FY 1980 Program: Efforts for this year include sustaining engineering support, continuing design and development activities to improve the anti-jam capabilities of the Air Force Satellite Communications System (AFSATCOM) payload on the sixth Satellite Data System (SDS) satellite (F-6), and continuing the multi-year development necessary to transition to the Space Shuttle. Also included are continuing efforts to improve satellite payload reliabilities.

3. FY 1981 Planned Program: The increase from FY 1980 to FY 1981 is due to the fact that the Space Shuttle optimization and AFSATCOM anti-jam improvement activity will peak in the form of final design review, development tests, qualification tests, and design validation. Sustaining engineering support and payload reliability improvements will continue.

4. FY 1982 Planned Program: The FY 1982 plan is to continue sustaining engineering support, continue development of the anti-jam improvements for the AFSATCOM payload, and continue the development efforts related to Space Shuttle optimization.

Program Element: #35158F
DoD Mission Area: Strategic Communications, #133

Title: Satellite Data System (SDS)
Budget Activity: Strategic Programs, #3

5. Program to Completion: This is a continuing program. As an integral part of the AFSATCOM (Air Force Satellite Communications) System, the program will continue to provide critical communications coverage and be totally compatible with the AFSATCOM aircraft and ground radio terminals. Sustaining engineering support will be required to maintain design compatibility and to incorporate improvements for survivability and reliability. Replenishment satellites will be procured to provide a reasonable probability of having a satellite available to launch in the event of an on-orbit failure.

6. Milestones:

	Date
System Preliminary Design Review	Mar 73
System Critical Design Review	Mar 74
Launch First Satellite (F-1)	
Launch Second Satellite (F-2)	
Full Operational Capability	
Launch Third Satellite (F-3)*	
AFSATCOM System IOC	May 79

* Subsequent launches will conform to a replenishment program necessary to

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

FY 1980 Resource Listing ($ in thousands):

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E Total for Program Element	12,800	23,500	36,300	25,500	Continuing	Not Applicable
Missile Procurement	83,200	37,900	100,300	107,500	Continuing	Not Applicable

Program Element: #35158F
DoD Mission Area: Strategic Communications, #133

Title: Satellite Data System (SDS)
Budget Activity: Strategic Programs, #3

The Fiscal Year 1981 RDT&E increase of $19.8 million is to implement the shuttle optimized satellite design. This will allow for shuttle ride sharing and attendant launch cost benefits, as well as providing some payload growth capability. The Fiscal Year 1981 Missile Procurement decrease is due

Budget Activity: #3 - Strategic Programs

Program Element: 35158F - Satellite Data System

Test and Evaluation Data

1. Development Test and Evaluation: The development contractor for the Satellite Data System (SDS) was Hughes Aircraft Company, El Segundo, California. The first satellite was launched in Initial Operational Capability was established in The first satellite (F-1) was funded entirely within the development program. The second satellite (F-2) was the first vehicle funded under the production program. The development hardware included engineering models of the communication subsystems, a structural model spacecraft (X-1) and a full-up qualification model spacecraft (Y-1). Development tests of the communications subsystems engineering models were completed in November 1973. Structural testing was satisfactorily completed on the X-1 engineering model spacecraft in May 1975. Systems level qualification was completed in October 1975 with all critical performance specifications met or exceeded. System level qualification was designed to demonstrate design integrity and performance to specification via a series of tests including shock, acoustic, modal survey, thermal, electromagnetic interference (EMI), solar-thermal vacuum, and integrated system test. The F-1 spacecraft was acceptance tested during the The Y-1 spacecraft was a fully configured spacecraft which has been refurbished and designated as flight vehicle (F-4).

2. Operational Test and Evaluation: A portion of the SDS Satellite system is part of the Air Force Satellite Communications (AFSATCOM) space segment. Classical separate IOT&E was not conducted on the space segments since all operational objectives/requirements were fully integrated into the DT&E effort and were not broken out separately. Compatibility, operational characteristics and orbit performance of payloads supporting AFSATCOM are scheduled to be demonstrated during the FOT&E of AFSATCOM. FOT&E of AFSATCOM is to be managed by AFTEC and scheduled to begin in FY 80. Results to date are contained in DT&E reports (see para. 1 above).

3. Systems Characteristics:

Characteristics	Objectives	Demonstrated
Data Rate in words per minute		
Message Bit Error Rate per ten thousand bits		
Anti-Jam Protection (db)		

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63228F
DOD Mission Area: Air Warfare Support, #225

Title: Next Generation Trainer Aircraft
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	1,900	2,000	14,400	TBD	TBD

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A need exists to maintain the Air Force's capability to provide primary flight training to undergraduate pilot candidates. This capability must be maintained in order for the United States Air Force (USAF) to sustain an adequate supply of pilots for its aircraft. The purpose of the Next Generation Trainer program is to develop a replacement, modernization or modification of the existing T-37 training aircraft. It is anticipated, using conservative projected training rates, that a significant number of T-37s will have reached the end of their service life by FY 1987. Successful accomplishment of this program will sustain the capability now maintained by the existing T-37 fleet.

BASIS FOR FY 1981 RDT&E REQUEST: Results of initial design studies will form the basis upon which the field of alternatives can be narrowed. FY 1981 efforts will focus on likely candidates and will result in a selection of aircraft and engine manufacturers to proceed into Full Scale Development.

OTHER APPROPRIATION FUNDS: Not applicable

Program Element: #63228F
DOD Mission Area: Air Warfare Support, #225

Title: Next Generation Trainer Aircraft
Budget Activity: Tactical Programs, #4

DEATAILED BACKGROUND AND DESCRIPTION: The T-37 aircraft, an integral component of the existing Undergraduate Pilot Training system, exhibits the following deficiencies:

(a) The aircraft, of early 1950's design, is approaching the end of its 15,000 hour certified service. As aircraft become unusable due to age, the remaining fleet will become numerically insufficient to sustain forecast pilot production beyond FY 1988.
(b) Excessive fuel consumption of the T-37 turbo-jet engines relative to that of currently available turbo-fan engines results in high operational costs and high drain on limited fuel supply.
(c) High cost of ownership results from excessive consumption of maintenance manhours per flying hour relative to modern aircraft of similar size and complexity.
(d) Engine noise levels significantly exceed the noise levels permissible under the Federal Aviation Regulation, Part 36.
(e) Limited range and endurance restrict aircraft sortie flexibility and training utility.
(f) Limited performance restricts the training envelope to altitudes below 25,000 feet, where airspace is becomming increasingly more congested, more hazardous, and more difficult to dedicate to aircraft training roles.
(g) Limited all weather capability restrict full training potential.
(h) Outdated instrument displays are not consistant with training requirements and transition to modern operational aircraft.

Procurement of a new/modified primary training aircraft, or modernization of existing airframes, will enable exploitation of the most cost-effective technological advancements in aircraft design. State-of-the-art technology in propulsion systems, avionics and airframe design will enable significant life cycle cost savings to be realized. By acquiring an aircraft optimized for Air Force primary training requirements, an opportunity exists to reduce existing fuel consumption in primary training by approximately 50% and to reduce maintenance manpower allocation by up to 30%. To insure a prudent phase-in of the required system, an initial operational capability of no later than FY 1987 is required.

RELATED ACTIVITIES: The Navy currently plans to replace their T-2 and TA-4 aircraft with a new training system, the Undergraduate Jet Flight Training System (VTXTS). The trainer itself is designated the VTX. The VTX trainer, as a minimum requirement must be carrier operable. It exceeds Air Force requirements in both performance and capability. The VTX would be significantly more costly for the Air Force to procure and to operate than the necessary replacement system. The pilot training programs of both the Navy and the Air Force are sufficiently large to justify the use of systems specifically tailored to individual Service needs. The Navy and the Air Force intend to develop two new aircraft systems to provide for all the basic and advanced training requirements of both Services in the future. The Services will ensure that all requirements, schedules, programming and budgeting are the fully coordinated positions of the Navy and Air Force. Any service-unique requirements, such as a hook on the advanced trainer for carrier landing, will be addressed and resolved at the outset, to avoid program perturbations later in the development cycles.

Program Element: #63228F
DOD Mission Area: Air Warfare Support, #225

Title: Next Generation Trainer Aircraft
Budget Activity: Tactical Programs, #4

WORK PERFORMED BY: The initial Systems Program Office (SPO) cadre has been formed within Air Force Systems Command's Aeronautical Systems Division/XRL at Wright-Patterson Air Force Base, Ohio. Efforts have been restricted to limited in-house efforts and have not resulted in commitment of funds prior to FY 1980. No contractors have been involved.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Program Manager has been designated and the initial systems program office cadre of planners and developers has been formed at Wright-Patterson Air Force Base, Ohio. The Mission Element Need Statement was approved in FY 1979. In-house efforts not resulting in the commitment of funds have provided planning and scheduling data necessary for formulation of plans for funded programs.

2. FY 1980 Planned Program: Initial funding is in FY 1980. $1.9 million will fund design competition by aircraft and engine manufacturers. The competition is to include studies for system development and other details as necessary in order to determine Full Scale Development configuration.

3. FY 1981 Planned Program: Results of competitive studies will be followed by selection of aircraft and engine manufacturers to proceed into Full Scale Development.

4. Planned FY 1982 Program: Initiation of Full Scale Development will take place. Source selection plans will be prepared and approved.

5. Program to Completion: Full Scale Development will be accomplished. Initiation of flight test of initial prototype will take place along with contractor and Air Force engine test.

6. Milestones

Event		Date
A. Mission Element Need Statement Approval: Milestone 0		Jun 79
B. Milestone I	*(Oct 79)	Sep 80
C. Aircraft/Engine Source Selection, Milestone II	*(May 80)	Mar 81
D. Full Scale Engineering Development Initiation	*(Oct 80)	Mar 81
E. Initial Flight Test	*(Jul 84)	Jul 85
F. Release of Long Lead Items	*(Oct 84)	Oct 85
G. First Production Item	*(Oct 86)	Oct 87
* Date presented in FY 1980 Descriptive Summary		

Explanation of Milestone Changes: The program was slipped one year due to fiscal limits in FY 1981.

Program Element: #63228F
DOD Mission Area: Air Warfare Support, #225

Title: Next Generation Trainer Aircraft
Budget Activity: Tactical Programs, #4

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	0	0	1,900	13,000	186,400	201,300

The program was slipped one year due to fiscal limits in FY 1981. A review of alternatives to need satisfaction is appropriate/has been directed. FY 80 funding will provide for that review, the results of which will provide a program focus upon which accurate cost estimates may be based.

Budget Activity: Tactical Programs, #4

Program Element: 63228F, Next Generation Trainer

Test and Evaluation Data

1. Development Test and Evaluation: The purpose of this program is to correct the deficiencies in T-37 aircraft for primary Undergraduate Pilot Training (UPT) to replace the aging T-37. This program is now beginning with a formalized Conceptual Phase.

The proposed Conceptual effort will consist of multiple parallel awards of study contracts to define the needed performance and associated equipment to effectively and economically meet the needs of Air Training Command for the next generation of primary trainer aircraft. Specifically, the Conceptual Studies will address cost verses performance for the development, acquisition, operation and support of various aircraft systems in terms of design characteristics and life cycle costs. Contractors will recommend performance goals for these systems. Airframers will address the development, acquisition, operational, and support costs of various related engines that may apply to their chosen systems. These parallel studies will help to firm up performance requirements and will lead to a narrowing of alternatives.

No experimental hardware, models or prototype demonstrations are planned under the proposed study contracts.

The studies will define aircraft, engine and systems performance required to meet the training need and show cost trades associated with different levels of performance. Study results will lead to establishing design requirements for a future system, leading to design efforts and an eventual full scale engineering development program.

Contractor conceptual studies will be utilized to develop a recommended Development, Test and Evaluation (DT&E) program tailored to the contractor's design/modification approach for development of a Next Generation Trainer system. Planning for test and evaluation will be based on the results of initial studies and previously acquired information.

In the conduct of these studies, it is not required to demonstrate reliability and maintainability. These parameters will be given appropriate consideration in accordance with applicable sections of AFR 80-5 during the analyses stage. Reliability Improvement Warranties will not be required. R&M terms (AFR 80-5), which specifically apply to the program, will be established during the conceptual phase. Qualitative and quantitative goals will be used in tradeoff analysis to develop support requirements and as inputs to the design process.

Specific contractors for this effort have not been identified. A Request for Proposals (RFP) should be issued by 3QFY 80.

2. Operational Test and Evaluation: The Air Force Test and Evaluation Center (AFTEC) will manage the Operational Test and Evaluation (OT&E) of a modified T-37, or replacement aircraft that may evolve from the NGT program. Recent dialogue between commanders of Air Force Systems Command, Air Force Logistics Command,

and Air Training Command indicates that the service life of the T-37 aircraft could be extended indefinitely, with durability and damage tolerance tests scheduled at appropriate intervals. If the service life of the T-37 is extended to 18,000 hours (for example), the initial operational capability for a replacement primary trainer aircraft could be moved to 1993, or later.

Future milestone decisions cannot be firmly scheduled and any attempts at scoping a specific OT&E Program would not be appropriate at this time. As clearer goals evolve from the NGT program, OT&E objectives can then be formulated to test the system's operational effectiveness and suitability (including reliability and maintainability) in a realistic pilot training environment.

3. Systems Characteristics:

DESIGN

ATC REQUIREMENT

Side-by-Side Seating
Twin Turbofan Engines
Ejection Seats
Anti-Ice Equipment
Single Point Refueling
Spin Resistant
Maximum Commonality of Systems and Support Equipment Between Trainer Aircraft
Nose Wheel Steering
Liquid O_2 System
Pressurized Cockpit

PERFORMANCE

ATC REQUIREMENT

Rate of Climb
≥ 2,000 fpm at 25,000'

Range
750 NM

Altitude
Normal Cruise 25,000'

"G" Loading
2.5 "Gs" at 25,000'

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63230F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Combat Aircraft Technology (CAT)
Budget Activity: Tactical Programs, #1

RESOURCES: (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,115	2,000	5,800	9,900	Continuing	
2472	Advanced Tactical Fighter Prog		2,000	5,800	9,900	Continuing	Not Applicable
2600	Enhanced Tactical Fighter (ETF) Lead-In	1,115	Project Terminated				

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The CAT program will focus on development of concepts and proving technology applicable to the next generation tactical fighter aircraft. Priority considerations will be given to manned systems which will permit penetration of central European defenses with a low degree of risk to attack targets with a high degree of cost effectiveness so as to counter projected threat capabilities into the next century. Mission area analysis has consistently shown a need for the capability to perform night and in-weather air-to-surface attack with conventional and nuclear munitions. High priority targets are armored units of enemy second echelon forces and enemy airfields. Length of time associated with defining and proving concepts and developing a new generation aircraft indicate that a new aircraft cannot enter the inventory in significant numbers and that most of its service life will be spent in the Twenty First century. The capabilities of future Soviet tactical fighter systems are not known,

BASIS FOR FY 1981 RDT&E REQUEST: The CAT program provides supporting technology base for future fighter development with initial emphasis on tactical night and in-weather air-to-surface attack. The Air Force will continue mission analysis and requirement definition studies begun in FY 1980 leading to formulation of Mission Element Need Statement and a Milestone Zero decision in FY 1981. Program will be structured to maintain flexibility and permit systems selection in the mid-1980s from a variety of air-to-surface and air-to-air options.

OTHER APPROPRIATION FUNDS: Not Applicable.

Project: #2472
Program Element: #63230F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Advanced Tactical Fighter Project
Title: Combat Aircraft Technology (CAT)
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The Combat Aircraft Technology (CAT) program has undergone major review and restructuring since the FY 1980 budget request was submitted. The Enhanced Tactical Fighter (ETF) project has been terminated. Termination of this mid term approach, however, lends an urgency to proceeding with deliberate speed toward a far term solution for the in-weather requirement.

Mission Area Analysis centering on the European commitments and projected United States, North Atlantic Treaty Organization (NATO) and Warsaw Pact (WP) capabilities clearly indicate that the Air Force will need to acquire new tactical aircraft systems Three specific factors are likely to become paramount: (1) aging and normal attrition of current forces, (2) evolution of threat capabilities and, (3) technological opportunities.

Current fighter force modernization, scheduled for completion in the mid to late 1980s depending on actual F-16 procurement, will not provide sufficient new airframes to displace the entire F-4 force. Escalating support costs will probably dictate

New technologies are emerging in aerodynamics, propulsion, materials, manufacturing techiques and avionics which will result in simpler, more reliable systems at significantly lower operating and acquisition costs. While some of these technical opportunities can be enjoyed through modification of existing systems, maximum utility can be realized through integration of several advanced technologies in a new system.

The most apparent and well documented deficiency in our tactical air power capability is the inability to attack targets at night and in-weather. Because of the immediacy of this need, the bulk of Air Force program efforts in the fighter area since the mid-1970s have been oriented towards solving this deficiency.

The Air-to-Surface Technology Evaluation and Integration Studies completed in 1976 found that

Project: #2472
Program Element: #63230F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Advanced Tactical Fighter Program
Title: Combat Aircraft Technology (CAT)
Budget Activity: Tactical Programs, #4

Normal growth of these systems with improved weapons and avionics should be able to maintain their qualitative superiority into the

Although it is apparent that the Air Force will need to acquire new tactical air power systems uncertainty exists concerning the dominant need in that time. Clearly, both air-to-air and air-to-surface mission deficiencies will grow as threat capabilities evolve; however, specific Soviet development decisions will have a major impact on determining the most critical mission area. These decisions should become more apparent by the mid-1980s. Additional factors such as budget constraints will also be more clearly defined by the mid-1980s. Therefore, the Air Force's development efforts in the CAT program will be structured to develop both the air-to-air and air-to-surface requirements and technical base so that appropriate options are available when a clearly defined acquisition decision becomes necessary in

RELATED ACTIVITIES: The Air Force has developed a structured approach to address deficiencies in night, adverse and in-weather attack capabilities against mobile targets. The primary program elements that address these deficiencies are CAT and the Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) program. The primary thrust of CAT is to develop the next generation tactical fighter aircraft. The aircraft will be characterized by high mission effectiveness, increased survivability, a quantum improvement in cost effectiveness and affordability, both in acquisition and in operating costs. The LANTIRN program will provide a highly effective near to mid-term capability for attack at night and under adverse weather conditions. The Air Force, Army and the Office of the Secretary of Defense are jointly and independently pursuing alternative approaches to the night and in-weather attack problem. Stand-off concepts such as "Assault Breaker" are being examined and are viewed as complementary to manned penetrators under investigation in the CAT program.

WORK PERFORMED BY: Pre-Milestone 0 and Concept Definition studies will be managed by the Air Force Systems Command/ Aeronautical Systems Division, Wright-Patterson AFB, OH. Contracts for studies have not yet been awarded.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Supported Mission Area Analysis and evaluated alternative technical approaches to night and in-weather attack.

2. FY 1980 Program: Initiation of mission analysis studies for an advanced tactical fighter and development of a Mission Element Need Statement (MENS) for the air-to-surface requirement.

3. FY 1981 Planned Program: The Air Force will contact industry for concept definition studies for an advanced tactical fighter. Conduct mission analysis and develop a MENS for the air-to-air requirement.

Project: #2472
Program Element: #63230F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Advanced Tactical Fighter Program
Title: Combat Aircraft Technology (CAT)
Budget Activity: Tactical Programs, #4

4. FY 1982 Planned Program: Completion and evaluation of concept definition studies leading to a Milestone I decision and initiation of a competitve concept validation/prototype phase.

5. Program to Completion: Entry into full scale engineering development for an advanced tactical fighter in the mid-1980s leading to an Initial Operational Capability in the

6. Milestones: Not Applicable.

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Program
	TOTAL FOR PROGRAM ELEMENT	1,000	6,000	8,000	32,444	279,956	328,400
2472	Advanced Tactical Attack System (ATAS)*	1,000	2,000	2,000	2,444	253,956	264,400
2600	Enhanced Tactical Fighter (ETF)**		4,000	6,000	30,000	26,000	66,000

* ATAS project has been restructured and changed to Advanced Tactical Fighter Program
** ETF project has been terminated

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63244F
DOD Mission Area: Air Warfare Support, #225

Title: Aircraft Nonnuclear Survivability
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,500	700	1,300	1,900	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the resources for the Air Force's participation in the Joint Logistics Commanders' Joint Aircraft Survivability Program. The Naval Material Command and the Army Material Development and Readiness Command are co-sponsors and contributors to the program. The program develops design guidance to improve the combat survivability of U.S. aircraft to nonnuclear threat weapons. The program also develops standard, triservice-approved vulnerability and survivability assessment methods. This program is conducted for the Joint Logistics Commanders by the Joint Technical Coordinating Group on Aircraft Survivability (JTCG/AS).

BASIS FOR FY 1981 RDT&E REQUEST: Based upon analysis of combat experience in Southeast Asia and intelligence gathered from the 1973 Mideast Conflict, the JTCG/AS, in conjunction with the Research and Development (R&D) organizations of the Logistics Commanders of the three Services, developed an overall technology plan to provide the knowledge required to improve the designs of combat survivable aircraft and equipment. This program funds the Air Force advanced development portion of this overall plan. Efforts are accomplished in the areas of threat weapon characterization, detection reduction, vulnerability reduction of aircraft systems and subsystems, improvement and validation of vulnerability and survivability assessment methodology, and in the preparation of aircraft survivability related design handbooks, military specifications and standards.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63244F
DOD Mission Area: Air Warfare Support, #225

Title: Aircraft Nonnuclear Survivability
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: In 1971, a Joint Technical Coordinating Group on Aircraft Survivability (JTCG/AS) was established under the Joint Logistics Commanders to acquire and make available technology for designing nonnuclear survivability into new aircraft. The charter of the JTCG/AS is (1) to implement interservice efforts to reduce nonnuclear vulnerability of aircraft; (2) to coordinate research and advanced development in nonnuclear survivability; and (3) to maintain liaison between technology experts and those actually designing new aircraft. In the fall of 1972, the JTCG/AS formulated a triservice nonnuclear survivability program named Test and Evaluation Aircraft Survivability (TEAS). The TEAS program was approved by Under Secretary of Defense for Research and Engineering (USDRE) and $10 million in USDRE funds were allocated for the program over a three year period (FY 73 - FY 75). As a technology-oriented program, TEAS involved experiments to strengthen the data base, evaluations of prototype hardware and development of engineering theory and design criteria. An USDRE decision in early FY 75 called for further nonnuclear survivability efforts to be budgeted by each of the Services beginning in FY 76. (Interservice coordination continues under the JTCG/AS.) The objective of this program element is to support the Air Force portion of the overall nonnuclear survivability efforts of the Department of Defense. As such, it will be a level of effort program coordinated with and complementary to Army and Navy programs.

RELATED ACTIVITIES: This program element is related to complementary programs of the Army and Navy and to Air Force programs to design aircraft with improved survivability in nonnuclear threat environments. The coordination of these efforts is through a central JTCG/AS office manned by an officer for each command represented on the Joint Logistics Commanders Group. Duplication is avoided through joint reviews by that office and the individual Service task agencies. Program is also related to Aerospace Flight Dynamics (62201F), Aerospace Propulsion (62203F), and Materials (62102F).

WORK PERFORMED BY: The Air Force Systems Command, Andrews AFB, MD, has lead responsibility for the Air Force nonnuclear survivability program. Subordinate units performing work are the Air Force Flight Dynamics Laboratory, the Air Force Aero Propulsion Laboratory, the Air Force Avionics Laboratory, and the Aeronautical Systems Division. All of these organizations are at Wright-Patterson AFB, OH. Major contractors are the Boeing Company, Seattle, WA; University of Dayton Research Institute, Dayton, OH; Systems Research Laboratories, Dayton, OH; Rockwell International, Los Angeles, CA; General Electric Co., Aircraft Engine Group, Cincinnati, OH; and Falcon Research and Development, Denver, CO.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: FY 1979 accomplishments: An aircraft Engine Nacelle Fire Test Simulator was completed at the Air Force Aero Propulsion Laboratory which was partially funded by this program. Significant improvement in fire protection in aircraft void areas through the use of chemical powder packs was achieved. A high energy laser Materials Test Data Bank was incorporated into the Combat Data Information Center. Human controller response for the ZSU-23 Threat Weapon was modeled for use in the P001 Survivability Attrition Model. Clutter and multi-patch considerations were incorporated into the SA-9 Surface-to-Air Missile Model in the TAC ZINGER

Survivability Assessment Model. Simplified vulnerability analysis procedures and methodology were developed to support trade studies during aircraft preliminary design. Repair time estimators were developed for parked aircraft vulnerability assessment methodology. Prior accomplishments: Include development of design criteria for survivable fuel cells, determination of the minimum effective concentration of inerting gasses required to protect F-16 fuel tanks against 23MM high explosive incendiary projectiles, development of analysis methods to predict behavior of structural composite materials to nonnuclear combat damage, demonstration of a compartmentalized lubrication system for vulnerability reduction of the F100 engine, completion of an A-10 combat damage repair time prediction analysis, and development of an improved fire extinguishing agent for use in the high airflow environment of combat damaged engine nacelles.

2. FY 1980 Program: A new task has been initiated in FY 1980 to optimize the agent used in chemical powder pack fire protection in aircraft void areas. Development of survivability enhancement design technology, criteria, military specifications, and standards is continuing. Fuel tanks with improved tolerance to hydrodynamic ram effects are being developed. Aircraft configurations for control of radar cross section are being investigated. Design criteria for the reduction of radar cross section and infrared signature, a design handbook for attachment and repair of armor systems, and military specifications for combat-damage tolerant aircraft structures and measurement of infrared signatures are being developed. Vulnerability assessment methodology is being expanded to parked aircraft studies and damage probability estimation techniques for specific systems and components are being developed. Vulnerability assessment data bases are being expanded for fuel system fire and explosion kill verification testing, component vulnerability ballistic resistance, material and component vulnerability to high energy lasers, and response of advanced composites to fragment impacts. The state-of-art in survivability assessment continues to be advanced by the development of standards for threat system human controller performance modeling and the integration of RF and electro-optical countermeasures effectiveness into tradeoff models. Surface-to-Air Missile Models are being standardized. Combat damage repair time estimation are being incorporated into assessment models. Fuel system hardening trade inputs are being developed for life-cycle cost models. State-of-the-art in modeling surface-to-air and air-to-air missiles is being extended.

3. FY 1981 Program: The following tasks will be continued into FY 1981: Optimizing chemical powder pack fire protection agents, developing hydrodynamic ram tolerant fuel tanks, aircraft radar cross section control, reduction of infrared signatures and radar cross sections, military specification for measurement of infrared signatures, development of damage probability estimation techniques, fuel system fire and explosion kill verification testing. integrating electro-optical countermeasures into tradeoff models, developing survivability trade inputs for life cycle cost models, and computer model development for advancing the state-of-the-art in threat missile modeling. New tasks being considered are protection against the 57MM High Explosive Incendiary (HEI) threat and analysis of combat data on aircraft with survivability modifications.

Program Element: #63244F
DOD Mission Area: Air Warfare Support, #225

Title: Aircraft Nonnuclear Survivability
Budget Activity: Tactical Programs, #4

4. FY 1982 Program: The following tasks are planned to be continued into 1982: Optimizing chemical powder pack fire protection agents, developing hydrodynamic ram tolerant fuel tanks, aircraft radar cross section control, reduction of infrared signatures and radar cross sections, development of damage probability estimation techniques, fuel system fire and explosion kill verification testing, integration of electro-optical countermeasures into tradeoff models, computer model development for advancing the state-of-the-art in threat missile modeling and protection against 57MM High Explosive Incendiary threat. New tasks being considered are fuel system vulnerability assessment to lasers, definition of inputs required for laser survivability models and assessments, and anti misting fuel testing.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data: No change in FY 1980 program.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63249F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Night Attack Program
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	15,600 1/	25,300 1/	74,800	44,400	60,200	220,300
2693	Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) 2/		9,700	55,300	35,200	60,200	160,400
2626	Night Attack Enhancement		400				400
2627	Terrain Following Radar (TFR)		1,600	7,900			9,500
2628	Millimeter Wave (MMW) Technology		1,100	4,400	3,300		8,500
2694	Single-Seat Laser Designator	15,600 1/	12,500 1/	7,200	6,200		41,500

1/ Includes funds previously identified for ATLIS II project within Program Element (PE) 64613, Common NATO Munitions, and transferred to Night Attack Program per Congressional direction. FY 1979 funds include $1.9 million in PE 64613 and an approved FY 1979 $13.7 million reprogramming request.

2/ The LANTIRN project replaces the Night Tactical Enhancement project previously described in the FY 1980 RDT&E Descriptive Summary. This change was outlined in a 2 Nov 1979 Under Secretary of Defense for Research and Engineering letter to the Chairmen of the Armed Services and Appropriations Committees.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The FY 1981 Night Attack Program has four separate projects. Its primary objective is the development of the Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN). Another major objective is development of a laser designator system for single-seat aircraft. Two other objectives include feasibility flight test demonstrations of existing hardware which will improve the precision night attack capability of existing fighter aircraft. The program will alleviate identified deficiencies present during night and adverse weather conditions in the Air Force's air-to-surface interdiction and close air suppport missions. It responds directly to an enemy ground attack threat which is continually growing in both quantitive and qualitative terms. Inherent with this increased enemy threat is the associated training, doctrine, and military equipment which provides them improved 24-hour-a-day attack capability. Air Force tactical fighter forces are used to delay, neutralize, or destroy this capability. The Air Force needs for improved night air-to-surface attack capability are specified and documented in the Air Force Planning Guide Mission Area Analysis, 1 December 1979.

Program Element: #63249F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Night Attack Program
Budget Activity: Tactical Programs, #4

BASIS FOR FY 1981 RDT&E REQUEST: The Night Attack funding request will complete the FY 1980 demonstration of target screener technology and initiate engineering development of a Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) fire control pod which will provide a day/night/under the weather attack capability for the F-16 and A-10 as well as other tactical aircraft. Efforts which examine the feasibility of adapting Terrain Following Radar technology for use on the F-4 and F-16 will be continued. The investigation of millimeter wave technology for use as an in-weather target acquisition device will also be continued. F-16 aircraft integration and flight testing of the single-seat laser designator system will be completed. The Night Tactical Enhancement project described in the FY 1980 Descriptive Summary was cancelled in favor of the LANTIRN program. Congress was notified of this action in a 2 November 1979 Under Secretary of Defense for Research and Engineering letter to the Chairmen of the Armed Services and Appropriations Committees.

OTHER APPROPRIATION FUNDS: ($ in Thousands)

LANTIRN Pods	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
Procurement (3010)			1,000	116,600	400,800	518,400
(Quantity)				(51)	(220)	(249)

Program Element: #63249F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Night Attack Program
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The threat posed by the enemy's formidable armored and air forces, especially of the Warsaw Pact against the North Atlantic Treaty Organization (NATO), has increased in the past few years and is projected to become stronger in both quantitative and qualitative terms. Enemy armor, equipped with night vision capability and accurate laser ranging systems, has been combined with new hardware, training and operational doctrine to assure a continued enemy thrust during night and adverse weather conditions. Successful interdiction and close air support missions against this projected threat require accurate target acquisition and weapons delivery. Even though target acquisition, laser designation and attack capability currently exist for day visual conditions, serious deficiencies occur when these tasks are required to be performed during night and adverse weather conditions. The need is well documented in several sources including the Air Force Planning Guide, Mission Area Analysis, 1 Dec 1979; NATO Rationalization, Standardization, Interoperability (RSI) Master Plan, 5 Sep 1979; and Tactical Air Forces Statement of Need, 302-79, Target Acquisition/Laser Designator for Single Seat Aircraft. This program is primarily dedicated to improving Air Force capability to conduct close air support and interdiction missions at night and in limited adverse weather across the spectrum of existing aircraft.

LANTIRN: The Low Altitude Navigation and Infrared System for Night (LANTIRN) pod is an air-to-ground electro-optical fire control system that integrates mature Heads-Up Display (HUD), Forward Looking Infrared (FLIR) sensor, laser designator and microprocessor computer technology into a podded system which can be utilized on most tactical aircraft. The system is designed to let a single-seat fighter pilot fly low to avoid enemy defenses while critical battlefield targets are acquired and recognized and aircraft weapons, such as the Imaging Infrared (IIR) Maverick missile, are launched. Additionally, the pod provides a single seat laser designation capability for laser guided bombs (LGBs).

TERRAIN FOLLOWING RADAR (TFR): This project's objective is a feasibility flight test demonstration of a TFR system on an F-4E PAVE TACK-equipped aircraft and the F-16. The F-4 TFR feasibility flight demonstration will investigate the utility of a manual TFR system for low level penetration and attack on a F-4E equipped with the PAVE TACK infrared sensor and laser designator pod. The RF-4 manual TFR system and other systems will be investigated for mounting under the current attack radar or in the wing station blister currently occupied by Target Identification System Electro-Optical (TISEO) system. This project does not develop a new radar for either the F-4 PAVE TACK or F-16 aircraft. The F-4 Manual TFR Program adapts existing technology to test feasibility of using manual TFR on the F-4 PAVE TACK mission. The F-16 TFR program investigates the technological feasibility of linking an automatic TFR system to the fly-by-wire flight control system. If these projects are successful, a full scale development and production program will be established.

MILLIMETER WAVE TECHNOLOGY: This project's objective is a feasibility flight demonstration of low cost night/adverse weather capability. Millimeter Wave demonstration includes terrain avoidance/blind letdown, short-range target acquisition and fire control system for night adverse weather attack. The concept includes a millimeter radar sensor, processor and a heads-up display (HUD). The millimeter sensor provides search and detection of moving and stationary targets at night and in a wide range of limited adverse weather conditions. The radar processor will detect moving targets and select high density target areas for display on the Heads-Up Display. The pilot then selects a target of interest, cues the radar via the hand control and flies the resulting HUD commands to the target. The fire control system will track the designated target and provide gun firing or weapons release command to the pilot. The millimeter

radar system may also provide a terrain elevation profile interleaved with the target search mode. A terrain profile would provide blind descent through clouds and safe flight at low altitude. This project does not develop a millimeter radar. It adapts an existing millimeter radar to an aircraft fire control system and cockpit display. This project is the only millimeter airborne fire control program which is investigating this technology for use on tactical Air Force aircraft.

SINGLE-SEAT LASER DESIGNATOR: This project will design, develop, and flight test a laser designator system intended for use on single-seat fighter aircraft, primarily the F-16. This laser designator system will provide the F-16 with the capability to radiate laser energy on pilot selected targets, thereby providing guidance to laser-guided ordnance which homes on the reflected laser energy. The laser designator will use modern state-of-the-art designator technology but eliminate the need for a second crewmember by including an automatic target tracking capability. Automatic tracker capability, high performance optics combined with television or infrared sensors, and increased gimbal performance characteristics under high "g" conditions and accelerated roll rates will provide a laser designator system with greater operational effectiveness than the current PAVE SPIKE laser designator used on F-4s. Component commonality with other systems is a goal of the program.

RELATED ACTIVITIES: There are no other Air Force or other Service efforts to develop an advanced fire control pod or laser designator equipped Forward Looking Infrared (FLIR) pod for single seat aircraft. The Navy F-18 pod has growth potential for a laser designator but for many other reasons, including increased costs, Forward Looking Infrared resolution, gimbal performance, and dependence on the host aircraft for cooling air, it is unsuitable for use on the F-16. There is no ongoing terrain following radar effort. A millimeter wave radar was developed by the Army for the AQUILA mini-Remotely Piloted Vehicle Program. There is a joint Defense Advanced Research Projects Agency (DARPA)/Air Force program investigating both X-band and millimeter wave radar. Data from this program will be used for the millimeter wave project. Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) procurement will be accomplished in Program Element (PE) 28031F. LANTIRN and the single-seat laser designator efforts are coordinated with with the F-16 and A-10 System Program Offices (SPO). LANTIRN efforts are also coordinated with the Maverick Missile SPO.

WORK PERFORMED BY: All Air Force efforts will be managed by the Aeronautical Systems Division, Wright-Patterson AFB, OH. Any F-16 efforts will necessarily involve the aircraft prime contractor, General Dynamics, Fort Worth, TX. Contractors for the LANTIRN, terrain following radar system, millimeter wave radar, and single-seat laser designator have not yet been selected.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The initial budget request for increased night attack capability ($10.0 million) was denied in the FY 1979 Authorization Bill. Internal Air Force efforts consisted of restructuring the program and incorporating Congressional direction to examine existing systems (F-18 Infrared pod) for possible adaptation to Air Force use. Approved FY 1979 reprogramming action of $13.7 million and $1.9 million of ATLIS II funds in PE 64613, Common NATO Munitions, were moved to Night Attack to align with FY 1980 Congressional direction (see next paragraph).

Program Element: #63249F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Night Attack Program
Budget Activity: Tactical Programs, #4

2. FY 1980 Program: FY 1980 Congressional action directed that $12.5 million requested for ATLIS II in PE 64613, Common NATO Munitions, be moved to the Night Attack Program and a competitive program for a F-16 pod initiated. The single-seat laser designator project will request design proposals from all qualified contractors in accordance with FY 1980 Congressional direction and award a contract for development. The LANTIRN project will begin with a demonstration of target screener technology and request competitive proposals on designs of a fire control pod designed to optimize low level employment of the Imaging Infrared (IIR) Maverick missile. The Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) pod will be equipped with a laser designator and infrared sensors. The terrain following radar (TFR) project for FY 1980 will adapt existing manual technology to the F-4E PAVE TACK system and perform a design definition study for an F-16 fully automatic TFR. The FY 1980 millimeter wave project will adapt technology and some existing hardware for use on a tactical aircraft.

3. FY 1981 Planned Program: The FY 1981 LANTIRN project will progress with design and development of prototype pods, wide field-of-view Heads-Up Display, and modifified LAU-88 missile launchers. Aircraft/pod/launcher integration will be initiated and IIR Maverick missiles will be purchased for flight test with LANTIRN technology and sensor correlation demonstration. Single-seat laser designator system will complete aircraft integration and flight test on the F-16. TFR hardware will be adapted to the flight test vehicle and complete a feasibility flight demonstration. TFR will be evaluated for continuation. The millimeter wave program will continue feasibility flight demonstration.

4. FY 82 Planned Program: The LANTIRN project will complete aircraft integration and flight test. Single-seat laser designator project will incorporate changes required as a result of flight test and finalize production design. Millimeter wave program will complete feasibility flight demonstration.

5. Program to Completion: The LANTIRN project will complete ground integration, reliability and maintenance qualification and flight test and finalize production design. The single-seat laser designator program will complete. The millimeter wave fire control feasibility flight test demonstration will be evaluated for further development.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

Program Element: #63249 Title: Night Attack Program
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222 Budget Activity: Tactical Programs, #4

8. Comparison with FY 1980 Budget Data: Resource listing from FY 1980 President's Budget ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT			12,800	31,300	50,800	94,900 1/
2627	Terrain Following Radar (TFR)			2,000	7,900	7,000	16,900 2/
2628	Millimeter Wave (MMW) Technology			1,100	4,400	3,000	8,500
2626	Night Tactical Enhancement (NITE), (Project 2357 from Program Element 64709 was transferred in FY 1980)	3,040*	4,500*	9,700	19,000	40,800	69,500 3/

* Beginning in FY 1980, Project 2357, Precision Attack Enhancement in Program Element (PE) 64709, Improved Tactical Bombing, was terminated and project efforts were transferred to the Night Attack Program, Project 2626.

1/ Total Night Attack Program costs have changed significantly due to initiation of the Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) and single-seat laser designator projects.

2/ TFR project is currently $1.6 million in FY 1980, zero in FY 1982 with total project now at $9.5 million. Suitability for project continuation will be decided after feasibility flight demonstration, which minimizes need to program FY 1982 funds at this time.

3/ Project for Night Tactical Enhancement cancelled in favor of LANTIRN, per 2 Nov 79 Under Secretary of Defense for Research and Engineering letter to the Chairmen of the Armed Services and Appropriations Committees. Night Tactical Enhancement funds were moved to LANTIRN.

FY 1981 Night Attack Program now includes LANTIRN ($160.4 million) and Single-Seat laser designator ($41.5 million) projects which were not reflected in FY 1980 data. LANTIRN replaced Night Tactical Enhancement project ($69.5 million) and added development costs. The Single-seat Laser Designator project replaced the ATLIS II project in Common NATO Munitions, PE 64613, and was included in the Night Attack Program per FY 1980 Congressional direction.

Project: #2693 Title: LANTIRN
Program Element: #63249F Title: Night Attack Program
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The threat posed by the enemy's formidable armored and air forces, especially of the Warsaw Pact against North Atlantic Treaty Organization (NATO), has grown considerably the past few years and is projected to become stronger in both quantitative and qualitative terms. Enemy armor, equipped with night vision capability and accurate laser ranging systems, has been combined with new hardware, training and operational doctrine to assure a continued enemy thrust during night and adverse weather conditions. Successful interdiction and close air support missions against this projected threat require accurate target acquisition and weapons delivery. Even though target acquisition, laser designation and attack capability currently exist for day visual conditions, serious deficiencies occur when these tasks are required to be performed during night and adverse weather conditions. The need is well documented in several sources including the Air Force Planning Guide; Mission Area Analysis, 1 Dec 1979; NATO Rationalization, Standardization, Interoperability (RSI) Master Plan, 5 Sep 1979; and Tactical Air Forces Statement of Need, 302-79, Target Acquisition/Laser Designator for Single Seat Aircraft. This project is primarily dedicated to improving Air Force capability to conduct close air support and interdiction missions at night and in limited adverse weather across the spectrum of existing aircraft.

The Low Altitude Navigation and Infrared System for Night (LANTIRN) pod is an air-to-ground electro-optical fire control system that integrates mature Heads-Up Display (HUD), Forward Looking Infrared (FLIR) sensor, laser designator and microprocessor computer technology into a podded system which can be utilized on most tactical aircraft. The system is designed to let a single-seat fighter pilot fly low to avoid enemy defenses while critical battlefield targets are acquired and recognized and aircraft weapons, such as the Imaging Infrared (IIR) Maverick missile, are launched Additionally, the pod provides a single-seat laser designation capability for laser guided bombs (LGBs).

RELATED ACTIVITIES: There are no other USAF or other services's efforts to develop an advanced fire control pod or laser designator equipped Forward Looking Infrared pod for single seat aircraft. The Navy F-18 pod has growth potential for a laser designator but for many other reasons, including increased R&D costs, Forward Looking Infrared resolution, gimbal performance, and dependence on the host aircraft for cooling air, it is unsuitable for use on the F-16. LANTIRN procurement will be accomplished in PE 28031F.

WORK PERFORMED BY: All Air Force efforts will be managed by the Aeronautical Systems Division, Wright-Patterson AFB, OH. Any F-16 efforts will necesarily involve the aircraft prime contractor, General Dynamics, Fort Worth, TX. Contractors for the LANTIRN pod have not yet been selected.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The initial request for increased night attack capability ($10.0 Million) was denied in the FY 1979 Authorization Bill. Internal Air Force effort consisted of restructuring the program and incorporating Congressional direction to examine existing systems (F-18 Infrared Pod) for possible adaptation to Air Force use.

Project: #2693
Program Element: #63249F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: LANTIRN
Title: Night Attack Program
Budget Activity: Tactical Programs, #4

2. FY 1980 Program: Congress was advised by 2 Nov 1979 Under Secretary of Defense for Research and Engineering letter to the Chairmen of the Armed Services and Appropriations Committees of Air Force intent to initiate the Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) project using $9.7 million of FY 1980 funds. The LANTIRN project will begin with a demonstration of target screener technology and request competitive proposals on designs of a fire control pod designed to optimize low level employment of the Imaging Infrared (IIR) Maverick missile. The LANTIRN pod will be equipped with a laser designator and infrared sensors. A Mission Element Need Statement for LANTIRN will be submitted to the Secretary of Defense.

3. FY 1981 Planned Program: The FY 1981 LANTIRN project will progress with design and development of prototype pods, wide field-of-view Heads-Up Display, and modified LAU-88 missile launchers. Aircraft/pod/launcher integration will be initiated and IIR Maverick missiles will be purchased for flight test with LANTIRN technology and sensor correlation demonstration.

4. FY 1982 Planned Program: The LANTIRN project will complete aircraft integration and flight test.

5. Program to Completion: The LANTIRN project will complete ground integration, reliability and maintenance qualification and flight test. Production design will be finalized.

6. Milestones: Not Applicable.

7. Resources: ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Estimated Cost
2693	Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN)		9,700	55,300	35,200	60,200	160,400

8. Comparison with FY 1980 Budget Data: Not Applicable.

LANTIRN was not included in the FY 1980 Budget. See paragraph 2 above.

Project: #2627 Title: Terrain Following Radar (TFR)
Program Element: #63249F Title: Night Attack Program
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222 Budget Activity: Tactical Programs,

DETAILED BACKGROUND AND DESCRIPTION: The threat posed by the enemy's formidable armored and air forces, especially the Warsaw Pact against North Atlantic Treaty Organization (NATO), has grown considerably the past few years and is projected to become stronger in both quantitative and qualitative terms. Successful interdiction and close air supp missions against this projected threat currently require accurate navigation, target acquisition and effective weapo delivery at low altitude. Effective low altitude ingress capability currently exists for day visual conditions; how ever, serious deficiencies occur when this task is required to be performed during night and adverse weather condi- tions. The need is well documented in the Air Force Planning Guide, Mission Area Analysis, 1 Dec 1979. This projec will improve Air Force capability to conduct close air support and interdiction missions at night and in limited adverse weather.

This project's objective is a feasibility flight test demonstration of a TFR system on an F-4E PAVE TACK-equipped ai craft and the F-16. The F-4 TFR feasibility flight demonstration will investigate the utility of a manual TFR syste for low level penetration and attack on a F-4E equipped with the PAVE TACK infrared sensor and laser designator pod. The RF-4 manual TFR system and other systems will be investigated for mounting under the current attack radar or in the wing station blister currently occupied by Target Identification System Electro-Optical (TISEO) system. This pro ject does not develop a new radar for either the F-4 or F-16 aircraft. The F-4 Manual TFR Program adapts existing technology to test the feasibility of using manual TFR on the F-4 PAVE TACK mission. The F-16 TFR program investi- gates the technological feasibility of linking an automatic TFR system to the fly-by-wire flight control system. If these projects are successful, a full scale development and production program will be structured.

WORK PERFORMED BY: All Air Force efforts will be managed by the Aeronautical Systems Division, Wright-Patterson AFB, OH. Any F-16 efforts will necessarily involve the aircraft prime contractor, General Dynamics, Fort Worth, TX. Contractors for the TFR system have not yet been selected. Texas Instruments of Dallas, TX, is a leading manufacture in this field.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: None

2. FY 1980 Program: The TFR project for 1980 will adapt existing manual TFR technology to the F-4E PAVE TACK system and perform design definition study for an F-16 fully automated TFR.

3. FY 1981 Planned Program: TFR hardware will be adapted to the flight test vehicle and complete a feasibility fligh demonstration. TFR will be evaluated for continuation.

4. FY 1982 Planned Program: None currently planned.

5. Program to Completion: Not Applicable.

Project: #2627
Program Element: #63249F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Terrain Following Radar (TFR)
Title: Night Attack Program
Budget Activity: Tactical Programs, #4

6. Milestones: Not Applicable.

7. Resources: ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
2627	Terrain Following Radar (TFR)		1,600	7,900			9,500

8. Comparison with FY 1980 Budget Data: Resource listing from FY 1980 President's Budget ($ in Thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
2627	Terrain Following Radar (TFR)			2,000 1/	7,900	7,000 2/	16,900

1/ Difference of $400 thousand from FY 1981 estimate was used to terminate Project 2626.

2/ Suitability for project continuation will be decided after feasibility flight demonstration, which minimizes need to program FY 1982 funds at this time.

Project: #2694 Title: Single-Seat Laser Designator
Program Element: #63249F Title: Night Attack Program
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The threat posed by the enemy's formidable armored and air forces, especially of the Warsaw Pact against North Atlantic Treaty Organization (NATO), has grown considerably the past few years and is projected to become stronger in both quantitative and qualitative terms. Successful interdiction and close air support missions against this projected threat require accurate target acquisition and effective weapons delivery. The Air Force requires a laser designation capability on F-16 single-seat fighter aircraft which are programmed to replace the two-seat F-4 in Europe and elsewhere. Some of these F-4s are operational with a TV laser designation system (PAVE SPIKE) which provides laser guidance for laser-guided bombs (LGBs). These aircraft are aging and will be replaced by F-16s resulting in an operational deficiency unless a single-seat laser designator capability is provided.

This project will design, develop, and flight test a laser designator system intended for use on single-seat fighter aircraft, primarily the F-16. This laser designator system will provide the F-16 with the capability to radiate laser energy on pilot selected targets, thereby providing guidance to laser-guided ordnance which homes on the reflected laser energy. The laser designator will use modern state-of-the-art designator technology but eliminate the need for a second crewmember by including an automatic target tracking capability. This tracker capability, combined with high performance optics with possibly television or infrared sensors, and increased gimbal performance characteristics under high "g" conditions and accelerated roll rates, will provide a laser designator system with greater operational effectiveness than the current PAVE SPIKE laser designator used on F-4s. Component commonality with other existing systems is a goal of the program.

RELATED ACTIVITIES: The Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) project (a separate project within the Night Attack Program) will develop an advanced fire control pod with a laser designator capability for single-seat aircraft. However, the LANTIRN pod is focused towards optimizing Air Force anti-armor weapons whereas the single-seat laser designator project will improve capability to deliver laser guided bombs. The Navy F-18 pod has growth potential for a laser designator but for many other reasons, including development costs, Forward Looking Infrared (FLIR) resolution, gimbal performance, and dependence on the host aircraft for cooling air, it is unsuitable for use on the F-16.

WORK PERFORMED BY: All Air Force efforts will be managed by the Aeronautical System Division, Wright-Patterson AFB, OH. Any F-16 efforts will necessarily involve the aircraft prime contractor, General Dynamics, Fort Worth, TX. Contractors for the single-seat laser designator have not yet been determined.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The initial budget request for increased night attack capability ($10.0 million) was denied in the FY 1979 Authorization Bill. Internal Air Force efforts consisted of restructuring the program and incorporating Congressional direction to examine existing systems (F-18 infrared pod) for possible adaptation to Air Force use. Approved FY 1979 reprogramming action of $13.7 million for ATLIS II and $1.9 million of ATLIS funds in Program Element 64613, Common NATO Munitions, were moved to Night Attack to align with FY 1980 Congressional direction (see next paragraph).

Project: #2694
Program Element: #63249F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Single-Seat Laser Designator
Title: Night Attack Program
Budget Activity: Tactical Programs, #4

2. FY 1980 Program: FY 1980 Congressional language directed $12.5 million request for ATLIS II in Program Element (PE) 64613, Common NATO Munitions, be moved to the Night Attack program and a competitive program for a F-16 pod initiated. The single-seat laser designator project will request design proposals from all qualified contractors in accordance with FY 1980 Congressional direction and award a contract for development.

3. FY 1981 Planned Program: Single-seat laser designator system will complete aircraft integration and flight test on the F-16.

4. FY 1982 Planned Program: Single-seat laser designator project will incorporate changes required as a result of flight test and finalize production design.

5. Program to Completion: Development will be completed in FY 1982.

6. Milestones: Not Applicable.

7. Resources: ($ in Thousands)

Project Number	Title	FY 79 Actual	FY 80 Estimate	FY 81 Estimate	FY 82 Estimate	Additional to Completion	Total Estimated Cost
2694	Single-seat Laser Designator	15,600 1/	12,500 2/	7,200	6,200		41,500

1/ FY 1979 funds include $1.9 million in PE 64613 and an approved 1979 $13.7 million reprogramming request.

2/ Includes funds previously identified for ATLIS II project within PE 64613, Common NATO Munitions and transferred to Night Attack Program per Congressional direction.

8. Comparison with FY 1980 Budget Data: No change, as some funds for a laser designator were previously identified in PE 64613, as explained in footnotes of paragraph 7 above.

FY 1981 DESCRIPTIVE SUMMARY

Program Element: #63306F
DOD Mission Area: Air Defense Suppression, #224

Title: Defense Suppression Weapons Advanced Technology
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to completion	Total Estimated Costs
	Total for Program Element			3,100	8,000	0	11.1
2615	Self-Protection Weapon			3,100	8,000	0	11.1

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Tactical aviation near the forward edge of the battle because of surface-to-air missiles (SAMs) and anti-aircraft artillery (AAA). Although EF-111s, F-4Gs, and Precision Location Strike Systems will be able to locally suppress defenses, current anti-radiation missiles can only be carried on specialized aircraft and are not optimized for the close-in engagements that appear to be the primary threat to NATO tactical aircraft. The planned Self-Protection Weapon will be a small lethal missile for all fighter/attack aircraft to carry in addition to their primary ordnance.

BASIS FOR FY 1981 RDT&E REQUEST: These funds will be used to initiate a competitive validation development phase by two contractors. Each will be required to demonstrate their concept through live firings.

OTHER APPROPRIATION FUNDS: Not applicable.

Project: 2615 Title: Self-Protection Weapon
Program Element: #63306F Title: Defense Suppression Weapons Advanced Technology
DoD Mission Area: Air Defense Suppression, #224 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Enemy land forces have placed extraordinary emphasis on air defense as evidenced by their increase in quantity and quality of mobile, low altitude capable air defense units. Surface to Air Missile Systems (SAMS) recently fielded or in development, near or within the Forward Edge of the Battle (FEBA) our current lethal defense suppression weapons, the High Speed Anti-Radiation Missile (HARM), currently in joint Air Force/Navy development will provide a significant increase in capability, but can be employed only by F-4G Wild Weasles and selected Navy aircraft. The Self Protection Weapon (SPW) will provide each attack aircraft with the ability to The SPW will be a low cost, lightweight weapon requiring minimal unique avionics and minimal increase in pilot workload.

RELATED ACTIVITIES: The Deputy Undersecretary of Defense, Research and Engineering, Tactical Warfare Programs, has taken the intiative to form a Tri-Service Steering Group for SPW development. The Army and the Air Force attempted to coordinate a Joint Mission Element Need Statement (MENS) for the SPW, however it was determined that the weapon requirements for helicoptors were incompatible with the fast moving fixed wing requirement. OSD agrees that the Army and Air Force weapon requirements are sufficiently different to justify separate weapon developments, but the Tri-Service Steering Group will monitor the development program of both the Army and Air Force programs to ensure technology transfer when possible. The Steering Group will make certain the Air Force program will produce a weapons system which can be used by the Navy in whole or in part if their requirements are changed. This program will transfer to PE 64302F, Defense Suppression Weapons Engineering Development for full scale engineering development.

WORK PERFORMED BY: The Armament Division of Eglin AFB, Florida manages the development program. The five contractors performing conceptual definition studies are: General Dynamics, Texas Instruments, Martin-Marietta, Hughes Aircraft, and Rockwell International.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Conceptual definition studies were begun in FY 1979, with $500,000 total spent under Program Element (PE) 63741F, Defense Suppression, by five contractors.

2. FY 1980 Program: No activities beyond the conceptual definition studies were begun because FY 1980 funds were not approved by Congress.

3. FY 1981 Program: Based on ongoing conceptual definition studies, two contractors will be selected for a competitive validation phase. The two best concepts will compete through a three year program to ensure program length and costs

Project: 2615 Title: Self-Protection Weapon
Program Element: #63306F Title: Defense Suppression Weapons Advanced Technology
DoD Mission Area: Air Defense Suppression, #224 Budget Activity: Tactical Programs, #4

stay within bounds. FY 1981 will primarily be devoted to missile design, subsystem fabrication and testing. Seeker and guidance units would be tower tested and avionics interface planning completed.

4. FY 1982 Program: Test aircraft will be modified to accept the prototype missiles. Captive flights to test the seeke units would be followed by safe separation releases. Actual missile firings will begin in late FY 1982.

5. Program to Completion: Full scale engineering under PE 64302F will begin in FY 1983. A timely production decision would allow an initial operational capability in FY 1986.

6. Milestones: Milestone 1 approval for entry into the validation phase should occur in FY 1980.

7. Resources:

8. Comparison with FY 1980 Budget Data: The Advanced Defense Suppression Weapon program in PE 63306F has been terminated by the Air Force. The SASC deleted FY 80 funds, stating that the three services must coordinate their defense suppression requirements. The Self Protection Weapon Program has been completely restructured as the design concept was refined and because of zero 1980 funding.

	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT	3,000	10,600	18,200	31,800
Project 2615 Self Protection Weapon	2,000	7,400	6,700	16,100
Project 2616 Ad Defense Suppression Wpn	1,000	3,200	11,500	15,700

FY 1981 DESCRIPTIVE SUMMARY

Program Element: #63313F
DOD Mission Area: Air-Superiority, #221

Title: Advanced Missile Subsystem Demonstration
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT			6,500	9,200	Continuing	Not applicable
2431	Passive/Active Radar Seeker			1,600	3,200	15,100	19,900
2697	Ducted Rocket Motor			4,900	6,000	Continuing	Not applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program is designed to demonstrate capabilities of advanced air-to-air tactical missile subsystems through flight test. Selected subsystems are integrated with a test missile airframe configuration and flight tested to prove new developments and allow intelligent, low-risk decisions on future tactical missile systems to meet the expanding threat. Emphasis will be placed on selecting those subsystems which can be utilized in current and projected tactical missiles.

BASIS FOR THE 1981 RDT&E REQUEST: During this period two efforts will be pursued. The Passive/Active Radar Seeker (PARS) work will provide beyond-visual-range, air-to-air, tactical missile capability to attack threat aircraft by guiding on their radar or ECM emissions. The Ducted Rocket Motor (DRM) effort will demonstrate a concept which has the potential to increase the range of tactical missiles in the 300 pound weight class by up to 100 percent.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #63313F
DOD Mission Area: Air Superiority, #221

Title: Advanced Missile Subsystem Demonstration
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The Passive/Active Radar Seeker (PARS) project will develop and demonstrate by cap tive and free flight testing the suitability of an advanced passive-active radar seeker for application in air-to-air missile systems. The objective is to demonstrate, by flight tests, the capability of a missile radar seeker to acquire and guide in midcourse on radar emissions of attack and fighter aircraft and to transition to active radar guidance in the terminal phase to minimize miss distance at target intercept. Threat fighter and attack aircraft employ radars in I and J-Band. Existing radar missiles can guide passively on targets jamming the specific missile frequency but not on emissions at other frequencies. Use of a wide band (approximately one octave) passive receiver during midcourse relieves the launch fighter of the need to update the missile through a command link when employed at the longer launch ranges. The capability to target threat aircraft by their radar emissions will force hostiles to exercise emission control and degrade the utility of their radars. The work to be performed in this project involves combining a wide band passive radar receiver with a narrow band active radar using a common antenna, all integrated in the limited volume characteristic of seekers for advanced medium range air-to-air missiles. Development of the Ducted Rocket Motor (DRM) technology was initiated in 1976 with exploratory work on gas generator fuels. Since that time, exploratory programs have developed additional fuels, flight weight combustors, and insulators. Successful engine performance has been demonstrated in ground, direct connect tests. Based on this successful exploratory effort and the need to fully demonstrate this new technology a flight test program was initiated in September 1978. At that time a plan was established for initial funding out of the Aero Propulsion Laboratory, PE 63302F, for further ground testing of the DRM and for the development of flight qualified hardware. This program element (63313F) will fund the flight test effort. Successful flight demonstration of the DRM propulsion concept will provide the medium range class tactical missiles with higher average speed to target, increased payload capability, longer range, or smaller size than solid rocket propulsion systems. Demonstration and evaluation of engine performance, missile performance limits, propulsion cost, and engine reliability will be an integral part of this program.

RELATED ACTIVITIES: Work involving passive or passive-dual mode missile seekers is being pursued by the Services in several programs. These efforts involve frequencies other than those of threat fighter and attack aircraft radars and are intended for application on large, long-range missiles. Successful demonstration of a small passive-active radar seeker sized for medium range air-to-air missiles will permit the option for development of an enhanced seeker variant for Advanced Medium Range Air-to-Air Missile (AMRAAM), PE 64314F, which could be deployed by 1990. Ducted Rocket Motor (DRM) ground test and component development, and propulsion test vehicle design and development was initiated in Program Element 63302F, Advanced Missile Propulsion. Successful demonstration of the DRM provides an option for an enhanced variant of the AMRAAM, PE 64314F.

WORKED PERFORMED BY: The Armament Development and Test Center, Eglin Air Force Base, FL, will manage the PARS development and test project. All work will be done under contract to qualified bidders. The Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, OH will manage the DRM project. Hughes Aircraft Company, Canoga Park, CA is the contractor.

Program Element: #63313F
DOD Mission Area: Air Superiority, #221

Title: Advanced Missile Subsystem Demonstration
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not Applicable

2. FY 1980 Program: Not Applicable

3. FY 1981 Planned Program: At least two contractors will be selected for competitive definition of the passive-active radar seeker. Work will include definition of interfaces with fighter Air Intercept (AI) radar, Armament Control System (ACS), and tactical electronic warning systems (TEWS). Passive only radar seekers (BRAZO program) were developed and flight tested between FY 1971 and FY 1977 by the Navy and Air Force. Advanced development solid state active radar seekers are being competitively developed by the Navy and Air Force during FY 1979 through FY 19 for application to the Advanced Medium Range Air-to-Air Missiles (AMRAAM). Studies relating to integration of a pa sive anti-radiation seeker mode with an active terminal radar seeker mode were completed in FY 1978. This concept definition phase will build on the results of the earlier efforts to define a seeker that will be compatible with use of an AMRAAM type airframe as a flight test vehicle. Fixed flow ducted rocket free jet testing will be comple during this period. Development and fabrication of the flight test hardware will be completed and flight test pre paration will be started. The final flight test plan will be issued.

4. FY 1982 Planned Program: A single Passive/Active Radar Seeker (PARS) contractor will be selected for design a fabrication of test hardware. Critical design review is planned at the end of this period. During this period, Ducted Rocket Motor (DRM) separation tests will be accomplished and flight tests begin. Data correlation and analysis will start in preparation for the final report.

5. Program to Completion: Fabrication of PARS test units will take place during FY 1983. Laboratory and roof-to testing will be performed in FY 1983 and FY 1984. Captive carriage flight tests will be conducted during FY 1984 and FY 1985. Free flight tests will be conducted in FY 1985 to complete the seeker subsystem demonstration. DRM flight tests with fixed fuel flow will be completed in FY 1983. Flight tests with variable fuel flow will be sta in FY 198[illegible]. This is a continuing program. Another demonstration project is planned to begin after FY 1982.

6. Resources: Not Applicable.

7. Milestones: Not Applicable.

Program Element: #63313F
DOD Mission Area: Air Superiority, #221

Title: Advanced Missile Subsystem Demonstration
Budget Activity: Tactical Programs, #4

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT				14,500	Continuing	Not Applicable
2431	Passive/Active Radar Seeker				1,600		
2697	Ducted Rocket Motor*				12,900		

*The FY 1980 budget was based on a plan for rapid and thorough demonstration of a fixed fuel flow Ducted Rocket Motor (DRM) as a potential motor for operational missiles. The current objective is a variable fuel flow DRM as a potential operational motor. Accordingly, the scope of the fixed fuel flow DRM testing was reduced and is the initial flight phase of demonstrating the capability of a variable fuel flow DRM.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63317F
DOD Mission Area: Theater-Wide (TNW), #242

Title: Theater Ballistic Missile
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	TITLE	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	20,000	2,000	0	0	Not Available	Not Applicable
	MRBM	2,000	2,000	0	0	Not Available	Not Applicable
	Pershing II (see PE #63311A)	18,000					

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program includes the development of concepts for a highly mobile Medium Range Ballistic Missile (MRBM) for theater deployment. MRBM concepts will provide advanced follow-on options for the modernization of long range Theater Nuclear Forces.

BASIS FOR FY 1981 RDT&E REQUEST: No FY 1981 or outyear funds are requested at this time for continuation of the MRBM program. In light of the recent decision to deploy the Pershing II and Ground Launched Cruise Missiles in Europe, the near-term MRBM system concept will not be pursued further at this time. Studies of the farther term highly mobile MRBM will be completed in FY 1980, providing data to support continued Department of Defense outyear planning.

OTHER APPROPRIATION: Not applicable.

Program Element: #63317F
DOD Mission Area: Theater-Wide (TNW), #242

Title: Theater Ballistic Missile
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: In FY 1978, the Secretary of Defense requested the Air Force to develop a plan for possible deployment of a Medium Range Ballistic Missile (MRBM) in Europe. Concurrently, the Army was conducting an advanced development program for Pershing II. In FY 1979, $20 million was provided to the Air Force for Theater Ballistic Missiles with $18 million specified for Pershing II and $2 million for MRBM. At the direction of the Secretary of Defense, the Air Force procured the services of the Army with a Military Interdepartmental Purchase Request for continued development of Pershing II by the Army Pershing Project Office. Competitive MRBM concept definition studies were conducted by the Air Force in FY 1979 and resulted in definition of a near-term MRBM concept and generation of several promising approaches to a farther term highly mobile advanced MRBM. These advanced MRBM concept studies will be completed in 1980 and will provide system concepts for potential upgrading of the survivability and effectiveness of long range Theater Nuclear Forces.

RELATED ACTIVITIES: This program is coordinated with the Army Deputy Chief of Staff for Research, Development, and Acquisition; the Defense Advanced Research Projects Agency; Defense Nuclear Agency; and the Department of Energy, Military Applications. Within the Air Force close association is maintained with the Ballistic Missile Office; Advanced Ballistic Reentry Systems program office; Air Force Rocket Propulsion Laboratory; Air Force Weapons Laboratory; Air Force Test and Evaluation Center; and Headquarters, Tactical Air Command.

WORK PERFORMED BY: The responsible Air Force agency is the Ballistic Missile Office, Norton AFB, CA. Current and potential contractors includes: McDonnell Douglas Astronautics Company, Huntington Beach, CA; General Dynamics, Convair Division, San Diego, CA; Boeing Co., Seattle, WA; Martin Marietta Aerospace, Orlando, FL; Research and Development Associates, Santa Monica, CA; General Research Corporation, Santa Barbara, CA; Science Applications, Inc., La Jolla, CA; E Systems, Inc., Greenville, TX; Logicon, Torrance, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Advanced Development Program for Pershing II was accomplished under PE #63311A by the Army. The Pershing II program transitioned to Full Scale Engineering Development in accordance with the Defense System Acquisition Review Council II decision on December 21, 1978. (See Descriptive Summary on Army program element #64311A for detailed description of the FY 1979-82 Pershing II Engineering Development program). MRBM studies were initiated at the direction of the Secretary of Defense, to include both near-term and advanced concepts. In support of the Air Staff MRBM study, definition was completed for a near-term MRBM concept which considered transporters, communications, security and basing options, and provided development costs and schedules. Effort was begun on several ideas for highly mobile advanced MRBM concepts.

Program Element: #63317F
DOD Mission Area: Theater-Wide (TNW), #242

Title: Theater Ballistic Missile
Budget Activity: Tactical Programs #4

2. FY 1980 Program: Conceptual design studies will be completed for an advanced Medium Range Ballistic Missile (MRBM) featuring high mobility; flexibility for rapid ground dispersal; advanced secure and reliable communication command, and control; improved transporter, ballistic missile, and reentry vehicle technology; enhanced security, safety, and survivability; and efficient air transportability for rapid intratheater or intertheater insertion of MRBMs, potentially into Europe or other theaters. Preliminary development cost estimates and time-phased schedules will be developed.

3. FY 1981 Planned Program: None.

4. FY 1982 Planned Program: Not applicable.

5. Program to Completion: No effort is currently planned beyond FY 1980, pending completion of this work and assessment of results in the context of Department of Defense planning for long range Theater Nuclear Force requirements in the late 1980s and early 1990s.

6. Milestones: Not applicable.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	TITLE	FY 1978 Actual	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT		20,000	4,000	15,900	Not available	Not available
	MRBM		2,000	4,000	15,900	Not available	Not available
	Pershing II		18,000				

The FY 1981 MRBM budget request was reduced from $15.9 million to zero. The elimination of MRBM funding beyond FY 1980 reflects the Department of Defense decision to develop and deploy Pershing II and Ground Launched Cruise Missiles and to complete FY 1980 advanced MRBM concept efforts as part of DoD planning for long range Theater Nuclear Force upgrades to survivability, effectiveness, and rapid force insertion. The FY 80 request of $4.0 million was reduced to $2.0 million by Congressional action.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63370F
DOD Mission Area: Counter Air #221

Title: Advanced Medium Range Air-to-Air Missile (AMRAAM)
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT [1]	18,300 [2]	27,300	25,600	1,100		464,200 [3]
2437	AMRAAM	18,300	27,300	25,600	1,100	Transition to FSED under Program Element (PE) 64314F in Fiscal year (FY) 1982. FSED funding $305.4M	464,200

[1] Funding shown FY 1979-FY 1982 is Air Force portion of Joint Air Force/Navy Validation program. Navy share of Validation program is $74.7M.

[2] Includes $2.0M in FY 1979 for Ducted Rocket Motor removed from this PE FY 1980 and beyond.

[3] Total includes $5.0M in FY 1977 and $6.8M reprogrammed in FY 1978 under PE 63316F, Navy share of Validation program ($74.7M) under PE 63370N, and Full Scale Development estimate of $305.4M. Does not include $18.9M in this PE in FY 1978 for AIM 7 Advanced Monopulse Seeker.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This joint Air Force/Navy program is structured in response to the Joint Service Operational Requirement and Mission Element Need Statement to develop an Air Superiority air-to-air missile with significant improvements in operational utility and combat effectiveness as a SPARROW follow-on missile. The need described is an adverse weather, all aspect beyond visual range air-to-air missile compatible with the F-14, F-15, F-16 and F-18, and with a performance envelope significantly improved over the AIM-7F/M, increased missile velocity, a "launch and maneuver" employment capability, and the capacity for multiple target attack during a single intercept. This program is jointly funded; Navy AMRAAM funding is in PE 63370N. The Counter Air Analysis indicates the crucial need for AMRAAM to counter the projected threat in 1986 and beyond. This threat includes improved air-to-air missiles.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funding for two competitive contractors to continue fabrication and testing of prototype missile hardware. Development, test, and evaluation missile firings will be initiated and continue throughout the year. Sixteen missiles per contractor will be fired during the competitive prototype missile firing program.

OTHER APPROPRIATION FUNDS: Not applicable. Procurement under PE 27163F to be initiated in FY1984.

Project: #2437
Program Element: #63370F
DOD Mission Area: Counter Air #221

Title: Advanced Medium Range Air-to-Air Missile (AMRAAM)
Title: Advanced Medium Range Air-to-Air Missile (AMRAAM)
Budget Activity: Tactical Program, #4

DETAILED BACKGROUND AND DESCRIPTION: This joint Air Force/Navy program has the overall objectives of continued improvement of United States air-to-air combat effectiveness. The Joint Air-to-Air Missile Requirements Study (JAAMRS) was initiated by the Under Secretary of Defense for Research and Engineering in October 1975. Combat deficiencies identified in South East Asia and the resultant improvements incorporated in the AIM-7F were reviewed to form the baseline for near and far term requirements definition. The study group reviewed the current and projected airborne threat spectrum, the Air Force/Navy roles and their relative priorities, and current technologies. The JAAMRS developed a Joint Service Operational Requirement (JSOR), validated in September 1978, which, with the Mission Element Need Statement (MENS), approved by the Secretary of Defense in December 1978, provides the basis for the AMRAAM development effort. The threat spectrum for which AMRAAM is optimized includes: manned aircraft (fighters, bombers, fighter-bombers and interceptors) operating from and at speeds up to Mach and with maneuvering accelerations up to and a majority of the threat which operates at altitudes up to and speeds to to Mach The projected aircraft threat includes: improved capability for air-to-air missiles.

The AMRAAM development effort has the objective of significantly increasing U.S. air-to-air capability and operational utility in the 1980s and beyond by producing a more effective, reliable, affordable, maintainable missile, with emphasis on low altitude targets in an Electronic Countermeasures environment. The proposed AMRAAM designs, in response to the MENS and JSOR, utilize inertial mid-course guidance and an active radar terminal guidance approach. Key features which will improve operational utility include: high average missile velocity, more range than Sparrow, increased maneuverability, multiple target attack, and launch and leave capabilities. Mature technologies, such as solid state electronics, high rate digital computers, and terminal guidance-aided fuzing are featured in the contractor approaches. Of prime importance is the requirement for the AMRAAM to be totally compatible with the fire/weapons control systems of the F-14, F-15, F-16 and F-18 aircraft. The prototype advanced development effort began in 1979 with the selection of two competitive contractors to fabricate and test components and then fabricate total prototype systems for live missile firings (16 each per contractor). Rail launchers will be developed to provide the necessary aircraft/missile interfaces and will be capable of AMRAAM and Sidewinder carriage. Ejection launchers will be modified SPARROW launchers or launchers developed for AMRAAM so as to maintain SPARROW launch capability.

This program element has a parallel Navy program element (63370N) which contains half the funds for this joint development of a common missile. Sucessful completion of this phase will allow an intensive Full Scale Development phase with first production deliveries in 1985. The Counter Air Mission Area Analysis clearly identifies AMRAAM as essential to the defense and survivability of U.S. forces and to the maintenance of Air Superiority against the threat projected beyond 1985.

Project: #2437 Title: Advanced Medium Range Air-to-Air Missile (AMRAAM)
Program Element: #63370F Title: Advanced Medium Range Air-to-Air Missile (AMRAAM)
DOD Mission Area: Counter Air #221 Budget Activity: Tactical Program, #4

RELATED ACTIVITIES: The AMRAAM development program is a joint Service effort with the Air Force as Executive Service. The Navy has assigned a Deputy Program Manager, an Assistant Chief Engineer, and assistants for Logistics and Budget. Close relationship with the F-14, F-15, F-16 and F-18 program offices is maintained. Other programs which are related to full employment capability for AMRAAM include: target identification, improved aircraft radar counter-counter-measures target track and missile guidance. The Office of The Secretary of Defense directed in the AMRAAM Decision Coordinating Paper (DCP #174) that an Operational Utility Evaluation (OUE) be performed. The OUE is to evaluate the comparative effectiveness of the AMRAAM and AIM-7M using single target track and multi-target track avionics in a realistic environment through analysis and man-in-the-loop simulation. Due to the avionics implications of the OUE, it will be performed under PE 64201F (Aircraft Avionics Equipment Development). Potential application of AMRAAM hardware for surface-to-air applications is being investigated under the auspices of the office of the Under Secretary of Defense for Research and Engineering (USDRE) with Air Force and Navy support. Funding for Full Scale Engineering Development is contained in Program Element 64314F beginning in FY 82. Procurement funding is under PE 27163F.

WORK PERFORMED BY: Government: Armament Division AMRAAM Joint System Project Office (AD/SD-7) Eglin AFB, FL; Naval Weapons Center, China Lake, CA; Pacific Missile Test Center, NAS Pt Mugu, CA; Contractors; Raytheon Company, Beford, MA; Hughes Aircraft Company, Canoga Park, CA

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: During the first quarter of FY 1977, the AMRAAM design definition was initiated based upon the Joint Service Operational Requirement as directed by USDRE with funding provided by Congress. Design efforts included performance optimization and cost trade-offs, and the beginning of laboratory testing and scintillation/miss distance reduction demonstrations at the White Sand Missile Range Test Facilities. Design proposals were prepared in anticipation of the prototype phase in FY 1978. A reprogramming request of $7.0M from the Air Force and $6.0M from the Navy was approved by Congress on 26 July 1978. The effort in this fiscal period included component development and evaluation; system performance/cost/ effectiveness evaluations; aircraft fire control/radar interface investigations; evaluation of Electronic Countermeasures and clustered target capability; and continued analysis of surface-to-air and long range applications of AMRAAM. Initiation of the AMRAAM Validation Phase (Prototype) was approved at Milestone I in November 1978. Thirty-three month Validaton Phase Contracts were awarded to Hughes Aircraft Co and Raytheon Company in February 1979. Primary efforts through FY 1979 include missile subsystem and system level design, development and test; AMRAAM launcher design and development; and F-15 Class II modification initiation.

2. FY 1980 Program: Design, development, and test will continue, seeker captive carriage testing will be initiated. Fabrication of the separation test and control test vehicles will be completed; delivery of guided test vehicles will begin. Rail and ejection launchers will be delivered and Class II modification to F-14, F-15 and F-16 was completed. Flight testing will be initiated with separation and control test missile firings.

Project: #2437 Title: Advanced Medium Range Air-to-Air Missile (AMRAAM)
Program Element: #63370F Title: Advanced Medium Range Air-to-Air Missile (AMRAAM)
DOD Mission Area: Counter Air #221 Budget Activity: Tactical Program, #4

3. FY 1981 Planned Program: During this period and early FY 1982 competitive prototype flight tests will be completed. Test data from all areas of evaluation will be compiled, reduced, and analyzed. Results will be formalized in support of presentations leading to Milestone II. Planning and actions for timely transition into Full Scale Engineering Development will be implemented.

4. FY 1982 Planned Program: Completion of flight testing. DSARC II planned November 1981. Full Scale Engineering Development will be initiated (Program Element 64314F).

5. Program to Completion: The AMRAAM program will begin full scale engineering development by one contractor in early FY 1982. Fabrication of pilot and preproduction hardware and extensive Development Test and Evaluation/Operational Test and Evaluation are planned, with Milestone III anticipated in FY 1985.

6. Milestones:

		Date
A.	Start Design Definition	Oct 76
B.	Complete Design Definition	May 77
C.	Start Pre-prototype Evaluations	Jul 78
D.	Complete Pre-prototype Evaluations	Sep 78
E.	Milestone I	Nov 78
F.	Award Adv Dev Contracts	Feb 79
G.	Subsystem Test Start	Mar 79
H.	Flight Tests Start	* (Sep 80) Oct 80
I.	Subsystem Test End	* (Sep 81) Oct 81
J.	Flight Tests End	* (Sep 81) Oct 81
K.	Milestone II	Nov 81

* Date presented in FY 1980 Descriptive Summaries.

7. Resources: Not Applicable

Project: #2437
Program Element: #63370F
DOD Mission Area: Counter Air #221

Title: Advanced Medium Range Air-to-Air Missile (AMRAAM)
Title: Advanced Medium Range Air-to-Air Missile (AMRAAM)
Budget Activity: Tactical Program, #4

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Complete	Total Project Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7,000 1/	18,300	27,300	22,200	1,000	80,800 3/
2437	AMRAAM	7,000 2/	13,800	26,100	21,600	1,000	74,500
2545	Launchers		2,500	1,200	600		4,300
2546	Ducted Rocket Motor (DRM)		2,000 4/				2,000

1/ Does not include $18.9M appropriated in this Program Element in FY 78 for AIM-7 Advanced Monopulse Seeker

2/ Reflects $7.0M original Air Force share (PE 63316F) of the total $13.0M reprogrammed in Navy and Air Force to continue definitions and approved by Congress on 26 July 1978. Only $6.8M is currently required due to estimating changes.

3/ Represents Air Force share of program funding; Navy funding of joint program ($74.7M) in PE 63370N.

4/ DRM funding provided to Rocket Propulsion Laboratory effort; DRM transferred to PE 63313F in FY 1980 and beyond.

The FY 1981 Budget data no longer separates Launcher as a specific project. The Launchers are being developed as an integral part of the two competitive AMRAAM contracts. The increase in funding in FY 1981 and FY 1982 is due to recent changes in test and evaluation funding policy and inflation. The total funding column now includes Full Scale Development estimate which was not included in the FY 1980 submission.

Budget Activity: Tactical Programs, #4

Program Element: 63370F - Advanced Medium Range Air-to- Air Missile (AMRAAM)

Test and Evaluation Data:

1. Development Test and Evaluation (DT&E): The Test and Evaluation Objective Annex (TEOA) and Test and Evaluation Master Plan (TEMP) have been formulated. Contracts were awarded to Hughes and Raytheon, 2 Feb 1979, for the competitive prototype phase. The Mission Element Need Statement (MENS) and the Joint Service Operational Requirement (JSOR) call for improved effectiveness (high velocity, launch and leave, multiple-target attack), operational utility (short range launch without Airborne Intercept Radar), reliability, maintainability and affordability. The DT&E portion of the program was initiated early FY 1980 with the start of captive carriage testing of the seekers. The first prototype missile firing is planned in early FY 1981 with completion in early FY 1982. The prototype systems tested during the latter part of this phase are anticipated to be nearly identical to the engineering development configuration missiles to be tested early in the next phase. Test objectives are to examine the potential of each contractor's prototype to meet JSOR requirements and be produced economically.

2. Operational Test and Evaluation (OT&E):

a. No AMRAAM OT&E has been accomplished to date. Combined development test and evaluation/initial operational test and evaluation (DT&E/IOT&E) is planned during the Demonstration and Validation Phase and Full Scale Engineering Development (FSED). In addition, a separate phase of IOT&E will be conducted at the end of FSED. Air Force is lead service with AFTEC as OT&E test agency.

b. Demonstration and Validation Phase. OT&E conducted during this phase will consist of monitoring DT&E tests. The missiles to be tested will be functionally but not mechanically similar to production items. The Air Force Test and Evaluation Center (AFTEC) will prepare an independent report on the projected operational effectiveness and suitability of both systems tested.

c. FSED. IOT&E will be combined with DT&E, where possible, when the AMRAAM configuration is representative of production missiles. A separate phase of IOT&E will be conducted near the end of FSED using pilot production missiles. Data collected during both the combined and separate phases of IOT&E will be used to provide a valid estimate of the AMRAAM's operational effectiveness and suitability to support Milestone III. FSED testing will be conducted from late FY 1983 through early FY 1985.

d. The Air Force Test and Evaluation Center (AFTEC) will have the overall management responsibility for AMRAAM IOT&E. The US Navy Operational Test and Evaluation Force (OPTEVFOR) will ensure that Navy requirements are included in the IOT&E test plan.

e. Specific test locations have not been determined. Ranges that have the capabilities (with modification) to test the AMRAAM are:

(1) White Sands Missile Range NM
(2) Eglin Gulf Test Range FL
(3) Pacific Missile Test Center Range CA
(4) Naval Weapons Center Test Range CA

f. Only preliminary AMRAAM initial operational test and evaluation (IOT&E) planning has been accomplished to date. The combined DT&E/IOT&E program will consist of approximately 58 total missile firings from the F-14, 15, 16, and 18 aircraft. During the last six months of the combined test period, a concurrent separate IOT&E test phase will be conducted which includes the F-15 firing 29 pilot production missions and 2800 hour captive-carry reliability program with another 20 pilot production missiles. The planned testing will be adequate for a production decision of the AMRAAM.

g. Decision Coordinating Paper (DCP) 174, 13 Jan 79, levied an additional required on the services to perform an operational utility evaluation (OUE). The OUE is to consist of an analysis effort, an air combat simulation, and a flight test. The USAF/USN position, that the analysis and simulation efforts will be adequate, recommended not conducting the special flight test because of the estimated resource impact and probable slip in initial operational capability (IOC) from The Office of the Secretary of Defense (OSD) has instructed the services to initiate the analysis and simulation tests and present the results at DSARC II (Nov 1981). The timing and scope of the OUE flight test (airborne simulation) is under consideration within OSD at this time. Since the Analysis and Simulation effort is primarily avionics oriented it will be performed under Program Element 64201F (Aircraft Avionics Equipment Development).

h. US Air Force and US Navy personnel will operate the AMRAAM throughout the development program. Contractor personnel will maintain the AMRAAM during Validation and Demonstration and the beginning of Full-Scale Engineering Development. Thereafter, all equipment will be maintained by US Air Force and US Navy personnel.

3. Systems Characteristics: The missile is being defined in response to the Mission Element Need Statement and the Joint Service Operational Requirement (JSOR). The objectives data listed below are tentative and reflect JSOR specifics which will continue to be subjected to cost/performance trade-offs.

TEST AND EVALUATION DATA:

A. Performance	Objectives	Demonstrated
Speed, Maximum Mach		
Missile Flight Launch Altitude, Ft		
Maximum		
Minimum		

Budget Activity: Tactical Programs, #4

Program Element: 63370F - Advanced Medium Range Air-to-Air Missile (AMRAAM)

Range:	
Maximum Nautical Miles	
Minimum, Ft	
Accuracy, Circular Error Probable	
Kill Probability, Percent	

B. Reliability

Mean Flight Hours Between Failure	450-600
Free Flight	.8-.85

C. Missile Description

Launch Weight (lb)	300-350
Warhead Weight (lb)	25-50
Guidance Type	Active RF Terminal/inertial midcourse
Compatibility	F-14, F-15, F-16, F-18

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63609F
DoD Mission Area: Interdiction/Naval Strike, #223

Title Advanced Attack Weapons
Budget Activity Tactical Program, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11,100	34,800	25,100	56,300	Continuing	N/A
2366	Hard Structure Munition	2,500		Transfer to PE 64615			
2369	Wide Area Antiarmor Munition	8,600	34,800	24,600	54,300	41,600	171,000
2577	Advanced Conventional Standoff Missile			500	2,000	187,800	190,300

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program is a prototype demonstration of advanced air-to-surface weapon systems and weapon system components. As such, it supports decisions to proceed into engineering development of various weapon systems and weapon system components. The major portion of the FY 1981 and FY 1982 budget is for the advanced development of the Wide Area Antiarmor Munitions (WAAM) program. This effort will satisfy the Tactical Air Forces' need for a multiple armor kill per pass capability in adverse weather conditions against rear echelon armored forces and for delivery from aircraft flying at minimum altitude.

BASIS FOR FY 1981 RDT&E REQUEST: Major design, fabrications, and components testing will be conducted on the WAAM concepts. The critical subsystem components (seeker, sensor, warheads, etc) will be demonstrated and integrated into subsystems. Multiple unique approaches to each concept will be pursued to maintain competition and reduce program risk. Advanced Conventional Standoff Missile concept definition will begin.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63609F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: Advanced Attack Weapons
Budget Activity: Tactical Program, #4

DETAILED BACKGROUND AND DESCRIPTION: The Wide Area Antiarmor Munition (WAAM) Program is responsive to the Mission Element Need Statement for Improved Wide Area Antiarmor Capability, dated 14 Sep 79. It will satisfy the Tactical Air Forces' need for a multiple armor kills per pass capability in all weather conditions against rear echelon armored forces and for delivery from aircraft at minimum altitudes. This capability is required to blunt the Soviet massed armor threat by interdicting Soviet rear echelon armored forces before they can reinforce first echelon forces and achieve a breakthrough. The major objective of the WAAM Validation Program is to demonstrate the critical subsystems (of candidate concepts with varying potential and risk) necessary to achieve a multiple kills per pass capability. These validation demonstrations will then determine which concept(s) enter engineering development. The Advanced Conventional Standoff Missile (ACSM) is intended for attack of airfields and other high-value targets. The development and deployment of a standoff misile will enable NATO to close high-threat Warsaw Pact airfields during the early days of a conflict. Weapon launch can be done from long standoff distances where launch aircraft attrition will be low. The United States, Federal Republic of Germany, and United Kingdom have written a NATO requirement for this capability.

RELATED ACTIVITIES: WAAM technology support is ongoing in Program Element (PE) 62602F, Conventional Munitions, and PE 63601F, Conventional Weapons Technology. Warhead, sensor, seeker, and dispenser technology projects in these PEs provide the basis for the WAAM concepts. Other related programs (Pave Mover, F-16 and A-10) will be integrated with WAAM to provide a total area antiarmor system capability. The WAAM program draws upon technology base advancements in millimeter wave and infrared guidance and self-forging warheads. The technology work is being accomplished cooperatively by the Air Force and Army under a 1978 Memorandum of Agreement between Army Missile Research & Development Command and AF Armament Division. ACSM will make extensive use of cruise missile technology.

WORK PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command (AFSC), Andrews AFB, MD and its subordinate organization, Armament Division (AD), Eglin AFB, FL. Contractor support for WAAM is provided by Boeing Aerospace Co., Seattle, WA; Martin-Marietta Aerospace, Orlando, FL; Honeywell Inc., Minneapolis, MN; AVCO, Everett, MA; and Hughes Aircraft, Canoga Park, CA.

Program Element: #63609F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: Advanced Attack Weapons
Budget Activity: Tactical Program, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Project 2366, Hard Structure Munitions (HSM) - Flight testing of the GBU-17 HSM with laser guidance was started this year. Based upon the results of the flight tests, the Air Force may propose the purchase of a small weapon for a limited capability. Project 2369, Wide Area Anti-Armor Munitions (WAAM) Validation of the Antiarmor Cluster Munition (ACM) continued with completion of the component designs, fabrication, and critical component demonstrations. In addition, validation contracts were awarded for the Extended Range Antiarmor Mine (ERAM) to design, fabricate, and test critical components.

2. FY 1980 PROGRAM: Project 2369, WAAM - The final phase of ACM validation will be completed in FY 1980 with system development and validation tests. Assuming a favorable Milestone II decision, ACM will advance in mid FY 1980 into Program Element (PE) 64607F, Wide Area Antiarmor Munitions. Validation efforts for the other two concepts will continue. Validation phase contracts have been awarded for the Wasp minimissile to accomplish system design, component fabrication and testing to include the seeker and airframe. ERAM will complete its submunition preliminary design phase and initial fabrication and testing of the classifier, sensor, and warhead.

3. FY 1981 PLANNED PROGRAM: Project 2369, WAAM - Validation efforts will continue this year. Wasp will accomplish critical subsystem (seeker, guidance and control package) demonstration and systems integration. ERAM will complete critical development and testing of the classifier, sensor, and warhead, and will complete the major part of system integration and validation testing. Project 2577, Advanced Conventional Standoff Missile (ACSM) - The major effort will be an attempt to formulate an international program. Design activities will continue.

4. FY 1982 PLANNED PROGRAM: Project 2369, WAAM - Validation of Wasp will continue. Drop tests, pattern tests, and live tests of emplanted sub-munitions will complete the ERAM concept validation phase. Limited testing of ACSM subsystems will be conducted.

5. PROGRAM TO COMPLETION: Project 2369, WAAM - Wasp will complete validation in FY 1984. A Defense System Acquisition Review Council II will be convened to review the program for a Full Scale Engineering Development decision. This will complete the WAAM effort in this Program Element.

Program Element: #63609F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: Advanced Attack Weapons
Budget Activity: Tactical Programs, #4

6. Milestones:

A.	Wide Area Antiarmor Munition (WAAM) Milestone 0		Sep 1979
B.	WAAM Antiarmor Cluster Munition (ACM) Milestone II Full Scale Engineering Development (FSED) Review	(Feb 80)*	May 1980
C.	WAAM Extended Range Antiarmor Mine (ERAM) Milestone II Review**		Apr 1982
D.	WAAM Wasp Milestone II Review		FY 1984

* Date presented in FY 1980 Descriptive Summary. Previous date did not allow for decision time at review council levels.

7. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	10,800	11,100	35,800	63,000	Continuing	N/A
2245	All Weather Guidance	300		Transfer to PE 63741F			
2366	Hard structure Munitions	3,400	2,500	Transfer to PE 64615F			
2369	Wide Area Antiarmor Munitions	7,100	8,600	34,800	55,100	14,100	119,700
2577	Advanced Conventional Standoff Missile			1,000	6,900	128,300	136,200

WAAM funds are reduced in FY81 by OSD. Program is restructured accordingly, with Wasp (the WAAM minimissile weapon) validation extended by an additional 15 months to 1984. The longer schedule results in increased "To Completion" and "Total Estimated Costs."

Advanced Conventional Standoff Missile funding reduced in FY 1981 and outyears as a result of updated management estimates. Program objectives remain unchanged.

Project: #2369 — Title: Wide Area Antiarmor Munitions
Program Element: #63609F — Title: Advanced Attack Weapons
DoD Mission Area: Interdiction/Naval Strike, #223 — Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The Mission Element Need Statement for Improved Wide Area Antiarmor Capability details the critical need for the Tactical Air Forces (TAF) to improve their armor kill capability against massed rear echelon armor. The Wide Area Antiarmor Munitions (WAAM) Program will improve the TAF sortie effectiveness by increasing the number of armor kills per pass.

This attack sequence may be conducted in any weather condition. The present TAF capability is limited (1) during periods of night or adverse weather, (2) in area attack capability, (3) in number of kills per pass and (4) in munitions that can be delivered from minimum altitude or standoff ranges to avoid the severe defensive environment. The need is to develop a weapon that will provide multiple kills per pass, during all hours/weather conditions and from extremely low altitudes or standoff distances. The ability to achieve multiple kills during a single pass will greatly improve the TAF antiarmor capability while decreasing its attrition to enemy defenses. WAAM has been designated as a major program and will use multiple contractors to reduce cost/schedule risk in order to achieve an operational capability at the earliest possible time. Three weapon concepts -- the Antiarmor Cluster Munition (ACM), the Minimissile (WASP), and the Extended Range Antiarmor Mine (ERAM) -- will be validated in this program. The ACM is an unguided improved antiarmor area cluster bomb that may be delivered at minimum altitudes or higher. The ACM submunition could also be packaged in a standoff delivered dispenser. The WASP is a minimissile that employs a terminal seeker and a lock-on-after-launch guidance mode. The Wasp is intended for delivery from aircraft-mounted pods for minimum altitude attack. ERAM is an airdelivered cluster weapon containing target activated land mines that provide a standoff kill capability against armor. The target does not have to contact the ERAM submunition to effect a kill; rather the ERAM's sensor classifies the target, determines the closest point of approach, and then fires a warhead at the target.

RELATED ACTIVITIES: WAAM technology support is ongoing in Program Element (PE) 62602F, Conventional Munitions, and PE 63601F, Conventional Weapons Technology. Warhead, sensor, seeker, and dispenser technology programs in these PEs provide the basis for the WAAM concepts. Other related Air Force programs (PAVE MOVER, F-16, A-10, and Assault Breaker) will be integrated with WAAM to provide a total wide area antiarmor system capability.

WORK PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command (AFSC), Andrews AFB, MD and its subordinate organization, Armament Division, Eglin AFB, FL. Additional contractor support is provided by Boeing Aerospace Co., Seattle, WA; Martin-Marietta Aerospace, Orlando, FL; Honeywell Inc., Minneapolis, MN; AVCO, Everett, MA; and Hughes Aircraft, Canoga Park, CA.

PROGRAM ACCOMPLISHMENTS & FUTURE PROGRAMS:

1. FY 1979 & Prior Accomplishments: Project 2369, Wide Area Antiarmor Munitions (WAAM) - Concept Definition studies initiated in FY 1977 were completed by multiple contractors on four WAAM concepts. Two competitive valida-

tion contracts for the Antiarmor Cluster Munitions (ACM) were awarded in late FY 1978. Two contracts for the competitive validation of the Extended Range Antiarmor Mine (ERAM) were awarded in June 1979. The Cyclops concept was eliminated in Jan 1979 to enable the program to live within funding constraints.

2. FY 1980 Program: The final phase of ACM validation will be completed in FY 1980 with system development and validation tests. Given a favorable Milestone II decision, ACM will advance in mid-FY 1980 into Program Element (PE) 64607F, Wide Area Antiarmor Munitions. Validation efforts for the other two concepts will continue. ERAM will complete its preliminary design phase and initial fabrication and testing of the classifier, sensor, and warhead. Two validation contracts were awarded for the Wasp minimissile in November 1979 to accomplish system design, component fabrication, and testing of seekers and airframe.

3. FY 1981 Planned Program: ACM will continue in Full Scale Engineering Development (FSED), in PE 64607F, with fabrication of test items, completion of Development Test and Evaluation (DT&E) and entry into Initial Operational Test and Evaluation (IOT&E). Validation efforts for the other two concepts will continue this year. WASP will complete critical subsystem (seeker, guidance and control package) demonstration and initial systems integration. ERAM will complete critical development and testing of the classifier, sensor and warhead and will complete the major part of system integration and validation testing.

4. FY 1982 Planned Program: Validation of Wasp will continue. Drop tests, pattern tests, and live tests of emplanted sub-munitions will complete the ERAM concept validation phase, if this effort is not cancelled (see FY 1981 Planned Program above). Given a favorable Milestone II decision, ERAM will advance in Mid FY 1982 into PE 64607F, for full scale engineering development.

5. Program to Completion: Wasp will complete validation in FY 1984. A Defense System Acquisition Review Council II will be convened to review the program for FSED decision. This will complete the WAAM effort in this Program Element.

6. Milestones:

A.	Antiarmor Cluster Munition (ACM) Validation Contract Award		Aug 1978
B.	Extended Range Antiarmor Mine (ERAM) Validation Contract Award		Jun 1979
C.	Wide Area Antiarmor Munitions (WAAM) Milestone 0		Sep 1979
D.	WASP Validation Contract Award	(Aug 1979)*	Nov 1979
E.	ACM Milestone II (Full Scale Engineering Development Decision) (FSED)) Review	(Feb 1980)*	May 1980
F.	ERAM Milestone II Review		Apr 1982
G.	WASP Milestone II Review		FY 1984

Project: #2369 — Title: Wide Area Antiarmor Munitions
Program Element: #63609F — Title: Advanced Attack Weapons
DoD Mission Area: Interdiction/Naval Strike, #223 — Budget Activity: Tactical Programs, #4

* Date presented in FY 80 Descriptive Summary. Previous date did not allow for decision time at review council levels.

7. Resources: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
2369	Wide Area Antiarmor Munitions	8,600	34,800	24,600	54,300	41,600	171,000

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
2369	Wide Area Antiarmor Munitions	7,100	8,600	34,800	55,100	14,100	119,700

FY81 funding level reflects reductions by OSD. Objectives and goals remain the same. The funding cut is accommodated by stretching the Wasp minimissile development time by 15 months. With the achievement of Milestone I in Nov 1979, the WAAM program is now baselined. Baseline costs exceed previous estimates due to the following: (1) Fact-of-Life Increase--negotiated contracts' price exceeded pre-negotiation estimates, (2) Inflation--due to Wasp program stretch-out to accommodate FY81 funding cuts.

Budget Activity: Tactical Programs, #4

Program Element: 63609F/64607F - Wide Area Anti-Armor Munitions (WAAM)

1. Development Test and Evaluation (DT&E):

a. Validation Phase: Testing for the Anti-armor Cluster Munition (ACM) will be conducted in early to mid FY80 by the two competing ACM contractors, Honeywell, Inc. and Martin Marietta Corp. Development testing for the other two WAAM concepts, the Extended Range Anti-tank Mine (ERAM) and the Wasp minimissile will be conducted by their respective contractors in FY82-83. Honeywell Inc. and Avco Inc. are the competing ERAM contractors; Hughes Aircraft Corp., and Boeing Aerospace Co., are competing Wasp contractors. DT&E tests will be conducted by contractor development engineers and technicians at contractor facilities and other appropriate test ranges. These tests will be supported and evaluated by Air Force Systems Command (AFSC) personnel. Common DT&E objectives for the validation phase are: (1) Demonstrate achievement of satisfactory pattern and kill mechanism performance, (2) Demonstrate the use of WAAM weapons in a variety of battlefield and countermeasure environments, (3) Demonstrate launch concepts and (4) Demonstrate the ability of Wasp and ERAM seekers to discriminate between real and false targets. An objective unique to ACM is demonstration of the orientation/stabilization device. Contractors will conduct extensive tests of critical subsystems: seekers, orientation and stabilization devices, and warheads. Dispenser drops of inert ACM's and ERAM's, and launch of instrumented Wasps will be accomplished to establish footprints and CEP. Live-round tests of individual submunitions will be conducted. Contractor development engineers and technicians will conduct development testing at Eglin AFB and other appropriate test ranges. The Air Force Test and Evaluation Center (AFTEC) will actively participate in this testing. Air Force Armament Division, Eglin AFB FL, will manage the DT&E program.

b. Full Scale Engineering Development (FSED): DT&E will be combined with Initial Operational Test and Evaluation (IOT&E). The majority of DT&E testing in FSED will be conducted by AFSC System Program Office and 3246th Test Wing personnel. Some remaining tests of subsystems will be accomplished by the contractors at their facilities. DT&E will be accomplished during (1) ACM - FY 81-82, (2) ERAM - FY 83-85 and (3) Wasp - FY 85-87. Common test objectives for this phase are to establish baseline performance characteristics for each concept and kill mechanism, to verify the predicted number of kills per pass against specified targets and to determine the effect of probable countermeasures on system performance. An assessment of the system support concept in meeting logistic requirements will be made. AFTEC will have overall management responsibility for the IOT&E program. The combined DT&E/IOT&E test program will include 170 ACM units, 116 ERAM units, and 46 Wasp minimissiles. Specific test locations are yet to be determined.

2. Operational Test and Evaluation (OT&E):

a. The WAAM concept will require operational test and evaluation for each of the three munition concepts: ACM, ERAM, and Wasp.

b. No WAAM OT&E has been accomplished to date.

c. Demonstration and Validation Phase. Only critical component and submunition tests are planned to be conducted during this phase. AFTEC will actively participate in the Demonstration and Validation (D&V) testing to determine, as much as possible, the projected operational effectiveness and suitability of each concept tested; however, no separate OT&E will be conducted. The specific objective of this phase is to determine the expected kills per pass of each concept when it is used in a realistic environment. This will be accomplished primarily by the evaluation of computer simulation and component test data. The majority of tests will be conducted by contractor personnel at contractor facilities. The remaining tests will be conducted by AFSC personnel at Eglin AFB FL.

d. Full Scale Engineering Development (FSED). OT&E conducted during this phase will be combined with DT&E when possible. Separate Initial Operational Test and Evaluation (IOT&E) will be conducted to accomplish OT&E objectives which cannot be combined with DT&E. Combined and separate IOT&E testing for each concept will be conducted during: (1) ACM - FY 81 and FY 82, (2) ERAM - FY 84, and (3) WASP - FY 85 and FY 87. Common IOT&E objectives for operational effectiveness during this phase are: (1) Measure the expected number of kills per pass against armored company arrays, (2) Estimate WAAM performance in various battlefield and countermeasures environments, (3) Estimate the ability of ERAM and WASP to accurately discriminate between real and false targets, (4) Estimate operational reliability, and (5) Estimate the effect of target location error. An objective unique to Wasp is to measure its ability to lock on after launch. The operational suitability objectives include determining the availability, maintainability, reliability, and logisitcs supportability of the systems. No unique suitability problems are anticipated. Test assets used during FSED DT&E/IOT&E will be soft tooled items. These assets will be representative of production items. Test assests programmed for separate IOT&E are: ACM - 102, ERAM -54, and Wasp - 12. At this time specific subsystems and support equipment requirements have not been identified. The requirements for each concept's test program will be defined as more data becomes available.

e. AFTEC will have the overall management responsibility for each of the three WAAM IOT&E programs.

f. Specific test locations have not been determined; however, it is likely that the Eglin AFB land range will be the primary test site. Due to the large expected footprint required by the three WAAM kill mechanisms, safety will probably be a prime consideration in test range selection. Specific test ranges will be selected when warhead characteristics are defined.

g. Preliminary IOT&E planning including a Test and Evaluation Master Plan (TEMP) and Test and Evaluation Objectives Annex (TEOA) have been accomplished to date. A plan has been developed that will provide sufficient system IOT&E.

h. US Air Force personnel will operate and maintain each WAAM muniton throughout each IOT&E program. Specific manpower will be drawn, as required, from Tactical Air Command, Air Force Logistics Command, and Air Training Command.

3. Systems Characteristics: Characteristics for each of the concepts will be definitized during validation. The objective of the program is to develop a system that can achieve multiple kills per pass of massed armor targets. The development goal is

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63616F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: Air Launched Assault Breaker
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT			7,100			7,100

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program will fund the demonstration of an air launched Assault Breaker variant. The Assault Breaker demonstration is to prove the concept of all weather acquisition, track and attack of mobile second echelon armor. The effort in this program will demonstrate the vectoring of a low flying aircraft loaded with Wide Area Anti-Armor Munitions (WAAM) to a tank target array by the PAVE MOVER radar system. This integration of real time target information and a multiple armor kill per pass capability will greatly improve the Air Force's armor kill capability.

BASIS FOR FY 1981 RDT&E REQUEST: Either an A-7 or F-4 aircraft will be modified to receive real time target information from the PAVE MOVER Radar. The demonstration of the vectoring of this aircraft loaded with WAAM munitions by the PAVE MOVER radar will begin at the end of the Fiscal Year.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #63616F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: Air Launched Assault Breaker
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND & DESCRIPTION: The Air Force and the Department of Defense have placed major emphasis on improving the national capability to defeat a Warsaw Pact armored assault. The Joint Army/Air Force/Defense Advanced Research Projects Agency (DARPA), Assault Breaker Program and the Air Force's wide area Anti-Armor Munition (WAAM) program are major efforts to attain this needed capability. The Assault Breaker Demonstration, comprised of ground and air launched missiles being guided by the PAVE MOVER radar, is scheduled for 1981-1982. The PAVE MOVER radar will have the capability to acquire, track and guide weapons to mobile, second echelon armor in all weather conditions. The WAAM program is developing munitions that are capable of attaining multiple armor kills per pass in all battlefield conditions. This program will demonstrate the ability of the PAVE MOVER radar to acquire tank targets and to pass this target information, in real-time, to low flying fighter aircraft loaded with WAAM munitions. This information, passed to attack aircraft will increase our Tactical Aircraft effectiveness while decreasing attrition due to decreased exposure time. This integrated acquisition and attack demonstration will be conducted during the joint Army/Air Force/DARPA Assault Breaker Demonstration.

RELATED ACTIVITIES: The PAVE MOVER radar, a joint Air Force/DARPA project, is being developed in Air Force Program Elements (PE) 64256F, Side Looking Airborne Radar; 63747F, PAVE MOVER; and DARPA PEs 62602E, Tactical Technologies; and 62711E, Experimental Evaluation of Major Innovative Technologies. The Anti-Armor Cluster Munition development is ongoing in PE 63609F, Advanced Attack Weapons and will transfer to PE 64607F, Wide Area Anti-Armor Munitions, in mid FY 1980. An Engineering Development program, PE 64616F, Air Launched Assault Breaker, has been established for follow-on efforts.

WORKED PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command (AFSC), Andrews AFB, MD and its subordinate organizations; Armament Division, Eglin AFB, FL and Electronic Systems Division, Hanscom AFB, MA. Additional contractor support will be provided but specific contractors have not been selected yet.

PROGRAM ACCOMPLISHMENTS & FUTURE PROGRAMS:

1. FY 1979 & Prior Accomplishments: Not Applicable.

2. FY 1980 Planned Program: Not Appliable.

3. FY 1981 Planned Program: Modifications on either an A-7 or F-4 aircraft that will allow the reception of real-time PAVE MOVER target information will be accomplished. Six live Anti-Armor Cluster Munitions (ACM) will be procured. An integrated demonstration of target acquisition, aircraft vectoring and live AGM drops on tank targets will begin at the end of this year.

4. FY 1982 Planned Program: The integrated demonstration (4 live missions) will be completed early this year and the program transitioned to PE 64616F.

Program Element: #63616F
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Air Launched Assault Breaker
Budget Activity: Tactical Programs, #4

5. Program to Completion: Not Applicable. Programs transitions in FY 1982.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data: Not Applicable.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63714F
DoD Mission Area: Land Combat Service Support #216

Title: DoD Physical Security Equipment-Exterior (Adv Dev)
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

TOTAL FOR PROGRAM ELEMENT	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Cost Estimate
	5,800	3,900	7,500	7,300	15,100	62,100

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the development of the Department of Defense (DoD) Base and Installation Security System (BISS), a DoD standardized exterior physical security system, by accomplishing advanced development tasks in four functional areas: detection, command and control, imaging, and entry control. A DoD need exists for a family of standardized modular equipment, integrable into system configurations to provide a level of security in consonance with the deployment mode, threat level, and sensitivity of the asset being protected.

BASIS FOR FY 1981 RDT&E REQUEST: This request provides for continued advanced development of technologies and prototype equipment for the Total BISS capability. The technology base and prototypes developed for the Initial BISS will deployed in three modes: permanent, semi-permanent, and mobile. Primary emphasis will be placed on detection, command and control, and imaging subsystems.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: # 63714F
DoD Mission Area: Land Combat Service Support #216

Title: DoD Physical Security Equipment-Exterior (Adv Dev)
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: This program responds to Secretary of Defense direction contained in Department of Defense (DoD) Directive 3224.3, 1 December 1976, which designates the Air Force as executive agency for the development of standardized exterior physical security equipment and systems for protection of bases and installations. The Air Force established the Base and Installation Security System (BISS) program to accomplish the necessary advanced and engineering development tasks in meeting the DoD component requirements. A world-wide increase in the level of terrorist threat and a greater emphasis on security protection for mission-critical resources necessitates the development of a standardized system capability for use by all DoD agencies. Established goals within the BISS program are the Initial BISS and Total BISS with scheduled availability dates of December 1979 and January 1986 respectfully. The Inital BISS is intended to provide Type C (production) specifications for equipment which provides a medium level security for small permanent locations and a partial system capability for selected resources deployed in a semi-permanent mode. The Total BISS objectives are to provide a capability for high level security, against all threat levels, for resources in three deployment modes: permanent, semi-permanent, and mobile. The objectives of this program in support of BISS are to provide a technology base, accomplish advanced development tasks, and develop prototype equipment for full-scale development and integration under Program Element (P.E.) 64715F, DoD Physical Security Equipment-Exterior (Eng Dev). Development of a technology base and prototypes is being carried out in four functional areas: detection, command and control, imaging, and entry control. Maximum utilization is being made of technology and prototypes developed by other Services and commercial sources whenever feasible.

RELATED ACTIVITIES: Full-scale development of equipment, subsystem/system integration and test, and type C (production) specification development is accomplished under P.E. 64715F, DoD Physical Security Equipment-Exterior (Eng Dev). Development of the BISS equipment is designed for interoperability with the Army interior security system (Facility Intrusion Detection System) and the Army tactical sensor system (Remotely Monitored Battlefield Sensor System). Management oversight of DoD physical security equipment programs is provided by the DoD Physical Security Equipment Action Group with the Chairperson residing in the Office of the Under Secretary of Defense Research and Engineering.

Program Element #63714F
DoD Mission Area: Land Combat Service Support #216

Title: DoD Physical Security Equipment-Exterior (Adv Dev)
Budget Activity: Tactical Programs #4

WORK PERFORMED BY: This program is managed by the Physical Security Systems Directorate, HQ Electronic Systems Division, Hanscom AFB, MA. Department of Defense (DoD) agencies performing advanced development tasks are: Rome Air Development Center, Griffiss AFB NY; Army Mobility Equipment R&D Command and Army Night Vision Laboratory Ft. Belvoir, VA; Army Waterways Experimental Station, Vicksburg, MS; Army Harry Diamond Laboratories, Adelphi, MD; Naval Avionics Center, Indianapolis, IN; Naval Ocean Systems Center, San Diego, CA; and the Naval Coastal Systems Center, Panama City, FL. In addition to the DoD agencies, the Department of Energy/Sandia Laboratories, Albuquerque, NM, performs advanced development tasks. In January 1979, a contract was awarded to Analytical Systems Engineering Corporation for the system engineering support and integration task.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Although there are many advanced development tasks which have been accomplished towards the initial Base and Installation Security System (BISS) capability, the following are examples of major subsystem components which have completed advanced development; small permanent communications and display segment, open ramp boundary sensor, magnetic/seismic line sensor (MILES) processor, MILES sensitivity tester, entry control identifier segment (voice print, fingerprint, and handwriting), the ported coaxial cable sensor and the waterborne intrusion detection segment.

2. FY 1980 PROGRAM: Advanced development continues in the following areas: installation security radar, pyroelectric vidicon imaging sensor, advanced fence sensor, advanced central data control/processing segment, sensor data acquisition, and infrared charge coupled device fence sensor.

3. FY 1981 PLANNED PROGRAM: The FY 1981 Planned Program consists of continued advanced development in support of total BISS. Primary emphasis will be placed on the advanced fence sensor, the advanced central data control/processing segment, sensor data acquisition, and advanced sensor signal processing techniques. The installation security radar is expected to complete advanced development in FY 1981.

4. FY 1982 PLANNED PROGRAM: The FY 1982 Planned Program consists of continued advanced development in support of total BISS. Primary emphasis will be placed on sensor data acquisition and advanced sensor signal processing techniques. The advanced fence sensor is expected to complete advanced development in FY 1982.

Program Element: # 63714F
DoD Mission Area: Land Combat Support #216

Title: DoD Physical Security Equipment-Exterior (Adv Dev)
Budget Activity: Tactical Programs #4

5. PROGRAM TO COMPLETION: This is a continuing program which will provide technology and prototype equipment for engineering development of Base and Installation Security System (BISS). Advanced development tasks will continue at a nominal level subsequent to the availability of the Total BISS capability to keep the system current with the state-of-the art technology, and to accept products of a dedicated exploratory development program for site security managed by the Defense Nuclear Agency.

6. MILESTONES: Not Applicable

7. RESOURCES: Not Applicable

8. COMPARISON WITH FY 1980 BUDGET DATA:

	FY 1978 Actual	FY 1979 Estmate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	5,194	6,000	3,900	7,400	Continuing	Not applicable

Reduction in FY 1979 due to delay in the award of the system engineering support and integration contract. Increase in FY 1981 due to inflation factors. This is the first year that estimates were made for total costs.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63718F
Title: Electronic Warfare Technology
DOD Mission Area: Electronic Warfare Counter C^3, #257
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11,990	10,000	14,400	19,700	Continuing	Not Applicable
691X	Electronic Warfare Technology	9,490	7,800	11,000	14,800	Continuing	Not Applicable
2432	Warning and Power Management Systems Technology	2,500	2,200	3,400	4,900	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides advanced development in the area of electronic warfare (EW) where an expanded technology base is needed to solve critical penetration aid problems for all classes of manned and unmanned aircraft. This program also provides for component, technique and subsystem development leading to the reduction of acquisition and life cycle cost of EW equipment.

BASIS FOR FY 1981 RDT&E REQUEST: This is a technology based program providing risk reduction and feasibility/military worth demonstrations of a broad spectrum of EW techniques, components and systems. Both generic applications to and in support of specific weapon systems are provided. Continual changes in enemy air defense doctrine and improvements in equipment dictate maintenance of a strong technology base in the countermeasures field. Efforts started in previous years in various areas including Electronic Countermeasures (ECM), and counter communication countermeasures will continue. Major new starts addressing critical needs are planned in advanced signal processing and receivers, and ECM. The major efforts scheduled for completion of FY 1981 are ECM, demonstration of a family of EW amplifier transmitter chains, and demonstration of an radar ECM system and the Surface Acoustic Wave receiver.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63718F
DOD Mission Area: Electronic Warfare Counter C^3, #257

Title: Electronic Warfare Technology
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Modern air warfare is dominated by the presence of a myriad of electronic devices that locate, monitor, guide and control offensive and defensive elements. Denial of enemy use of these devices while retaining the capability for our own systems is the function of electronic warfare. The survivability of our aircrews and the number of weapons delivered to the target are directly relatable to the efficiency of our electronic warfare (EW) systems. It is axiomatic that an enemy faced with a strong EW capability will attempt to enhance his capability through changes in tactics and improved equipment. To gain and maintain an advantage requires a strong EW technology program to provide demonstrated alternatives that counter any initiatives made by the enemy defense.

Hardware and techniques developed under this program are structured into six classes with a supporting analysis and simulation effort that guides the allocation of funding through the evaluation of new concepts and techniques. The six hardware areas are: (1) radar signature reduction to delay and impair acquisition and tracking of our aircraft by enemy radar; (2) warning and power management receivers to alert crews of our aircraft to impending attack and to control our jammer for optimum efficiency; (3) on-board jamming systems, components and techniques needed to jam enemy radar; (4) offboard or expendable systems to confuse enemy radars and dilute enemy defenses; (5) tactic and electronic collection systems to inform the field commander of changes in the electronic environment; and (6) the development of standardized and low cost components and systems to enable the Department of Defense to better afford the increasing amount and sophistication electronic countermeasures equipment required on modern aircraft.

RELATED ACTIVITIES: The efforts in this program are closely coordinated with the Program Element (PE) 63734F, Electro-Optical Warfare, and other electro-optical and EW programs as well as the advanced development work in similar activities conducted by the Army and the Navy. Exploratory development efforts are phased into this program from PE 62204F, Aerospace Avionics. Completed EW efforts are transitioned into the engineering development programs; PE 27252F, EF-111A; PE 64710F, Reconnaissance Equipment; PE 64724F, Tactical C^3 Countermeasures; PE 64738F, Protective Systems; PE 64737F Airborne Self Protection Jammer; and PE 64739F, Tactical Protective Systems. Joint Service efforts are in radar warning receivers (NAVY), a jamming system (Air Force) and the Advanced transmitter for the ALQ-99 installed on the EF-111A and EA-6B. A tri-Service effort for jamming and a new threat warning system are planned. radar countermeasure efforts are coordinated with the Navy and the Air Force special program office (HAVE EXIT).

WORK PERFORMED BY: The Air Force Avionics Laboratory, Wright-Patterson Air Force Base, OH, manages the program. The major contractors are: Calspan Corporation (formerly Cornell Aeronautical Laboratory), Buffalo, NY - study and analysis; Kuras-Alterman Corporation, Fairfield, NJ - jammer control and modulation techniques, Magnavox, Fort Wayne, IN - jammer techniques; SEDCO Corporatin, Farmingdale, NY - antenna techniques; GTE Sylvania Corporation, Mountain View, CA - communications jammers; Georgia Institute of Technology, Atlanta, GA - Electronic Warfare technique analysis; Norden, Norwalk, CT - jammer techniques; Motorola, Phoenix, AZ - radar signal receivers and early warning radar ECM; Raytheon, Goleta, CA - jamming; Northrop, Chicago, IL - Common EW transmitter chains; and Sperry, Clearwater, FL - Radio frequency sources.

Program Element: #63718F
DOD Mission Area: Electronic Warfare Counter C^3, #257

Title: Electronic Warfare Technology
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Prior year accomplishments include numerous comprehensive studies and analyses to guide Air Force Electronic Warfare (EW) plans and programs; demonstration of radar warning receiver improvements for B-52, jammers for strategic applications, improved chaff, both radar countermeasures, and development of the Advanced Power Management System (APMS) in Project 2432 designed to evaluate EW power managed sysytem concepts for future threat environments.

2. FY 1980 Program: The FY 1980 efforts will consist of the continuation and completion of development efforts begun in previous years as well as several new starts. Tasks that will continue in FY 1980 include: analysis of various penetration aids; electronic countermeasures (ECM) technique evaluation and effectiveness study; development of a broad band (1-18 gigahertz (GHz) amplifier ; technique development for a radar countermeasure development of a countermeasure system; development of a modularized tactical communications command and control (C^3) countermeasures system for use with tactical electronic warfare pods or installed on the EF-111 and EA-6B; fabrication of a fast set-on frequency synthesizer (.5-18 GHz) to replace voltage controlled oscillators; fabrication of an advanced receiver for dense signal environments using Surface Acoustic Wave technology to reduce size and cost; and joint Service funding of a Navy directed development of a radar warning receiver. New starts for FY 1980 include: a new threat warning system definition study, integrated radar and Electro-Optical EW system concepts, development of an radar countermeasures system, radar active expendable decoys, and the development of terrain bounce countermeasure techniques against radars. Scheduled for completion are: the for advanced EF-111A applications (joint Air Force/Navy), and system integration and test of the APMS concept.

3. FY 1981 Planned Program: The FY 1981 program will consist of continuation of prior year efforts with several new starts. To be continued in FY 1981 are: the analysis and simulation activity, advanced radar signal processing technique a new threat warning system study to identify requirements for new radar signal receivers; broadband field effect transistor pre-amplifiers; development of an integrated radio frequency (RF)/Electro-Optical tactical countermeasure system to reduce size and cost of future ECM systems; the expendable RF decoy to counter threats; the countermeasure demonstration and improvement to the advanced power management system. New starts include: improvements to the Wild Weasel F-4G and other electronic surveillance and targeting systems; an advanced missle fuze jammer to dud or predetonate missiles; a joint Air Force/Navy development for modularized jamming systems; a joint service electronic countermeasures transmitter; a digital RF memory to store replicas of threat signals; new receiver concepts based upon dielectric filters and acoustical optic (BRAGG CELL) frequency discriminators to reduce size and cost of advanced radar signal receivers; advanced signal processors to handle dense and exotic signal environments expected in the late 1980's; and a major effort to develop the next generation threat warning system. Scheduled for completion are: the wave warning and ECM system efforts, the common RF transmitter chains demonstration, the radar ECM system, the frequency synthesizer to replace voltage controlled oscillators and the countermeasure flight test.

Program Element: #63718F
DOD Mission Area: Electronic Warfare Counter C^3, #257

Title: Electronic Warfare Technology
Budget Activity: Tactical Programs, #4

4. FY 1982 Planned Program: The FY 1982 program will consist of continuation and completion of prior year efforts together with several new starts. To be continued in FY 1982 are: Electronic Countermeasure (ECM) technique evaluation research and simulation, Wild Weasel and Electronic Support Measures improvements, missile fuze jammers, and the countermeaure demonstation, tactical counter communication, command and control (C^3) development, the transmitter, advanced signal recognition techniques, digital memory sources, advanced receiver technology demonstration and new threat warning systems. New starts are planned in: drone or remotely piloted vehicle jamming payloads, radar cross section reduction for advanced tactical aircraft designs, improved aerodynamic and doppler producing chaff, detection and ECM. Scheduled for completion in FY 1982 are: the radar radio frequency expendable decoy, and the broadband Field Effect Transistor pre-amplifier.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	9,438	10,000	10,000	20,000	Continuing	Not Applicable
Project 691X	7,438	7,500	7,800	15,200	Continuing	Not Applicable
Project 2432	2,000	2,500	2,200	4,800	Continuing	Not Applicable

FY 1979: Funding in FY 1979 included a $1,990 thousand increase. This was a result of a reprogramming action to provide additional funds for a radar detection and countermeasure test and evaluation.

FY 1980: No change.

FY 1981: Funding in FY 1981 represents a $5,600 thousand decrease inorder to fund higher priority Air Force requirements in other technology base programs. The impact of this decrease will delay technology efforts in areas where neither the anticipated technology nor the requirement has fully matured.

Project: 691X
Program Element: #63718F
DOD Mission Area: Electronic Warfare Counter C^3, #257

Title: Electronic Warfare Technology
Title: Electronic Warfare Technology
Budget Activity: Tactical Programs, # 4

DETAILED BACKGROUND AND DESCRIPTION: Modern air warfare is dominated by the presence of a myriad of electronic devices that locate, monitor, guide and control offensive and defensive elements. Denial of enemy use of these devices while retaining the capability for our own systems is the function of electronic warfare. The survivability of our aircrews and the number of weapons delivered to the target are directly relatable to the efficiency of our electronic warfare (EW) systems. It is axiomatic that an enemy faced with a strong EW capability will attempt to enhance his capability through changes in tactics and improved equipment. To gain and maintain an advantage requires a strong EW technology program to provide demonstrated alternatives that counter any initiatives made by the enemy defense.

Hardware and techniques developed under this program are structured into six classes with a supporting analysis and simulation effort that guides the allocation of funding through the evaluation of new concepts and techniques. The six hardware areas are: (1) radar signature reduction to delay and impair acquisition and tracking of our aircraft by enemy radar; (2) warning and power management receivers to alert crews of our aircraft of impending attack and control the jammer for optimum efficiency; (3) on-board jamming systems, components and techniques needed to jam enemy radar; (4) offboard or expendable systems to confuse enemy radars and dilute enemy defenses; (5) tactic and electronic collection systems to inform the field commander of changes in the electronic environment; and (6) the development of standardized and low cost components and systems to enable the Department of Defense to better afford the increasing amount and sophistication electronic countermeasures equipment required on modern aircraft.

RELATED ACTIVITIES: The efforts in this program are closely coordinated with the Program Element (PE) 63734F, Electro-Optical Warfare, and other electro-optical and EW programs as well as the advanced development work in similar areas conducted by the Army and the Navy. Exploratory development efforts are phased into this program from PE 62204F, Aerospace Avionics. Completed EW efforts are transitioned into the engineering development programs; PE 27252F, EF-111A; PE 64710F, Reconnaissance Equipment; PE 64724F, Tactical C^3 Countermeasures; PE 64738F, Protective Systems; PE 64737F, Advanced Self Protection Jammer; and PE 64739F, Tactical Protective Systems. Joint Service efforts are in radar warning receivers (NAVY), a jamming system (Air Force) and the Advanced transmitter for the ALQ-99 installed on the EF-111A and EA-6B. A tri-Service effort for tactical communications jamming and a new threat warning system are planned. radar countermeasure efforts are coordinated with the Navy and the Air Force special program office (HAVE EXIT).

WORK PERFORMED BY: The Air Force Avionics Laboratory, Wright-Patterson Air Force Base, OH, manages the program. The major contractors are: Calspan Corporation (formerly Cornell Aeronautical Laboratory), Buffalo, NY - study and analysis; Kuras-Alterman Corporation, Fairfield, NJ - jammer control and modulation techniques, Magnavox, Fort Wayne, IN - jammer techniques; SEDCO Corporatin, Farmingdale, NY - antenna techniques; GTE Sylvania Corporation, Mountain View, CA - communication jammers; Georgia Institute of Technology, Atlanta, GA - Electronic Warfare technique analysis; Norden, Norwalk, CT - jammer techniques; Motorola, Phoenix, AZ - radar signal receivers and early warning radar ECM; Raytheon, Goleta, CA - jamming; and Northrop, Chicago, IL - Common EW transmitter chains.

Project: 691X
Program Element: #63718F
DOD Mission Area: Electronic Warfare Counter C^3, #257

Title: Electronic Warfare Technology
Title: Electronic Warfare Technology
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Prior year accomplishments include numerous comprehensive studies and analyses to guide Air Force Electronic Warfare (EW) plans and programs; demonstration of techniques in a B-52 for the of jamming interference in radar warning receivers; fabrication of an jammer for strategic penetration; a jamming system to counter Soviet systems; demonstration of more efficient chaff dispensing techniques and broadband chaff designed to counter gigahertz (GHz) threat radars; flight test demonstration of a countermeasure technique; flight test and follow-on development of a jammer; and simulation test of the Soviet jammer for strategic penetration applications.

2. FY 1980 Program: The FY 1980 efforts will consist of the continuation and completion of development efforts begun in previous years as well as several new starts. Tasks that will continue in FY 1980 include: analysis of the effects on a defensive radar network of various penetration aids; electronic countermeasures (ECM) technique evaluation and effectiveness study; development of a broad band (1-18 GHz) amplifier using Field Effect Transistors; technique development for a radar countermeasure development of a countermeasure system; development of a modularized tactical communication, command and control countermeasures systems for use with tactical electronic warfare pods or installed on the EF-111A and EA-6B; fabrication of an advanced receiver for dense signal environments using Surface Acoustic Wave technology to reduce size and cost; and joint Service funding of a Navy directed development of a radar warning receiver. New starts for FY 1980 include: integrated Radar and Electro-Optical EW system concepts, development of an countermeasures system, radar active expendable decoys, advanced radar signal tracking devices, the development of ; countermeasure techniques against radars. Scheduled for completion are the transmitter for advanced EF-111A applications (joint Air Force/Navy) and a jammer for the B-52.

3. FY 1981 Planned Program: The FY 1981 program will consist of continuation of prior year efforts with several new starts. To be continued in FY 1981 are: the analysis and simulation activity, including technique research to exploit radio frequency (RF) signal and radar antenna characteristics for future ECM systems; advanced radar signal processing and tracking techniques to identify exotic radar signals; a new threat warning system study to identify requirements for new radar signal receivers; broadband field effect transistor pre-amplifiers; development of an integrated RF/Electro-Optical (EO) tactical countermeasure system to reduce size and cost of future ECM systems; the expendable RF decoy to counter countermeasure demonstration. New starts include: improvements to the Wild Weasel F-4G (improved signal receiver/processing); an advanced missile fuze jammer to dud or predetonate missiles; a joint Air Force/Navy counter communication, command and control development for modularized jamming systems; a joint service ECM transmitter; improvements to tactical Electronic Support Measures systems (improved signal receiver/processors); recognition system to take advantage of peculiar threat signal parameters; and signal processors to handle dense and exotic

signal environments . Scheduled for completion are: wave warning and Electronic Countermeasures (ECM) system efforts, the common radio frequency (RF) transmitter chains demonstration, the radar ECM system, and the countermeasure development.

4. FY 1982 Planned Program: The FY 1982 program will consist of continuation and completion of prior year efforts together with several new starts. To be continued in FY 1982 are: ECM technique evaluation research and simulation, Wild Weasel and Electronic Support Measure system improvements, missile fuze jammers, the tactical counter communications development, the transmitter, the countermeasure demonstration, advanced signal recognition techniques, drone or remotely piloted vehicle jamming payloads, radar cross section reduction for advanced tactical aircraft designs, improved aerodynamic and doppler producing chaff, detection and ECM. Scheduled for completion in FY 1982 are: the radar RF expendable decoy and the broadband pre-amplifier.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
691X	Electronic Warfare Technology	9,470	7,800	11,000	14,500	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Project 691X	7,438	7,500	7,800	15,200	Continuing	Not Applicable

FY 1979: Funding in FY 1979 included a $1,990 thousand increase. This was a result of a reprogramming action to provide additional funds for a radar detection and countermeasure test and evaluation.

FY 1980: No change.

FY 1981: Funding in FY 1981 represents a $4,200 thousand decrease inorder to fund higher priority Air Force requirements in other technology base programs. The impact of this decrease will delay technology efforts in areas where either the anticipated technology or the requirement has not fully matured.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63727F
Title: Advanced Communication Technology
DoD Mission Area: Tactical Command and Control, #254
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	9,090	3,700	4,200	5,200	Continuing	N/A
2277	SEEK TALK *	6,490					
2345	Jam Resistant Data Link Transmission	1,800	3,500	3,600	3,700	Continuing	N/A
2538	Integrated Communications, Navigation Identification Avionics***		200	600	1,500	Continuing	N/A
2594	Adaptive High Frequency/Very High Frequency Communications**	800				Continuing	N/A

* Transferred to PE 27423F, Advanced Communication Systems in FY 1980
** To be transferred to PE 33131K, Minimum Essential Emergency Communications Network (MEECN)
*** To be transferred to PE 63253F, Advanced System Integration Demonstrations

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Modern military systems and weapons derive much of their value from data links, which increase the timeliness of information transfer and improves accuracy and standoff range of weapon systems.

As tactical aircraft and missions increase in complexity and scope, equipment using advanced technologies are applied to improve aircraft effectiveness. The cost, both financial and equipment availability terms, to modify and integrate new equipment into existing aircraft must be minimized. The Jam Resistant Data Link Transmission project is developing and applying technologies to protect future data links from jamming, this project is part of the Joint Service Weapon Data Link (JSWDL) program; as such this advanced technology will be available for use by other Services. The Integrated Communication Navigation Identification (CNI) Avionics project will integrate the functions of current and planned CNI equipment into a single modular architecture. This system will employ advanced, high potential payoff technology to develop a family of

interchangeable common modules that would become candidates for standardization. By encouraging Tri-Service and North Atlantic Treaty Organization participation in adopting the Integrated Communication, Navigation and Identification (CNI) Avionics concept, our military capability can be multilaterally enhanced.

BASIS FOR FY 1981 RDT&E REQUEST: The Air Force is required to perform tactical operations in an increasingly complex electronic countermeasures (ECM) environment. To insure data links will function in the presence of ECM, an advanced development development will be completed to provide a very high degree of jam-resistance to a compressed video signal. Preparation will be made to install this modem in a GBU-15 test bed for captive flight tests, starting in FY 1981. To improve integration of new CNI equipment into aircraft, development of an optimal architecture for a CNI signal processor will be continued. This architecture will be used for design and fabrication of a signal processor using radio frequency large scale integration, single integrated circuit radio, and very large scale integration techniques. Integrated CNI algorithms and software will be concurrently developed.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63727F
DoD Mission Area: Tactical Command and Control, #254

Title: Advanced Communication Technology
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Modern military weapon systems derive much of their value from data links, which increase the timeliness of information transfer and improve accuracy and standoff range of weapon systems.

The Jam Resistant Data Link Transmission project is developing and applying technologies to protect future data links from jamming. This project is part of the Joint Service Weapon Data Link Program; as such this advanced technology will be available for use by other Services. These advanced technologies will provide jam resistance, low probability of intercept, resistance to antiradiation weapons and provide the needed to support new weapons and sensor systems. This project will develop and demonstrate advanced jam-resistant data link technology applicable to sensor imagery, command guidance/status and control transmission. This project is intended to achieve a high degree of commonality and standardization in data link design to provide the technology required to protect imagery, data and command/guidance communication links from electromagnetic threats. This program will develop modular improvements to existing data link architecture (e.g., the Joint Services Weapon Data Link in Program Element 64742F, Precision Location Strike System (PLSS)), and is in direct support of Tactical Air Command Required Operational Capability (TAC ROC 1-72, "Multi-purpose Drones for the Tactical Forces" and Tactical Air Forces Required Operational Capability (TAF ROC) 324-73, "Reconnaissance Data Link System." As tactical aircraft and missions increase in complexity and scope, equipment using advanced technologies are applied to improve aircraft effectiveness. The cost, both in financial and equipment availability terms, to modify and integrate new equipment into existing aircraft must be minimized. The Integrated Communication Navigation Identification (CNI) Avionics project will integrate the functions of current and planned CNI equipment into a singular modular architecture. This system will employ advanced, high potential payoff technology to develop a family of interchangeable common modules that would become candidates for standardization. Additional payoffs are significant reduction in life-cycle costs, size and weight as well as modular adaptability to future threats and technological advanced in hardware and software. By encouraging Tri-Service and North Atlantic Treaty Organization participation in adopting the CNI Avionics concept, our military capabilities can be multilaterally enhanced. Significant reduction in life-cycle cost will be sought by commonality of user equipment across current CNI systems (high frequency, ultra high frequency, and L-band), and new systems such as the Joint Tactical Information Distribution System (JTIDS; PE 64754F); the Global Positioning System (GPS; PE 63241F) and the Jam Resistant Voice System (SEEK TALK; PE 27423F).

RELATED ACTIVIES: The Jam Resistant Data Transmission project is related to Surface Defense Suppression 64733F,

Program Element: #63727F
DoD Mission Area: Tactical Command and Control, #254

Title: Advanced Communication Technology
Budget Activity: Tactical Programs, #4

Precision Location Strike 64742F, Navy Modular Weapon Improvements Program, PE 25645N; and the Army Modular Integration Communication Navigation System; PE 64748A.

WORK PERFORMED BY: Air Force Systems Command (AFSC), Air Force Avionics Laboratory, Wright-Patterson AFB, OH. Contractors include: TRW Defense and Space, Redondo, CA; General Dynamics Electronic Division, San Diego, CA; ITT Avionics Division, Nutley, NJ; GTE Sylvania, Needham, MA; Lincoln Laboratories, Lexington, MA; Electromagnetic Compatibility Analysis Center, Annapolis, MD; General Elecgric Company, Utica, NY; Motorola Inc., Scottsdale, AZ; RCA Corporaton, Camden, NJ; and AEL Inc., Lansdale, PA.

PROGRAM ACCOMPLISHEMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Joint Service Weapon Data Link Plan was developed. Advanced development of a jam resistant imagery data link was started. Efforts to develop advanced antenna nulling techniques for weapons data link, an imagery test and evaluation facility and image compression techniques were started. A frequency management analysis of the impact of data links was completed. Image compression techniques for evaluation in conjunction with the spread spectrum modem and a received transmitter subsystem development was started. The initial systems architecture of Integrated Communication Navigation Identification Avionics was started in the Multifunction, Multiband Airborne Radio System program in Program Element 62204F, Aerospace Avionics.

2. FY 1980 Program: An advanced antenna for weapon systems development will continue, weapon/pod integration of the Joint Service Weapon Data Link will be started and a standard image compression module design will be completed. Initial development of an optimal architecture for a Communication Navigation Identification (CNI) signal processor will be started. This architecture will be used for design and fabrication of a signal processor using radio frequency large scale integration techniques. Integrated CNI algorithms and software will be concurrently developed.

3. FY 1981 Planned Program: Efforts in data link modem technology will be started. An advanced pod antenna development will be completed. Weapon/pod integration and GBU-15 flight test will continue. Integrated Communication Navigation Identification Avionics (ICNIA) signal processor development will continue. An effort will be started to design and fabricate a fiber optic multiplex data bus for concurrent use by multiple communication and navigation processing functions, such as Joint Tactical Information Distribution System and Global Positioning System.

4. FY 1982 Planned Program: An advanced image compression subsystems and an advanced spread spectrum modem will be integrated into a flight demonstration of a captive GBU-15 weapon. Efforts to develop advanced wide band data link technology using technologies and low probability of intercept capabilities will be continued. The ICNIA project will be transferred to PE 63253F.

Program Element: #63727F
DoD Mission Area: Tactical Command and Control, #254

Title: Advanced Communication Technology
Budget Activity: Tactical Programs, #4

Program to Completion: Within the Joint Service Weapon Data Link architecture modular technlogies will be developed to use _ and significantly reduced susceptability to jamming, wide band video and digital data with an _ multi-beam antenna system, and extremely jam resistant data link. Focal plane processing technology development will continue.

MILESTONES: Not Applicable

RESOURCES: Not Applicable

Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5,400	7,100	3,700	4,200	Continuing	N/A
2277	SEEK TALK *	3,900	5,300				
2345	Jam Resistant Data Link Transmission	1,000	1,800	3,500	3,600	Continuing	N/A
2538	Integrated Communications, Navigation Identification Avionics			200	600	Continuing	N/A
2594	Adaptive High Frequency/Very High Frequency Communications	500	(800)**	(1,000)**		Continuing	N/A

* Transferred to PE 27423F, Advanced Communication Systems in FY 1980
** To be transferred from PE 33131K, Minimum Essential Emergency Communications Network (MEECN)

An additional $100 thousand esclation as added in FY 1982.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 63739F
DOD Mission Area: Target Surveillance, Reconnaissance and Target Acquisition, #255

Title: Advanced Drone/Remotely Piloted Vehicle
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,000	3,500	4,200	2,800	Continuing	Not Applicable
2355	Special Projects/Mini-Remotely Piloted Vehicles	2,000	3,500	4,200	2,800	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides for advanced development of systems and subsystems for Air Force drones and Remotely Piloted Vehicles (RPVs). The Tactical Air Forces have identified a need for low cost expendable drones for defense suppression including a requirement to investigate advanced sensor and seeker types to expand and enhance the mission capability of expendable drones. The Special Projects/Mini-RPVs effort verifies the military applications of advanced subsystems including sensors/seekers to enhance the cost effectiveness and mission flexibility of mini-RPVs.

BASIS FOR FY 1981 RDT&E REQUEST: Advanced technology efforts which integrate various sensors/seekers in mini-RPVs and demonstrate low cost airframe and engine concepts will be continued. The principle efforts planned include flight test and concept evaluation of a millimeter wave seeker on a mini-RPV, component evaluation of an electric powered propulsion system for use in mini-drones and other advanced sensor/seeker investigations.

OTHER APPROPRIATION FUNDS: Not Applicable

Project: #2355 Title: Special Projects/Mini-Remotely Piloted Vehicles
Program Element: # 63739F Title: Advanced Drone/Remotely Piloted Vehicle Development
DOD Mission Area: Target Surveillance, Reconnaissance and Target Acquisition, #255 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: A Joint Air Force/Defense Advanced Research Projects Agency (DARPA)/German Federal Ministry of Defense program began in 1975 to demonstrate a very low-cost expendable mini-Remotely Piloted Vehicle (RPV) equipped with an anti-radar seeker for defense suppression. This concept has matured into the Harassment Vehicle program and is planned to begin full scale engineering development in Program Element (PE) 64746F, Expendable Drones, as a Joint United States/Federal Republic of Germany development program.

In addition to the emitter seeker used for the Harassment Vehicle demonstration, DARPA expanded its investigation into advanced technology sensors/seekers for expanding and improving the mission capability of mini-drones. The objectives of Project 2355, Special Projects/Mini-RPVs is to continue the efforts initiated by DARPA by integrating and testing new sensors/seekers on mini-RPVs, demonstrating low-cost advanced launch concepts, and pursuing advanced mini-air vehicle and engine developments.

RELATED ACTIVITIES: Advanced developments for United States Army mini-RPVs are accomplished in PE 63725A, Remotely Piloted Vehicles/Drones, and are directed toward future mini-RPV reconnaissance and surveillance missions. The United States Air Force accomplishes RPV engineering development in PE 64746F, Expendable Drones. Inter-service coordination in the RPV area are accomplished through reviews by the Office of the Secretary of Defense, the Joint Technical Coordination Group for RPVs which emphasizes technological interchanges, and the Tactical Air Command/Training and Doctrine Command Coordinating Group which focuses on the operational aspects of RPVs. Advanced mini-RPV sensor development initiated by Air Force/DARPA will be continued in this project.

WORK PERFORMED BY: The Aeronautical Systems Division at Wright-Patterson Air Force Base, OH, is responsible for efforts accomplished in this program element. Most of the testing is accomplished at the Hill-Wendover-Dugway Test Range, UT, and the Nellis Test Ranges, NV. Contractors participating in Special Projects/Mini-RPV tasks are: General Dynamics, Pomona, CA, and Developmental Sciences Incorporated, City of Industry, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Concept definition and design studies for an advanced multi-mission RPV were completed in Project 2119, Advanced RPV Investigations in FY 1977. Project 2355, Special Projects/Mini-RPVs, was started in FY 1977 to continue advanced sensor developments initiated by DARPA to expand mission application and lower the cost of expendable mini-RPV systems. Studies and tests were conducted on millimeter wave (MMW) and acoustic sensors. These efforts indicated that the MMW sensor possessed sufficient potential to warrant further investigation. In FY 1978, a MMW seeker was integrated into a mini-RPV and flight tested. A total of twelve flights were accomplished to demonstrate autonomous search, terminal dive, and pull-out on a target. Using the data generated from these tests, a follow-on effort was initiated in FY 1979 to upgrade the sensor, and optimize the software for continued validation testing. In FY 1979, a Harassment Vehicle live warhead demonstration to address Congressional system effectiveness concerns was successfully completed. Investigation of electric powered propulsion systems for mini-drone application was initiated.

Project: #2355 Title: Special Projects/Mini-Remotely Piloted Vehicles
Program Element: # 63739F Title: Advanced Drone/Remotely Piloted Vehicle Development
DOD Mission Area: Target Surveillance, Reconnaissance and Target Acquisition, #255 Budget Activity: Tactical Programs, #4

2. FY 1980 Program: Special Projects/Mini-Remotely Piloted Vehicle (RPV) tasks will continue to include: flight test of the millimeter wave sensor; demonstration of mini-RPV advanced airframe, engine and launch concepts; and investigation of advanced sensor and electronic warfare systems applicable to mini-RPVs.

3. FY 1981 Planned Program: Special Projects/Mini-RPV advanced development efforts will be continue. The millimeter wave sensor validation effort will be completed. Demonstration of mini-RPV advanced airframe, engine and launch concepts will be continued. Advanced sensor and electronic warfare investigation to enhance and expand the mission capabilities of mini-RPVs will be continued.

4. FY 1982 Planned Program: Special Projects/Mini-RPV development efforts will continued. An electric propulsion system will be integrated into a mini-drone and flight demonstrations initiated. Advanced seekers/sensors investigatio will be continued to enhance and expand the mission capabilities of mini-RPVs.

5. Program to Completion: This is a continuing program. Special Project/Mini-RPV level-of-effort advanced technology programs will be continued to enhance and expand mission capabilities of mini-RPVs.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5,379	2,000	5,500	11 400	Continuing	Not Applica
1964	Advanced Launch and Recovery	1,015					
2233	Advanced RPV	300		2,000	8,400	59,600	72,300
2355	Special Projects/Mini-RPVs	4,064	2,000	3,500	3,000	Continuing	Not Applica

FY 1980 funds ($2,000 thousand) for the Advanced RPV project (Project 2233) were not provided by Congress. Further funding requests for this project have been deferred until mission needs are better defined.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63742F
Title: Tactical Identification Systems
DOD Mission Area: Tactical Command and Control, #254
Budget Activity: Tactical Program, # 4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimate Costs
	TOTAL FOR PROGRAM ELEMENT	4,000	5,100	14,700	10,200	Continuing	Not Applicable
1177	Non-Cooperative Identification Techniques	3,000	2,100	2,700	4,200	Continuing	Not Applicable
2599	North Atlantic Treaty Organization (NATO) Identification System	1,000	3,000	12,000	6,000	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this program element is to accomplish advanced development of techniques that can be used to provide reliable long range air-to-air identification of aircraft in both all-weather and hostile electromagnetic countermeasure environments. This program is necessary because the numerical superiority of the projected threat demands that we be capable of engaging the enemy at long ranges with our advanced air-to-air missile systems. The long range identification that is a prerequisite for such engagements

BASIS FOR FY 1981 RDT&E REQUEST: In FY 1981 this program element will provide funds for the development of techniques that permit identification data to be obtained from existing on-board sensors. These sensors can be exploited through the application of suitable data processing algorithms. To complement the development of these techniques, this program will also determine optimum methods for integrating the identification subsystems with the fire control systems of the fighters. The work to be accomplished will have primary application to the F-15 and F-16.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63742F
DOD Mission Area: Tactical Command and Control, #254

Title: Tactical Identification Systems
Budget Activity: Tactical Program, #4

DETAILED BACKGROUND AND DESCRIPTION: Beyond visual range identification of airborne targets is in the counter-air mission area. This fact is repeatedly addressed in reports of Air Force experiences in Southeast Asia, the Airborne Intercept Missile Evaluation Study and most recently by Tactical Air Command Statement of Need 304-79. In March 1978, North Atlantic Treaty Organization (NATO) Long Term Defense Program Task Force Five on Air Defense

This program element will fund the advanced development of cooperative and non-cooperative identification techniques that can be applied to the problem. Both types of identification technology must be developed

Project 1177, Non-coopertive Identification Techniques is developing sensor techniques that will permit autonomous identification of both hostile and friendly aircraft. Included in these techniques is the Dual Mode Recognition technique which identifies the aircraft

High Range Resolution radar, another technique under development, will identify aircraft by

on the target aircraft. Project 1177 is also developing a data processing algorithm that will integrate identification data from several sources and provide the pilot with a high confidence target classification. Project 2599, NATO Identification System (NIS), will provide the resources required for Air Force support of the multinational development of NIS. The initial work on NIS will focus on advanced development of a secure and jam-resistant cooperative (question and answer) subsystem for positive identification of friendly forces. This work, in conjunction with related efforts of Army and Navy provides a balanced U.S. attack on the

RELATED ACTIVITIES: The efforts of this program element are planned and accomplished in close coordination with the work under Program Element (P.E.) 63706A, Identification Friend or Foe; P.E. 63515N, Advanced Identification Techniques; P.E. 63267N, NATO Identification System; and P.E. 64725F, Aircraft Identification Systems. In general, P.E. 64725F will provide the engineering development of techniques that are successfully demonstrated in this Program. All work is coordinated through the U.S. IFF Development Program for which the Air Force is lead service.

WORK PERFORMED BY: This program is managed by the Air Force Avionics Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, OH. Contractors supporting this program are: Westinghouse Corp., Baltimore, MD; Hughes Aircraft Co., Culver City CA; McDonald Douglas Aircraft Corp., St. Louis, MO; and Hazeltine Corp, Greenlawn, NY.

PROGRAM ACCOMPLISHMENTS

1. FY 1979 and Prior Accomplishments: An electro-optical device, the Laser Augmented Target Acquisition Recognizer was flight tested in an F-4 aircraft. The feasibility of using Dual Mode Recognition (DMR) in an F-15 was demonstrated. DMR is implemented through software that makes use of the

on the target aircraft. Eagle Eye, a system that enhances visual identification capability was refined by this

program. Initial computer algorithms have been written for use of High Range Resolution in S-band radar. An identification data integration effort has developed the structure for establishing a composite identification on board the fighter. Preliminary work on the preparation of a North Atlantic Treaty Organization (NATO) Standardization Agreement for the NATO Identification System (NIS) was supported by this Program.

2. FY 1980 Planned Program: In FY 1980 the F-15 flight demonstration of the dual mode recognition technique integrated into the Programmable Signal Processor will begin and the task will transition to engineering development. A ground demonstration of identification-data integration is planned to commence. Advanced development of the dual mode recognition technique for F-16 begins, Tests to verify the feasibility of accomplishing air-to-air identification by using existing Radar Warning Receiver Processors will be initiated. NATO operational requirements for identification will be translated into system performance specifications.

3. FY 1981 Planned Program: Advanced development of the application of the dual mode recognition technique to the F-16 will be completed. Simulation evaluation of data-integration algorithms is to be conducted. The application of Electronic Suport Measures (ESM) techniques to air-to-air identification will receive continued study. The functional design of the cooperative (question and answer) component of the NATO Identification System will be completed.

4. Planned FY 1982 Program: Techniques that permit identification data to be derived from information will continue to be refined. The advanced development of identification techniques based on ESM will transition to engineering development. Designs for the cooperative subsystem of NIS will be fabricated.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,701	3,000	5,100	15,600		
1177	Near Term IFFN	1,701	2,500	2,100	3,600	Continuing	Not Applicable

Program Element: #63742F
DOD Mission Area: Tactical Command and Control, #254

Title: Tactical Identification Systems
Budget Activity: Tactical Program, #4

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
2599	Future Identification Techniques		500	3,000	12,000	Continuing	Not Applicable

The $500 thousand increase in Project 1177 in FY 1979 was for additional development work on the dual mode recognition techniques. The $900 thousand decrease in Project 1177 in FY 1981 provides resources for higher priority programs. The change to Project 2599 is discussed in the project descriptive summary.

Project: #2599 Title: NATO Identification System (NIS)
Program Element: #63742F Title: Tactical Identification Systems
DOD Mission Area: Tactical Command and Control, #254 Budget Activity: Tactical Program, #4

DETAILED BACKGROUND AND DESCRIPTION: The need for an improved identification capability

This system, the NATO Identification System (NIS), is to be developed through a multi-national cooperative development program. The U.S. will support the development of NIS through the tri-service U.S. Identification Friend or Foe (IFF) Development Program established by Under Secretary of Defense for Research and Engineering in January 1979. The Air Force is lead Service for this Program and it will provide its support for the advanced development of NIS through this project. Because of its lead role on NIS, the Air Force advanced development activities will be broad in scope and include studies on threat, frequency requirement, general weapons interface, system architecture and transition planning. Additionally, the Air Force will fund the development of technology that is key to the design of NIS subsystems. The thrust of the near term effort on NIS will be to establish the basis for the cooperative development of a high performance, jam-resistant and secure cooperative (question and answer) subsystem.

RELATED ACTIVITIES: The NATO Identification System Project will be implemented in close coordination with all efforts under the U.S. IFF Development Project. These efforts include the following program elements: Program Element (P.E.) 64725F, Aircraft Identification Systems; P.E. 63706A, Identification Friend or Foe; P.E. 64709A, Identification Friend or Foe; P.E. 63515N, Advanced Identification Technology; P.E. 63267N, NATO Identification System; and P.E. 64211N, AIMS/ATCRBS/MK XII. The work under Project 2599 will transition to P.E. 64725F, Project 2598 for engineering development.

WORK PERFORMED BY: The Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, OH will manage this project. The following contractors supported this project in FY 1979: Teledyne Electronics, Newbury

Park, CA; Hazeltine Corp., Greenlawn, NY, ITT Avionics Division, Nutley, NJ; E-Systems, St. Petersburg FL; RCA Corp., Camden, N.J.; Tracor Inc., Austin, TX; Bendix Corp., Baltimore, MD; Raytheon Co., Sudbury MA; and Magnavox, Ft Wayne, IN. Major support is also provided by Massachusetts Institute of Technology (MIT) Lincoln Laboratory, Lexington, MA and the Electromagnetic Compatibility Analysis Center, Annapolis, MD.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: This project was initiated in FY 1979 with several studies of the technology that could be applied in the design of the cooperative subsystem of the NIS. The results of this government/industry study were used to establish the U.S. contribution to the refinement of the draft NATO Standardization Agreement on NIS.

Project: #2599 — Title: NATO Identification System (NIS)
Program Element: #63742F — Title: Tactical Identification Systems
DOD Mission Area: Tactical Command and Control, #254 — Budget Activity: Tactical Program, #4

2. FY 1980 Planned Program: Refinement of the standardization agreement for the cooperative system of NIS will continue. The application of high technology antennas, clocks and matched filters to NIS will be studied and the performance of these devices will be demonstrated. Studies will be accomplished to determine the most effective level of performance to build into the question and answer component of NIS.

3. FY 1981 Planned Program: The development of the NIS question and answer subsystem will continue and a preliminary specification will be completed. The advanced development of the application of high technology devices for the NIS question and answer subsystem will continue.

4. FY 1982 Planned Program: The development of the NIS question and answer subsystem will continue. The specific tasks to be accomplished will be based on terms of multilateral development agreements with our North Atlantic Treaty Organization (NATO) partners. It is expected that competitive advanced development designs will be fabricated and prepared for test.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimate Costs
2599	NATO Identification System	1,000	3,000	12,000	6,000	Continuing	N/A

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2599	Future Identification Techniques		500	3,000	12,000	Continuing	N/A

The $500 thousand increase in FY 1979 was for additional studies to support the preparation of the NATO Standardization Agreement.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64756F (#63746F) Title: Side Looking Airborne Radar (SLAR)
DoD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255 Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs *
	TOTAL FOR PROGRAM ELEMENT	12,899	9,000	27,400	19,700	34,600	132,822
2037	SLAR Sensors (Formerly SLAR Sensors/Exploitation)	5,847	9,000	4,300	4,000	5,100	50,422
2451	SLAR Exploitation (Formerly Advanced SLAR Components)	7,052	0	22,100	5,000	9,500	50,700
2647	Manual Radar Reconnaissance Exploitation System (MARRES)	0	0	1,000	0	0	1,000
2648	PAVE MOVER	0	0	0	10,700	20,000	30,700

* NOTE: Total shown is United States contribution. The Federal Republic of Germany (FRG) has contributed $6,500 thus far. The FRG is not contributing in FY 1978, FY 1979, FY 1980 and FY 1981. Continued FRG funding participation in FY 1982 and beyond is currently under consideration.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to develop and test advanced SLAR components and systems capable of collecting, transmitting, processing, and exploiting reconnaissance and strike information during night and adverse weather conditions from an airborne platform. Requirements include reliable detection, and location of fixed, mobile, or moving tactical targets from long standoff ranges, near real time data exploitation, direct weapons bus control and/or handoff to strike systems. The FRG jointly funded a digital SLAR system development program in FY 1976.

BASIS FOR FY 1981 RDT&E REQUEST: These funds will be used to complete development, fabrication and test of advanced digital SLAR ground exploitation systems. Included is the continuing development of an initial demonstration prototype of the TR-1 SLAR exploitation system and initiation of nonrecurring engineering for the ground station. Development and testing of the preproduction will be completed. Deficiencies in the current AN/UPD-4 SLAR ground exploitation system will be corrected. Advanced development of SLAR electronic counter-countermeasures will continue.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #64756F (#63746F) Title: Side Looking Airborne Radar (SLAR)
DOD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is the development and test of advanced Side Looking Airborne Radar (SLAR) components and systems to meet operational adverse weather reconnaissance and strike requirements. SLAR reconnaissance systems provide a unique capability to penetrate clouds and other atmospheric conditions in daylight or at night, operate at ranges beyond defensive threats, and provide accurate location and other useful intelligence about targets under conditions in which non-radar sensors are ineffective.

Operational requirements include: reliable detection, location and stand off strike of fixed, mobile, moving, non-emitting tactical size targets (jeep, truck, tank) from long ranges (to nautical miles) over wide areas nautical mile swaths); near-real time air-to-surface data transfer (up to nautical miles); and near-real time processing and exploitation (less than The ability to selectively targets is desired. Additionally, the capability to detect targets concealed by camouflage or foliage is desired. To meet these requirements, advanced digital sensor processing and exploitation technologies will be used. Current operational SLAR equipment is limited to a maximum range of 30 nautical miles, which is inadequate for operation in a environment or for adequate border surveillance. Lack of near real time air-to-surface data transfer and use of analog optical image processing and exploitation limits information timeliness. Also, current SLAR systems have resolutions that are not sufficient for

The major effort in this program is an advanced digital SLAR system development previously known as the AN/UPD-X. The effort is based on a previous United States/Federal Republic of Germany (US/FRG) jointly funded effort known as the AN/UPD-5 and the Advanced Synthetic Aperture Radar System. The UPD-5 SLAR development, which used analog processing techniques, was terminated in FY 1973 by mutual agreement. The analog techniques could not meet operational requirements. In July 1974, the FRG formally agreed to participate in the initial phase of the UPD-X on a 50-50 funding basis. The FRG is not participating in the current phase of the development. Participation in future development is under negotiation. In FY 1977, FY 1978, FY 1979 and FY 1981, funds in this program element (PE) are combined with classified PE funds to develop the Advanced Synthetic Aperture Radar System (ASARS).

The development of the image exploitation/data handling segment for the system is given high priority in this program so that the full potential of the sensor is operationally realized.

In 1978, examination of synthetic aperture SLAR technology and advanced scan beam moving target indicator (MTI) weapons guidance SLAR technology being pursued in PAVE MOVER (PE 63747F) indicated the potential feasibility of multi-mode, SLAR sensor. In anticipation of confirmation of technical feasibility and potential benefits of such a system, engineering development funds of the PAVE MOVER, PE 63747F, program were transferred to this PE.

Additional efforts in this program include near term development and qualification of components and techniques required to reduce deficiencies in current operational SLAR systems in the areas of target positioning and electronic counter-countermeasures.

Program Element: #64756F (#63746F) Title: Side Looking Airborne Radar (SLAR)
DoD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255 Budget Activity: Tactical Programs, #4

RELATED ACTIVITIES: Program Element (PE) 63208F, Reconnaissance Sensors/Processing Technology, is performing advanced development efforts in foliage penetration radar techniques. PE 27431F, Tactical Air Intelligence Systems Activities, is developing advanced techniques for managing tactical reconnaissance information. Exploited SLAR data will be an input to this system. The development of Advanced Synthetic Aperture Radar System (ASARS) is jointly funded by PE 64756F and other program elements (PE numbers available to appropriately cleared individuals). Advanced development of the weapons bus guidance and strike options is being developed in PE 63747F, PAVE MOVER. PE 27213, RF-4C Squadrons, procures upgrades to the AN/UPD-4 SLAR developed in this PE. PE 27215F, TR-1 Squadrons and other classified PEs procure operational SLAR sensors and ground stations.

WORK PERFORMED BY: This program is managed by Aeronautical Systems Division, Wright-Patterson AFB, OH, and supported by the Air Force Avionics Laboratory, Wright-Patterson AFB, OH, Rome Air Development Center, Griffiss AFB, NY, and Electronic Systems Division, Hanscom AFB, MA.

Contractors for current efforts are: Control Data Corporation, Minneapolis, MN, modifying the automatic change detection device previously fabricated; Environmental Research Institute of Michigan, Ann Arbor, MI, providing program technical support; Goodyear Aerospace Corp, Litchfield Park, AZ, modifying a previously constructed digital radar processing device and developing exploitation prototypes; Hughes Aircraft Corp, Culver City, CA, developing the ASARS system and performing electronic counter-countermeasure (ECCM) analysis; and Technology Services Corp, LaJolla, CA, performing ECCM analyses.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: During 1974, the advanced SLAR development program, known as the AN/UPD-X, was initiated with three phases: Phase I, Analysis and Digital Demonstration; Phase II, Competitive Prototyping; and Phase III, Pre-Production Prototyping. The Federal Republic of Germany (FRG) was invited to participate. Fabrication of a digital radar processor device and an automatic change detection device was initiated. These devices will be used to process data from an AN/ADP-10 radar set (the airborne segment of a currently operational SLAR system) and will demonstrate digital processing of a radar with 30 nautical mile range, 10 nautical mile swath, and 10 foot resolution. During FY 1975 the FRG agreed to jointly fund Phase I of the program with an option to continue through subsequent phases. During FY 1976, Phase I test planning was completed and the airborne segment of the digital radar processing device was installed in a C-141 test aircraft and initial checkout was completed. Fabrication of the ground segment of the digital radar processing device continued. Factory checkout of the digital change detection device was completed and the device delivered to the Air Force. Three parallel, system definition/design trade-off studies were initiated, along with equipment preparation for an operational demonstration of near-real time air-to-ground transmission and processing of SLAR data. Contracts for the design and fabrication of two ECCM devices were initiated. During the Transition Quarter, the final acceptance tests of the digital change detection device were completed and the operational demonstration of near-real time SLAR data transmission and processing was carried out in Europe (1976 COLDFIRE/REFORGER exercises). During FY 1977 the system definition/design trade-off studies were completed. The ground segment for the digital SLAR processing device was delivered to the Air Force for test and evaluation. The electronic counter-counter-

measures (ECCM) devices were delivered. Phase II of the UPD-X effort was initiated which includes design and fabrication of the jointly developed Advanced Synthetic Aperture Radar System (ASARS) sensor. Prototyping of SLAR beacons was completed. Advanced ECCM technique analysis and design continued. Analysis of the combat utility of advanced SLAR exploitation data handling techniques were conducted during the 1977, 1978 and 1979 REFORGER exercises. The program was restructured to compensate for the lack of continued Federal Republic of Germany (FRG) participation. Phase II was established as Initial Operational Baseline Component Prototyping and Phase III as Full Scale Development of Product Improvements to more closely align phase titles with conventional Air Force development efforts. During FY 1978, design and acquisition of an advanced brassboard image display, analysis and exploitation system was initiated. During FY 1979, design and acquisition of brassboard image display, analysis and exploitation equipment continued. Assembly and checkout of the preproduction ASARS equipment was begun. Integration of the air-to-surface data transfer and ground processing portions of the advanced brassboard sensor system with the exploitation segment began. Planning for transition of appropriate portions of the program to the engineering development category commenced.

2. FY 1980 Program: Acquisition and testing of the brassboard image display, analysis and exploitation equipment will continue. Preparation of the initial production ground and exploitation equipment specifications will be initiated. Integration of appropriate elements of the advanced ground exploitation system and the ground processing system will be initiated. Development of follow-on advanced ECCM devices and techniques will be continued. Initial analysis of the PAVE MOVER advanced development program for suitability for transition to engineering development as an option will be performed.

3. FY 1981 Planned Program: Phase II, Initial Operational Baseline Component Prototyping, will continue. The sensor will be tested. Advanced development of follow-on ECCM devices will be completed. Integration of appropriate elements of the advanced ground exploitation system with the ground processing system will be completed as part of the initial production ground processing and exploitation system specifications preparation. Phase III, Product Improvement Full Scale Development, will begin. This will result in the development of enhanced ECCM, expanded swath modes, and other performance features for the baseline UPD-X sensor as well as a full capability ground image display, analysis and exploitation system. Final analysis of the PAVE MOVER advanced development program for suitability for transition to engineering development as an option will be performed.

4. FY 1982 Planned Program: Development and test of the Advanced TR-1 ground exploitation system will be completed. Nonrecurring engineering to support the ground station production will continue. Phase III, Product Improvement will continue and engineering development of PAVE Mover as an added option for the or as a separate system will be initiated.

5. Program to Completion: Full scale development will continue. Product improvements will complete Development Test and Evaluation(DT&E), and Initial Operational Test and Evaluation (IOT&E) leading to production decisions in CY 1984 - CY 1985 for surveillance sensor upgrades and the advanced ground exploitation segment. PAVE MOVER engineering development will complete DT&E/IOT&E in CY 1985.

Program Element: #64756F (#63746F) Title: Side Looking Airborne Radar (SLAR)
DOD Mission Area: Tactical Surveillance, Reconnaissance, Target Acquisition, #255 Budget Activity: Tactical Programs, #4

6. Milestones.

			Date:
A.	Initiation of Phase I, Analysis and Digital Demonstration		Jul 73
B.	Complete Phase I		Sep 77
C.	Complete Phase II, Initial Baseline Prototyping		Jun 81
D.	Complete Phase III, Product Improvement	(Dec 83)*	Dec 84
E.	Complete PAVE MOVER Option		Dec 84

* Date presented in FY 1980 Descriptive Summaries

Explanation of Milestone Changes: The delay in Phase III, Product Improvement, completion is due to FY 1980 fiscal constraints and stretchout of Phase II completion until late FY 1981. Start of some Phase II efforts were deferred for a start in FY 1982 instead of FY 1981 to allow analysis of Phase II results. Phase III completion was likewise delayed.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data: ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion**	Total Estimated Costs*
	TOTAL FOR PROGRAM ELEMENT	9,415	10,900	9,000	18,000	40,500	107,628
2037	SLAR Sensors/Exploitation (Formerly SLAR Sensors)	8,575	5,847	9,000	18,000	40,500	95,522
2451	SLAR Exploitation (Formerly Advanced SLAR Components)	840	5,053	0	0	0	12,106

* NOTE: Total shown is United States contribution. The Federal Republic of Germany (FRG) has contributed $6,500 thus far. The FRG is not contributing in FY 1978, FY 1979 and FY 1980. Continued FRG funding participation in FY 1981 and beyond is currently under consideration.

** NOTE: Additional cost to completion includes $23,500 for engineering development of PAVE MOVER option transferred from the outyear Program Element 63747F funds.

$1.999M FY 1979 funds were reprogrammed into the program from various PE's to support an accelerated exploitation system development. $8.5M was added to the program in FY 1981 to provide for "soft copy" digital display interpreter training and nonrecurring software engineering for the production TR-1 ground station. $11.3M was added in Additional

Program Element: #64756F (#63746F)
DOD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255

Title: Side Looking Airborne Radar (SLAR)
Budget Activity: Tactical Programs, #4

to Completion to support completion of testing and required updates to product improvement prototypes identified in testing. Other increases are the result of applying standard escalation indices. Projects 2647 and 2648 were added to provide additional visibility for these tasks.

Budget Activity: Tactical Programs, #4
Program Element: #64756F (#63746F)

TEST AND EVALUATION DATA:

1. Development Test and Evaluation: There are three major hardware contractors in the current program. They are: Goodyear Aerospace Corp., Litchfield Park, AZ, which has built a digital radar processing device consisting of airborne and ground-based elements; Control Data Corp (CDC), Minneapolis, MN, which has built a digital automatic change detection device; and Hughes Aircraft Corp, Culver City, CA, which is building a prototype sensor system. The Goodyear and CDC equipment has been interfaced with an airborne side looking radar (the AN/APD-10) of the type currently operational in the Air Force inventory, and is being used to help define Phase II (Initial Operational Baseline) and Phase III (Product Improvement) hardware interfaces and characteristics. This Goodyear/CDC demonstration system will be of lesser performance than the eventual preproduction system in that range will be limited to 30 nautical miles (nm) versus and swath will be limited to 10 nm vs nm. Digital flight checkout of the airborne digital radar processing element was successfully completed in October 1975. Final acceptance tests of a digital automatic change detection device were completed in September 1976, and final acceptance tests of a Goodyear digital radar image processing device were completed in September 1977. The Hughes preproduction Advanced Synthetic Aperture Radar System sensor is jointly funded by Program Element (PE) 64756F, Side Looking Airborne Radar (SLAR) and other programs (details will be supplied to appropriately cleared individuals). Development Test and Evaluation (DT&E) of the ASARS preproduction prototype will include maintainability and reliability testing. DT&E of the ground exploitation segment will be performed in two separate evaluations. One DT&E effort, the TR-1 Exploitation Demonstration System (TREDS) will verify the ability of the ground segment to deal with the critical parameters sensor control, management and display problems associated with the unique modes of the sensor. The second DT&E effort associated with the Advanced Building blocks for Large-area Exploitation (ABLE) system will verify ability to deal with the critical parameters of exploitation management and search mode productivity. Operation demonstrations of both exploitation systems will be given in Europe in Results of the demos will be used to update the production ground station specifications. DT&E of product improvements will be performed in the 1985 timeframe.

2. Operational Test and Evaluation: An Operational Test and Evaluation (OT&E) of the Side Looking Airborne Radar (SLAR) exploitation segment is tentatively scheduled in conjunction with the COMPASS CAPE ground segment OT&E. COMPASS CAPE is the unclassified nickname for acquisition efforts associated with the TR-1. An independent OT&E will be managed by the Air Force Test and Evaluation Center (AFTEC) and conducted by a test team composed of representatives from AFTEC, Air Force Logistics Command, Air Training Command, Strategic Air Command, and the Tactical Air Forces. The item tested will be the future operational system. The OT&E will be conducted primarily at a European test site using the type of personnel who will be expected to operate and maintain the operational system. Operational testing will estimate operational effectiveness and suitability to include reliability and maintainability of the SLAR exploitation segment. System interface with other COMPASS CAPE collection systems and the NATO and United States command, control, and communications structure will also be addressed. An OT&E of the modifications to the airborne sensor and ground exploitation segment is tentatively scheduled in FY 1985. Specific responsibilities for this operational testing have not yet been defined. However, the testing will address electronic counter-countermeasures (ECCM) characteristics, increased swath coverage and automatic change detection (if employed by the

COMPASS CAPE ground station). Testing and reporting will be in conjunction with the COMPASS CAPE OT&E. Test objectives pertaining to the SLAR OT&E will be separately identified in the AFTEC published COMPASS CAPE OT&E Final Report. PAVE MOVER operational testing responsibilities will be addressed when the system completes advanced development and planning for an OT&E is directed.

3. System Characteristics: The detailed characteristics of the system have not been finalized. Potential operational characteristics subject to system trade-offs are:

Characteristics	Demonstrated Performance
Range	To be measured in Initial Operational Test and Evaluation
Swath	
Resolution	
Data Transfer	
Processing & Exploitation	
Reliability, Availability, Maintainability	< 20% Maintenance manhours per flight hour for total aircraft with 95% probability of mission success

Scan Beam Moving Target Indicator/Strike: (PAVE MOVER engineering development)

Range	
Target Location/Weapon Guidance Accuracy	
Scan Angle (from broadside)	
Multiple Target Engagement	
Weapon Types	
Resolution	
Stand Off Strike	Real time
Reliability, Availability, Maintainability	TBD pending final systems definition

Project: #2451 Title: SLAR Exploitation
Program Element: #64756F (#63746F) Title: Side Looking Airborne Radar (SLAR)
DOD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is the development and test of advanced Side Looking Airborne Radar (SLAR) Exploitation components and systems to meet operational adverse weather reconnaissance and strike requirements. SLAR reconnaissance systems provide a unique capability to penetrate clouds and other atmospheric conditions in daylight or at night, operate at ranges beyond defensive threats, and provide accurate location and other useful intelligence about targets under conditions in which non-radar sensors are ineffective. Extraction of intelligence from the SLAR sensor is critical to the successful employment of the total system.

Operational requirements include near-real time processing and exploitation (less than minutes) to achieve: reliable detection if possible) and location of fixed, mobile, moving, nonemitting tactical size targets (jeep, truck, tank) over wide areas nautical mile swaths). To meet these requirements, advanced digital exploitation techniques will be used. Lack of near-real time image exploitation limits information timeliness of current operational SLAR systems.

The major effort in this project is advanced digital SLAR system exploitation development which was previously part of the AN/UPD-X Program. The effort is based on a previous United States/Federal Republic of Germany (US/FRG) jointly funded effort known as the AN/UPD-5. The UPD-5 SLAR development, which used analog processing techniques, was terminated in FY 1973 by mutual agreement. The analog techniques could not meet operational requirements. In July 1974, the FRG formally agreed to participate in the initial phase of the UPD-X on a 50-50 funding basis. The FRG is not participating in the current phase of the development. Participation in future development is under negotiation.
to be exploited. The development of the
image exploitation/data handling segment for the system is the highest priority element of this project.

RELATED ACTIVITIES: Program Element (PE) 27431F, Tactical Air Intelligence Systems Activities, is developing advanced techniques for managing tactical reconnaissance information. Exploited SLAR data will be an input to this system. PE 27215F, TR-1 Squadrons and other classified PE's procure operational tactical SLAR ground exploitation stations.

WORK PERFORMED BY: This program is managed by Aeronautical Systems Division, Wright-Patterson AFB, OH, and supported by the Air Force Avionics Laboratory, Wright-Patterson AFB, OH, Rome Air Development Center, Griffiss AFB, NY, and Electronic Systems Division, Hanscom AFB, MA.

Contractors for current efforts are: Control Data Corporation, Minneapolis, MN, modifying the automatic change detection device previously fabricated; Environmental Research Institute of Michigan, Ann Arbor, MI, providing program technical support; and Goodyear Aerospace Corp, Litchfield Park, AZ, developing exploitation prototypes. Prime contractor for the TR-1 ground station and additional TR-1 exploitation prototypes is to be determined through competitive award.

Project: #2451 Title: SLAR Exploitation
Program Element: #64756F (#63746F) Title: Side Looking Airborne Radar (SLAR)
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255 Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: During 1974, the advanced SLAR development program, known as the AN/UPD-X, was initiated with three phases: Phase I, Analysis and Digital Demonstration; Phase II, Competitive Prototyping; and Phase III, Pre-Production Prototyping. The Federal Republic of Germany (FRG) was invited to participate. Fabrication of a digital automatic change detection device was initiated. This device will be used to process data from an AN/ADP-10 radar set (the airborne segment of a currently operational SLAR system) and will demonstrate digital change detection processing of a radar with 30 nautical mile range, 10 nautical mile swath, and 10 foot resolution. During FY 1975, the FRG agreed to jointly fund Phase I of the program with an option to continue through subsequent phases. During FY 1976, Phase I test planning was completed. Factory checkout of the digital change detection device was completed and the device delivered to the Air Force. Three parallel, system definition/design trade-off studies were initiated, along with equipment preparation for an operational demonstration of near-real time air-to-ground transmission and processing of SLAR data. During the Transition Quarter, the final acceptance tests of the digital change detection device were completed and the operational demonstration of near-real time SLAR data transmission and processing was carried out in Europe (1976 COLDFIRE/REFORGER exercises). During FY 1977, the system definition/design trade-off studies were completed.

Phase II of the UPD-X effort was initiated which includes design and fabrication of exploitation equipment for the jointly developed Advanced Synthetic Aperture Radar System (ASARS) sensor system. Analysis of the combat utility of advanced SLAR exploitation data handling techniques were conducted during the 1977, 1978 and 1979 REFORGER exercises. The program was restructured to compensate for the lack of continued Federal Republic of Germany (FRG) participation. Phase II was established as Initial Operational Baseline Component Prototyping and Phase III as Full Scale Development of Product Improvements to more closely align phase titles with conventional Air Force development efforts. During FY 1978, design and acquisition of an advanced brassboard image display, analysis and exploitation system was initiated. This system, known as the Advanced Building blocks for Large Area Exploitation (ABLE) is designed to address the exploitation of the large quantities of search mode data from a SLAR sensor and the management of exploitation assets. During FY 1979, design and acquisition of ABLE exploitation equipment continued. Assembly and checkout of the preproduction ASARS equipment was begun. Planning for transition of appropriate portions of the program to the engineering development category commenced.

2. FY 1980 Program: Acquisition and testing of the ABLE equipment will continue. Preparation of the initial production ground and exploitation equipment specification will be initiated. A TR-1 Exploitation Demonstration System (TREDS) will be constructed to address exploitation of the unique modes of the system. Integration of appropriate elements of the TREDS and the ground processing system will be will be initiated. This effort is funded in Project 2037 for FY 1980.

Project: #2451 — Title: SLAR Exploitation
Program Element: #64756F (#63746F) — Title: Side Looking Airborne Radar (SLAR)
DOD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255 — Budget Activity: Tactical Programs, #4

3. FY 1981 Planned Program: Phase II, Initial Operational Baseline Component Prototyping, will be completed. Integration of appropriate elements of the TREDS with the ground processing system will be completed as a part of the initial production ground processing and exploitation system specification preparation. Phase III, Product Improvement Full Scale Development, will begin. This will result in the development of a full capability ground image display, analysis and exploitation system.

4. FY 1982 Planned Program: Development and test of the TREDS will be completed. Nonrecurring engineering to support the ground station production will continue. Phase III, Product Improvement will continue.

5. Program to Completion: Full scale development will continue. Product improvements will complete Development Test and Evaluation(DT&E), and Initial Operational Test and Evaluation (IOT&E) leading to production decisions in CY 1984 - CY 1985 for upgrades to the ground exploitation segment.

6. Milestones:

			Date:
A.	Initiation of Phase I, Analysis and Digital Demonstration		Jul 73
B.	Complete Phase I		Sep 77
C.	Complete Phase II, Initial Baseline Prototyping		Jun 81
D.	Complete Phase III, Product Improvement	(Dec 83)*	Dec 84
E.	Complete PAVE MOVER Option		Dec 84

* Date presented in FY 1980 Descriptive Summaries

Explanation of Milestone Changes: The delay in Phase III, Product Improvement, completion is due to FY 1980 fiscal constraints and stretchout of Phase II completion until late FY 1981. Start of some Phase III efforts were deferred for a start in FY 1982 instead of FY 1981 to allow analysis of Phase II results. Phase III completion was likewise delayed.

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs *
2451	SLAR Exploitation (Formerly Advanced SLAR Components)	7,052	0	22,100	5,000	9,500	50,700

Project: #2451 — Title: SLAR Exploitation
Program Element: #64756F (#63746F) — Title: Side Looking Airborne Radar (SLAR)
DOD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255 — Budget Activity: Tactical Programs, #4

8. Comparison with FY 1980 Budget Data: ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion**	Total Estimated Costs *
	TOTAL FOR PROGRAM ELEMENT	9,415	10,900	9,000	18,000	40,500	107,628
2037	SLAR Sensors/Exploitation (Formerly SLAR Sensors)	8,575	5,847	9,000	18,000	40,500	95,522
2451	SLAR Exploitation (Formerly Advanced SLAR Components)	840	5,053	0	0	0	12,106

* NOTE: Total shown is United States contribution. The Federal Republic of Germany (FRG) has contributed $6,500 thus far. The FRG is not contributing in FY 1978, FY 1979 and FY 1980. Continued FRG funding participation in FY 1981 and beyond is currently under consideration.

** NOTE: Additional cost to completion includes $23,500 for engineering development of PAVE MOVER option transferred from the outyear Program Element 63747F funds.

Program was broken out into separate project to increase visibility. $1.999M FY 1979 funds were reprogrammed into the program from various PE's to support an accelerated exploitation system development. $8.5M was added to the program in FY 1981 to provide for "soft copy" digital display interpreter training and nonrecurring software engineering for the TR-1 ground station. $3.5M was added in Additional to Completion to support completion of testing and required updates to product improvements prototypes identified in testing. Other increases are the result of applying standard escalation indices.

Project #2451
Budget Activity: Tactical Programs, #4
Program Element: #64756F (#63746F)

TEST AND EVALUATION DATA:

1. Development Test and Evaluation: There are two major hardware contractors in the current program. They are: Goodyear Aerospace Corp., Litchfield Park, AZ. which is building a digital radar exploitation prototype; and Control Data Corp (CDC), Minneapolis, MN, which has built a digital automatic change detection device. The Goodyear and CDC equipment has been interfaced with an airborne side looking radar (the AN/APD-10) of the type currently operational in the Air Force inventory, and is being used to help define Phase II (Initial Operational Baseline) and Phase III (Product Improvement) hardware interfaces and characteristics. This Goodyear/CDC demonstration system will be of lesser performance than the eventual preproduction system in that range will be limited to 30 nautical miles (nm) versus nm, swath will be limited to 10 nm vs and will not address mode exploitation. Final acceptance tests of a digital automatic change detection device were completed in September 1976. Development Test and Evaluation (DT&E) of the Advanced Synthetic Aperture Radar System (ASARS) preproduction prototype will include maintainability and reliability testing. DT&E of the ground exploitation segment will be performed in two separate evaluations. One DT&E effort, the TR-1 Exploitation Demonstration System (TREDS) will verify the ability of the ground segment to deal with the critical parameters sensor control, management and display problems associated with the unique modes of the sensor. The second DT&E effort associated with the Advanced Building blocks for Large-area Exploitation (ABLE) system will verify ability to deal with the critical parameters of exploitation management and search mode productivity. Operational demonstrations of both systems will be given in Europe in Results of the demos will be used to update the production ground station specifications. DT&E of product improvements will be performed in the 1985 timeframe.

2. Operational Test and Evaluation: An Operational Test and Evaluation (OT&E) of the Side Looking Airborne Radar (SLAR) exploitation segment is tentatively scheduled in conjunction with the COMPASS CAPE OT&E. An independent OT&E will be managed by the Air Force Test and Evaluation Center (AFTEC) and conducted by a test team composed of representatives from AFTEC, Air Force Logistics Command, Air Training Command, Strategic Air Command, and the Tactical Air Forces. The item tested will be the future operational system. The OT&E will be conducted primarily at a European test site using the type of personnel who will be expected to operate and maintain the operational system. Operational testing will estimate operational effectiveness and suitability to includ reliability and maintainability of the SIAR exploitation segment. System interface with other COMPASS CAPE collection systems and the NATO and United States command, control, and communications structure will also be addressed. An OT&E of the modifications to the airborne sensor and ground exploitation segment is tentatively scheduled in FY 1985. Specific responsibilities for this operational testing have not yet been defined. However, automatic change detection (if employed by the COMPASS CAPE ground station) will be tested. Testing and reporting will be in conjunction with the COMPASS CAPE OT&E. Test objectives pertaining to the SIAR OT&E will be separately identified in the AFTEC published COMPASS CAPE OT&E Final Report.

Project: #2451
Budget Activity: Tactical Programs, #4
Program Element: #64756F (#63746F)

3. System Characteristics: The detailed characteristics of the system have not been finalized. Potential operational characteristics subject to system trade-offs are:

Characteristics	Objective	Demonstrated Performance
Range Swath Resolution		To be measured in Initial Operational Test and Evaluation
Data Transfer Processing & Exploitation Reliability, Availability, Maintainability	Consistent with total system to achieve $\leq$ 20% maintenance manhours per flight hour for total aircraft with 95% probability of mission success.	

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63747F
DoD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: PAVE MOVER
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5,600	6,700	13,200	5,100	35,700 *	79,700

* In addition, follow-on engineering development funds programmed in PE 63746F, Side Looking Airborne Radar.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: In the face of numerically superior Warsaw Pact ground forces which also possess extremely lethal air defenses, a critical need exists for a revolutionary new capability to strike second echelon ground forces. The need includes the ability to provide rapid response times, to sustain high fire rates, in all weather, day or night in order to arrest a breakthrough attempt of massed Soviet ground forces. To fill this need, the Department of Defense has undertaken the Assault Breaker, a cooperative standoff strike concept, as a high priority initiative. PAVE MOVER is the Assault Breaker radar sensor and control subsystem which will: (1) provide the capability to guide standoff missiles at high rates of fire; (2) operate in real time, day, or night in all weather; (3) provide of enemy second echelon stopped or moving ground targets, to include dispersions and areas of advancement; (4) provide the ability to translate second echelon enemy movements into battle planning and strike targeting activities; (5) measurably enhance the probability of mission success of

BASIS FOR FY 1981 RDT&E REQUEST: These funds will be used to demonstrate the PAVE MOVER airborne radar and ground control subsystem capabilities for standoff cooperative strike against mobile ground targets. This program is only a portion of the overall Assault Breaker End to End demonstration, as it provides only the sensor and control subsystem portion of the Assault Breaker. The PAVE MOVER radar will be carried in an F-111 platform for the demonstration, with radar data being down linked to its ground station. The radar will acquire and simultaneously track multiple ground targets and guide multiple air or ground launched missiles, and cue penetrating aircraft. The ground subsystem will process relative target and weapon positions and provide real time guidance commands back to the weapon via a data uplink back to the PAVE MOVER radar. The weapon will receive guidance commands/data through an onboard transponder which will detect and demodulate the information encoded in the PAVE MOVER radar signal. In addition to demonstrating a capability for all weather, day/night, standoff strike operations, PAVE MOVER will also be subjected to Electronic Countermeasures and Electronic Counter Counter Measures evaluations.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63747F
DoD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, # 255

Title: PAVE MOVER
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The PAVE MOVER Program (formerly the Low Visibility Moving Target Acquisition Strike) was established to develop advanced techniques and equipment for adverse weather, day/night, long range/wide area, detection, location and strike of moving ground vehicles from safe stand-off ranges. In 1978, the PAVE MOVER advanced development work was restructured as a jointly funded Air Force/Defense Advanced Research Projects Agency effort which supports the Assault Breaker Concept. The primary objective is to develop a Moving Target Indicator (MTI) radar suitable for fixed wing aircraft applications, and demonstrate that a system using the data from one or more such radars can locate stopped or moving ground targets with sufficient accuracy and timeliness to conduct effective tactical standoff strike operations. Strike options will include real time cueing of conventional tactical airborne strike forces, and guide multiple air-to-ground launched stand-off missiles against multiple stopped/moving ground targets. Major program efforts include radar and ground processor development; hardware and software demonstrations in the FY81-1982 Assault Breaker End-to-End field demonstrations; and detailed investigation into radar performance, system accuracy, required processor capability, command and control interfaces, limited target classification through data correlation techniques and radar signal processing, electronic counter-counter-measures, force structure impact and cost. Preliminary studies have indicated that the highest tactical utility of PAVE MOVER MTI radar technology could accrue if the PAVE MOVER advanced development products were programmed as a follow on engineering development

We have programmed $30 million out year dollars for this purpose which is to be completed in FY 1985. Other portions are included in PAVE MOVER program plans for engineering development in the event that further research indicates that the planned merger is not feasible on a cost, technical or tactical basis. A specific PAVE MOVER achievement anticipated is development of an MTI radar for fixed wing aircraft use, which is capable of detecting and

Advanced development also includes a small area kilometers spot image radar mode having a resolution for the detection/track of stopped vehicles, positionable out to a range of PAVE MOVER efforts to preclude enemy exploitation and interference include development of low probability of intercept (LPI) techniques to enable the radar signal to remain undetected by enemy receivers; but also incorporates electronic counter-counter-measures (ECCM) techniques to counter enemy attempts to jam the radar. To provide a high probability of timely target destruction or mobility kill, weapon guidance/aircraft strike cueing will use either the PAVE MOVER MTI radar's inherent internal relative range/azimuth reference grid (relative position of weapon with respect to the target) or a common grid system (such as the tactical LORAN or Precision Location Strike System grid). Total system strike accuracy (including target location, weapon location and guidance and control errors) using the PAVE MOVER relative range/angle grid is being designed to circular error probable (CEP) at kilometers. Strike accuracy with a common grid system is estimated at meter CEP at kilometers.

Program Element: #63747F
DoD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: PAVE MOVER
Budget Activity: Tactical Programs, #4

RELATED ACTIVITIES: Although the PAVE MOVER Moving Target Indicator (MTI) Radar offers a strike capability against movable ground targets, its interoperability with the Precision Location Strike System (PLSS) could significantly enhance PLSS by adding the capability to target and strike emitting ground (PLSS) targets (such as surface to air missile guidance radars) when they shut down and move. The PAVE MOVER radar and Army's Stand-Off Target Acquisition System (SOTAS), being developed under PE 63736A, are also complementary and cooperative programs. SOTAS addresses the need for a Division level asset to counter the near Forward Edge of the Battle Area (FEBA) enemy armor problem while the PAVE MOVER radar is intended as a theater resource for wide area battlefield management and strike to include second echelon elements. The surface to surface missiles, which will be guided by PAVE MOVER during the Assault Breaker End to End demonstration, are also candidates for the Army's Corps Support Weapon System. Formal liaison is maintained between the services through the Assault Breaker Steering Group and the Assault Breaker Executive Committee comprised of appropriate civilian executives from the Office of the Under Secretary of Defense for Research and Engineering, the Defense Advanced Research Project Agency (DARPA), and Air Force and Army General Officers. A number of joint development activities have taken place between the services including the joint Army, Air Force, DARPA, Assault Breaker concept definition studies in CY 1979 and numerous exchanges of test data for use in target correlation and tracking software development. Present plans call for

as a follow-on engineering development effort beginning in FY 1982. The would take place if on-going studies indicate that it is technically feasible and operationally suitable. Current PAVE MOVER advanced development is maintaining maximum commonality to facilitate these plans. The PAVE MOVER is being jointly funded by the DARPA, PE 62702E and 62711E. The DARPA portion of this effort includes 6.8 million dollars in FY 1979 and prior, 7.75 million dollars in FY 1980, and 3 million dollars in FY 1981. This joint Air Force/DARPA PAVE MOVER program supports the Assault Breaker concept.

WORK PERFORMED BY: This program is being managed by the Rome Air Development Center, Electronic Systems Division, Griffiss AFB, NY. The PAVE MOVER Responsible Test Organization is the Armament Division 3246 Test Wing, Eglin AFB, FL. The Air Force Test and Evaluation Center, Kirtland AFB, NM will evaluate Assault Breaker demonstration results for overall operational suitability for Air Force missions. The Massachusetts Institute of Technology Research and Engineering Bedford, MA will assist the Program Office in overall Assault Breaker concept studies, test planning and evaluation of demonstration results, as well as assist government personnel in parallel studies leading to engineering development. Lincoln Laboratories, Lexington, MA will assist the Program Office in evaluating/ documenting the PAVE MOVER radar performance during the FY 1981 demonstrations. The PAVE MOVER dual prime radar/ground subsystem (competin contractors are Hughes Aircraft, Culver City, CA; and Grumman/Norden, Norwalk, CT.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A study by the Rome Air Development Center in 1974 concluded that the Moving Target Indicator Radar concept was feasible and offered the potential for locating and precisely striking moving

enemy armor by coupling the Army's Stand-Off Target Acquisition System (SOTAS) and the Distance Measuring Equipment elements of the Air Force's Advanced Location Strike System (ALSS). The study was substantiated by a hardware tie in of SOTAS and ALSS for a demonstration culminating in the successful detection, track, strike and destruction of a moving truck. Taking data from both systems, a computer processor was used to establish automatic target track and provide target data to the ALSS for strike control. In FY 1975, two all-weather ALSS controlled DME guided weapons were launched on separate missions with total system errors of

Ground processor development was initiated in FY 1975 to support the joint feasibility demonstration. In FY 1977, a contract was awarded to Pattern Analysis and Recognition Corporation to develop a simulator/test bed for use in developing, refining, and verifying target prediction algorithms as well as functional interfaces.

The Multiple Antenna Surveillance Radar (MASR) was developed and flight demonstrated by Lincoln Laboratory as the the brass board predecessor of the PAVE MOVER program. It employs a Displaced Phase Center Antenna (DPCA) array for motion compensation and a coherent radar system featuring adaptive digital processing to provide a capability to detect slow moving ground targets from a single platform. Laboratory static tests of these techniques were concluded in early FY 1976. A proof-of-concept brassboard test model was fabricated and demonstrated on a Twin Otter aircraft. MASR proof-of-concept flight testing was initiated in July 1976. As a part of this development activity, Lincoln Laboratory conducted an extensive investigation of the Electronic Countermeasures vulnerability of the MASR. A number of recommendations surfaced which have been incorporated into the radar development task. Modification of this system to include electronic scanning, capability, and increased signal processing was completed in the third quarter, FY 1978. Final MASR demonstrations, concluded in FY 1979, included highly accurate, automatic moving target ground targets with extremely low
The MASR also developed/demonstrated
the high utility of employing algorithms which enable the radar processor to automatically
The MASR also demonstrated processor algorithms for
extracting MTI radar data to
The MASR was phased out in FY 1979.

During FY 1976, Westinghouse completed a study of alternative radar approaches. This study concluded that superior performance, lower risk development, and greater operational utility would be achievable by going to non-displaced phased center array (DPCA) techniques, higher frequency, and advanced pulse doppler filter processing techniques. This has resulted in the definition of the PAVE MOVER MTI Radar development. Subsequent analyses have led to the decision to phase out the MASR program in FY 1979 and focus development on the PAVE MOVER Radar. A dual contract has been awarded for the competitive procurement of the PAVE MOVER MTI radar as a joint Air Force/Defense Advanced Research Projects Agency program in support of Assault Breaker. Contract awards were made in the fourth quarter, FY 1978 to two competing contractors (Hughes Aircraft and Grumman/Norden). PAVE MOVER Preliminary Design Reviews and Critical Design reviews have been accomplished. Hardware development of the PAVE MOVER airborne radar and ground subsystem

continues on schedule. A PAVE MOVER Test and Evaluation Master Plan has been completed and will be annexed to the Assault Breaker Demonstration Plan. Assault Breaker Concept Definition studies were initiated in FY 1979. A Concept of Operations is being prepared for Assault Breaker.

2. FY 1980 Program: PAVE MOVER airborne radar and ground subsystem hardware/software development will complete qualification, and will be installed in two F-111 aircraft as Class II modifications (one F-111 installation for each of the two competing radars). Checkout of the complete PAVE MOVER, to include radars, ground subsystems, off the shelf data links and related software/hardware will be completed in the fourth quarter FY 1980. The Assault Breaker Concept Definition Studies will be completed and prepared for use in Milestone II decisions. The studies examining the technical feasibility of

will be completed. In addition, preliminary studies of the operational suitability of

will be compared with the foregoing technical feasibility studies of The outcome of these comparisons will be used in a decision as to whether the balance of the PAVE MOVER parallel engineering design studies will focus on producing specifications for a or for specifications for a radar. The Assault Breaker End-to-End Demonstration Plan will be completed and coordinated with respective Air Force, Army and Defense Advanced Research Projects Agency offices.

3. FY 1981 Planned Program: Demonstrations of Stand-Off cooperative strike will be conducted using the two PAVE MOVER competing radars. The demonstration is broken into two phases: (1) baseline PAVE MOVER demonstrations; and (2) Assault Breaker End-to-End demonstrations. The baseline PAVE MOVER radar demonstrations include (1) radar/ground subsystem checkout and accuracy verification experiments; (2) demonstration of PAVE MOVER low probability of intercept and Electronic Counter Counter Measures (ECCM) features, to include red team evaluation of radar ECM resistance; (3) demonstration of PAVE MOVER command guidance of short range air launched missiles (GBU-9 HOBO missiles) launched from penetrating aircraft against ground targets. Following the baseline Air Force/PAVE MOVER demonstration the PAVE MOVER will join the Army/Air Force/Defense Advanced Research Projects Agency in the Assault Breaker End to End demonstrations. The Assault Breaker demonstrations consist of a joint baseline demonstration segment, an Air Force variant and an Army variant. The baseline demonstration consists of launching Army standoff surface to surface Corps Support Weapon missiles against multiple moving ground targets using PAVE MOVER for cooperative target acquisition and weapon guidance. The Air Force Assault Breaker variant demonstration consists of two segments. In the first segment, the PAVE MOVER will be used to acquire ground targets and cooperatively guide standoff air launched missiles (specially configured air launched T-16 Patriot missiles, launched from a second standoff airborne platform) against multiple movable ground targets. The second segment of the Air Force variant consists of using PAVE MOVER from a standoff high altitude platform to acquire and track moving ground targets, and to provide cue vectoring commands and target update information to a low altitude pentrating strike aircraft. The Army Assault Breaker variant does not utilize PAVE MOVER as the target sensor. Rather, the Army Standoff Target Acquisition System (SOTAS) radar will be used to guide Corps Support Weapon Surface to Surface missile to strike ground targets.

Program Element: #63747F
DoD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: PAVE MOVER
Budget Activity: Tactical Programs, #4

4. FY 1982 Planned Program: The Assault Breaker End to End demonstrations will be concluded. Tentative plans include taking the PAVE MOVER to FY 1982 REFORGER exercises. The results of the demonstrations, user assessments and parallel studies will be used to restructure the program as required. Final PAVE MOVER platform determinations/system overall architecture will be made. Full Scale Engineering Development will begin.

5. Program to Completion: It is anticipated that some unique command and contol aspects of the PAVE MOVER strike ground control subsystem will remain in Advanced Development beyond FY 1982. All PAVE MOVER Engineering Development to include Development Test and Evaluation/Initial Operational Test and Evaluation is tentatively planned to be completed in the FY 1985 time frame

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Resources (Project Listing): ($ in thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 81 Estimate	Additional to Completion	Total Estimate Costs
TOTAL FOR PROGRAM ELEMENT	5,500	5,600	6,700	13,800	*	42,300

* Follow-on Engineering Development funds programmed in

In addition, $35,000 thousand was added in FY 1982-1985 to accelerate PAVE MOVER for a 1985 Assault Breaker planned Initial Operating Capability.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64201F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: Aircraft Avionics Equipment Development
Budget Activity: Tactical Program, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimated	FY 1981 Estimated	FY 1982 Estimated	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7,100	12,600	17,100	12,700	Continuing	N/A
2257	Standard Avionics Modules	1,400	1,500	1,100	1,500	Continuing	N/A
2258	Standard Medium Accuracy Navigation	1,700	500	0	0	Continuing	14,974
2259	Radar ECCM Improvement Program	1,600	2,800	2,000	2,500	Continuing	N/A
2298	Computer and Software Standardization	0	200	1,100	1,000	Continuing	N/A
2519	Radar Programmable Signal Processor	1,700	6,500	10,600	7,000	30,300	56,100
2560	Jovial Language Control Facility	0	0	800	700	Continuing	N/A
2590	Standard Fuel Savings Advisory System	700	1,100	1,500	0	0	3,300

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The standardization of airborne electronics equipment is an essential element to low life cycle costs and improved reliability. This program is the only means of transitioning general standardization technology from the brassboard stage (outputs of advanced development programs or commercial efforts) to aircraft procurement and update programs. The important intermediate steps of applications engineering, modification engineering multi-purpose interface module development and qualification testing are accomplished through this program element preparatory to establishing a position of purchasing in large quantities for multiple applications. Products completing development include the Standard Medium Accuracy Navigator for A-10 application. An adaptive digital avionics module for multiplex is also being developed. A generic radar programmable processor is required to provide improved air-to-air operations, electronic counter-counter-measures (ECCM), air-to-ground operations and reduced life cycle costs in multiple application for combat fighters and strategic bombers. The standard fuel savings advisory system is needed to achieve a near term cost effective improvement of fuel consumption in KC-135, B-52, C-141 and C-5 aircraft. The system will save 4% of the trip fuel consumption for these aircraft. The Jovial language control will insure the stability and configuration of the Jovial higher order language. The facility will save the Air Force over $15M/ year in compiler acquisition cost alone.

Program Element: #64201F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: Aircraft Avionics Equipment Development
Budget Activity: Tactical Program, #4

Basis for FY 1981 Request: During FY 81 the standard avionics modules project will support the AF avionics planing effort. It will fund planning efforts for hardware standardization such as the standard radar altimeter, air data computer and flight warning subsystems. Project 2259 the Radar Electronic Counter Counter-Measures (ECCM) improvement program will flight test F/FB 111 ECCM terrain following radar fixes. Project 2297 will begin to establish efforts to reduce Air Force acquisition and operational costs of airborne computers and related software development tasks. During FY 81 the F-15 demonstrator will begin flight test to evaluate advanced radar programmable signal processor modes for air-to-air and air-to-ground operations for generic use. The F-16 radar programmable processor software development will begin. A radar/weapon system Operational Utility Evaluation planned for initiation in FY 1980 will continue in FY 1981 with extensive analysis and weapon system simulation. Close coordination will be maintained with other Air Force program offices to insure ease of incorporation of applicable technology. In FY 1981 the Standard Fuel Savings Advisory System will complete flight test. Source selection for application on C-52, KC-135, C-141 and B-52 aircraft will be completed. Fuel Savings Advisory System production will begin to save 4-6% on C-5, KC-135, C-141 and B-52 aircraft. The Jovial language facility will be established at Wright-Patterson AFB, OH to control higher order programming languages for Air Force use.

Other Appropriation Funds: Not Applicable

Program Element: #64201F
DoD Mission Area: Interdiction/ Naval Strike, #223

Title: Aircraft Avionics Equipment Development
Budget Activity: Tactical Program, #4

DETAILED BACKGROUND AND DESCRIPTION: This program has been established to permit engineering development of avionic equipments that are candidates for standardized equipment for future aircraft or proposed to satisfy specific production requirements for current and future aircraft. No other program element provides the specific application engineering necessary to translate the results of advanced development programs to actual form, fit and function standard avionics equipments for navigation, radar and processing needs. For example, the Standard Precision Navigator was transitioned from an advanced development program Advanced Avionics for Aircraft (63203F) where feasibility was demonstrated. Program Element (PE) 64201F has produced an engineering development model for broad applications to Air Force aircraft. This model has completed testing with production and installation in the B-52 aircraft expected to begin in FY 1980. In FY 1979, the Standard Medium Accuracy Navigator flight tests were completed The projects for standardization and improvement of airborne radars are aimed at the existing and evolving Warsaw Pact threats in radar intercept/locations, jamming and anti-radiation weapon systems. The Standard Medium Accuracy Navigator is finishing qualification flight tests. Avionics multiplex control modules, compatible processor hardware, software sets and advanced displays will be developed in the next five years. Without this specific program, separate costly development programs for each individual aircraft application would be conducted by the aircraft production or modification program office. The radar Electronic Counter-Counter Measures (ECCM) improvement program will address improved ECCM performance of the F/FB-111 and other aircraft radar to allow them to perform their operational mission. The standard fuel savings advisory system will standardize a system on KC-135, B-52, C-141 and C-5 aircraft.

RELATED ACTIVITIES: There is a close relationship between the products of this program and the technological building blocks developed in exploratory and advanced development programs such as PE 63203F, Advanced Avionics for Aircraft and PE 622047, Aerospace Avionics. Techniques, components and subsystems showing a high payoff potential can be progressively transitioned through the development process until a specific weapon system application is identified and engineering development task established. PE 64412 will be supported by the products developed under 64412. The radar programmable signal processor RPSP investigates the generic radar improvements possible through exploration of the PSP in the F-15. ECCM testing data obtained from PE 63750 will be used in developing ECCM software for the project. Avionics standards developed under this program will be transitioned to PE 64219F (Integrated Digital Avionics) for application and maintenance.

WORK PERFORMED BY: Program management will be provided by elements of the Air Force Systems Command (AFSC) with all projects under the direction of the Aeronautical Systems Division, Wright-Patterson AFB, OH. Major contract of Project 2257 are with the Actron Division of McDonnell Douglas Aircraft Company, Monrovia, CA and ARINC, Annapolis, MD. Project 2258 contractors include Litton Industries, Woodland Hills, CA, Singer-Kearfott Division, Little Falls,

Rockwell-Autonetics Division, Anaheim, CA. Project 2259 includes, as the major contractor, Texas Instruments Corporation, Dallas, TX and Project 2519 will have the Hughes Aircraft Corporation, Culver City, CA as contractor along with the McDonnell Douglas Aircraft Company during FY 1979-81 with follow-on F-16 related work by the Westinghouse Corporation, Baltimore, MD. The Simmonds Prejijion Corp, Vergeenes, Vermont, will be test an advisory system on KC-135 aircraft for KC-135 application. DELCO Corp, Santa Barbara, CA will test a fuel savngs system on C-141 aircraft. Lear Siegler, Grand Rapids MI will test a system on a B-52 aircraft.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishment: The Standard Precision Navigator completed qualification testing and is established as the standard high accuracy Inertial Navigation System for the Air Force. B-52D/G/H aircraft will be modified with this system. The Common Strategic Doppler development qualification and selection was completed in late FY 1978. The Teledyne-Ryan Corporation was selected for the production phase for B-52 and KC-135 program. Standard avionics module efforts will continue to develop the bi-polar adaptive digital avionics module for B-52 update. Joint efforts with the Joint Tactical Information Distribution System (JTIDS) and the Global Positioning System to devise interface integration hardware and software modules for those programs. The Standard Medium Accuracy Navigator qualification was completed. Studies of the F-111 terrain following radar (TFR) were completed to determine if selected fixes to the TFR would be effective in the operational environment. The design development and fabrication of the advanced radar programmable signal processor began. The effort is aimed at reduced equipment proliferation, increased reliability and reduced support costs for our combat aircraft while producing required performance. Three standard fuel savings advisory system contractors were awarded test contracts for B-52, C-141 and KC-135. Tests performance advanced electronic counter counter-measures (ECCM) software techniques for air-to-air and air-to-ground application will be incorporated.

2. FY 1980 Program: In FY 1980, the Standard Avionics Module Project will continue to test a standard Air Force power supply for wide application to selected aircraft. Electronic Counter-Countermeasures fixes for the F/FB-111 aircraft will continue design development. F-4 and other aircraft will be investigated for simple ECCM fixes. In Project 2297, a common computer module study will be contracted to identify/specify common avionics computer modules. Another study will address common computer modules for common tactical/strategic aircraft application. Software standardization for a family of avionics processors will be studies to provide an in-house capability to centralize, update and control software specifications and standards. Management, economics and support will be addressed in an effort to develop common compilers and instruction sets. The Standard Medium Accuracy Navigator will complete development for A-10 aircraft. During FY 1980, the Radar Programmable Signal Processor (RPSP) project will be fabricated and complete check out. The design will incorporate track while scan, frequency agility, non-cooperative target recognition electro optical identification, helicopter detection and track and a programmable symbol generator. These characteristics will support operational efficiency in a variety of existing

aircraft, especially the F-15 and F-16 aircraft. During FY 1980 a F-16 common radar software programmable signal processor effort will begin as a part of Project 2519. Multiple aircraft application will be considered. An F-15 test bed aircraft will also begin modification for an FY 1981 flight test. In accordance with direction in the Advanced Medium Range Air-to-Air Missile (AMRAAM) Decision Coordinating Paper (DCP #174), an Operational Utility Evaluation (OUE) is planned. The OUE will be performed under Project 2519 and will consist of analysis and simulation to evaluate operational effectiveness of the F-15 and F-16 simulated weapon systems using the AIM-7F or AMRAAM missile with single target track or multiple target track avionics in a realistic air combat environment. During FY 1980, demonstration testing of a Standard Fuel Savings Advisory System will continue on B-52H and C-141 aircraft to demonstrate basic system utility. KC-135 fuel saving flight tests will be completed.

3. FY 1981 Planned Program: Project 2257 will continue to assess efforts to identify candidate subsystems to be developed and designated as Air Force standard items. Project 2259, Radar Improvement Program (RIP) will begin flight test F/FB-111 electronic counter-counter-measures (ECCM) Terrain Following Radar (TFR) fixes. ECCM studies/design and fabrication efforts which concentrate on F-4, F-106, C-130 and A-7D aircraft will continue. Project 2297 will begin to establish a coordinated series of efforts to reduce Air Force acquisition and operational costs of airborne computers, related peripherals and software development tools. This project will begin testing of a standard family of analog-digital and digital-analog conversion modules for aircraft avionics use. Standard software support modules for the standard computer family will continue development. Another effort will revise developed support system packages for use on general purpose computers on a wide scale for improved software management. During FY 1981 the F-15 RPSP will be extensively flight tested. Close coordination will be maintained with other Air Force program offices to assure ease of production incorporation of applicable technology is possible. The F-16/common radar efforts will continue to develop software to support a flight test of F-16 aircraft in Program Element 64412. The radar/weapon system OUE planned for initiation in FY 1980 will be completed in FY 1981. In 1981 the Standard Fuel Savings Advisory System will complete qualification. Source selection for application on B-52, KC-135, C-141 and C-141 and C-5 aircraft will be completed. The Jovial language facility will begin service at Wright-Patterson AFB, OH to control costs of Air Force software.

4. FY 1982 Planned Program: Project 2257 will continue to control AF avionics developments and identify candidates for subsystem development which will save dollars and support requirements. Project 2259, radar improvement program (RIP) will finish flight tests to quantify ECCM fixes for TFR operations in the combat environment. Project 2297 will continue to support computer and software development efforts which reduce costs of future avionics software and computers. During FY 1982 the F-15 test bed will complete testing of hardware and software changes to the F-15 aircraft to demonstrate generic air-to-air and air-to-ground radar programmable signal processor improvements. These improvements will be used to the F-16/common radar development effort to insure maximum commonality is maintained. The air-to-ground software for the F-16/common radar will be developed. The Jovial language facility will continue to serve AF needs in the control of higher order language to save $15M year in software costs.

Program Element: #64201 Title: Aircraft Avionics Equipment Development
DoD Mission Area: Interdiction/Naval Strike #223 Budget Activity: Tactical Program, #4

5. Program to Completion: Continued effort will be made to identify candidate modules and subsystems for standardization to manage required specifications and to initiate those hardware developments required to Prove feasibility. The Radar Improvement Program (RIP) continues to concentrate on electronic counter countermeasure improvements in radars for RF-4, C-130E and A-7D aircraft. Standardization of avionics computers and software is a continuing program program to keep abreast of technology and nurture standardization of processing. The demonstration testing of advanced tactical mission capabilities will be completed in 1985. Radar programmable signal processor work will introduce advanced tactical software/hardware programs and radar update to improve operational usefulness, reduce life cycle costs and standardize the technology to the extent possible.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	14,347	5,200	12,600	18,700	Continuing	Not Applicable
1927	Standard Precision Navigator	200				0	15,800
2257	Standard Avionics Modules	1,500	1,400	1,300	1,900	Continuing	Not Applicable
2258	Standard Medium Accuracy Navigator	10,547	1,700	500	0	0	14,947
2259	Radar Improvement Program	500	1,600	2,800	5,100	Continuing	Not Applicable
2297	Airborne Computer Standardization	0	0	100	1.000	Continuing	Not Applicable
2298	Specification and Software Standardization	0	0	100	1,400	Continuing	Not Applicable
2365	Strategic Doppler	1,600					4,220
2466	Tactical Operator Controls and Displays	0	0	100	1,200	Continuing	Not Applicable
2518	Acquisition/Strike Modules	0	0	100	2,000	35,000	37,100
2519	Radar Programmable Signal Processor	0	400	6,500	4,600	47,500	59,000
2590	Standard Fuel Savings Advisory	0	100	1,100	1,500	0	2,700

Program Element: #64201 Title: Aircraft Avionics Equipment Development
DoD Mission Area: Interdiction, #422 Budget Activity: Tactical Program, #4

Reduced FY 81 and outyear allocations for projects under 64201 caused the F-111 RIP program to be delayed one to two years. The Airborne computer and software standardization efforts have been delayed and combined in reduced scope. The tactical operator controls and displays and acquisition/ strike module program has been cancelled. The Jovial language facility project is planned. A radar/weapon system Operational Utility Evaluation is planned as a task under Project 2519 in response to Office of the Secretary of Defense direction.

Project: #2519
Program Element: #64201F
DoD Mission Area: Interdiction, #422

Title: Radar Programmable Signal Processor
Title: Aircraft Avionics Equipment Development
Budget Activity: Tactical Program, #4

DETAILED BACKGROUND AND DESCRIPTION: Warsaw Pact employment of large scale operations produces a significant air-to-air targeting problem. They also display the capability for round-the-clock armor attack in all weather operations. Significant improvements in the number of sophistication of the threat requires penetrators to fly at the lowest possible altitude. Radar electronic counter-counter measures (ECCM) characters are needed tomake fighter and bomber aircraft less susceptible to air-to-air and air-to-ground electronic counter measures. All weather beyond-Visual-Range Identification (BVRID), track while scan (TWS), ECCM protection and raid assessment are needed to aid pilots make optimum missile launch decisions which increase effectiveness. THe generic radar programmable signal processor (RPSP) program will develop and demonstrate algorithms which provide there improved capabilities and F-15 demonstrator test bed will be used to test the software developed under a portion of this program. The project will perform a coordinated series of efforts which will develop RPSP improvements and utilizations for many aircraft. The effort performed in concert with PE 64412. The F-16/Common Radar software programmable signal processor effort will take advantage of the technological opportunity of the F-15 RPSP software improvements for future multiple aircraft applications.

RELATED ACTIVITIES: The techological transfer of RPSP equipment was developed by PE 27133 with the APG 63 radar. Non-cooperative Identification techniques and equipment was provided from PE 63742/1177. Efforts are carefully reviewed to ensure that they are not duplicative. The Electronically agile radar program PE 62341 will provie some air-to-ground technology for the RPSP demonstration. The efforts from project 2519 will be used to support in line F-15 aircraft for selected air-to-air PSP improvements. The project will support PE 64412 all weather strike radar future aircraft combat radar developments.

WORKED PERFORMED BY: The Aeronnautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, OH will manage this Project. The project receives support from the Air Force Avionics Laboratory, Wright-Patterson AFB, OH. The project major contractors are McDonnell Douglas Aircraft Company, St Louis, MO, and the Hughes Aircraft Corporation, Culver City, CA. F-16 related work will be accomplished by Westinghouse Corporation, Baltimore, MD and General Dynamics Corporation, Dallas, TX.

Project: #2519
Program Element: #64201F
DoD Mission Area: Interdiction, #422

Title: Radar Programmable Signal Processor
Title: Aircraft Avionics Equipment Development
Budget Activity: Tactical Program, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: During FY 1979 a series of efforts began to develop fabricate and improved radar programmable signal processor. Software development work on the air-to improvements software began on track while scan, raid assessment, passive ranging search enhancement. F-16/common radar studies began.

2. FY 1980 Program: In FY 1980 advanced development software will be completed for track while scan, raid assessment (ECCM), passive ranging and long range search enhancement. Roof house tests will be completed. Flight software check out completed F-16/common radar software will began preparation. Studies to assess future aircraft application will be completed. The F-15 modification for flight test will be completed. A radar/weapon system Operational Utility Evaluation is planned for initiation to include an evaluation of the effectiveness of the F-15 and F-16 simulated weapon systems using AIM-7F or the Advanced Medium Range Air-to-Air Missile with and without multi-target track avionics. An FY 1980 reprogramming request will be submitted to support this effort.

3. FY 1981 Program: During FY 1981 the advanced software will bee flight tested to demonstrate the utility of the new software modes. Hardware modification will be completed to provide th basis for advanced non-cooperative target recognition (NCTR) and air-to-ground ECCM and high resolution ground map. Software will be finalized for these modes of operation. Aircraft modification will began for an FY 1982 flight test. F-16/common radar software will supported to gain maximum technology transfer. The radar/weapon system Operational Utility Evaluation will be completed in FY 1981.

4. FY 1982 Planned Program: During FY 1982 an F-15 demonstration test bed will complete testing of hardware and software changes to the F-15 RPSP to demonstrate generic air-to-air and air-to-ground RPSP improvements. F-16/common radar software will be suppoted to gain maximum technology transfer.

5. Program to Completion: The completion of RPSP and associted capabilities testing of advanced tactical mission capabilities will be completed in FY 1985 radar programmable signal processor work will introduce advanced tactical software/hardware programs and radar update to improve operational usefulnness, reduced life cycle costs and standardize RPSP technology to the extent possible.

6. Milestones: Not Applicable.

Project: #2519
Program Element: #64201F
DoD Mission Area: Interdiction, #422

Title: Radar Programmable Signal Processor
Title: Aircraft Avionics Equipment Development
Budget Activity: Tactical Program, #4

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
2519	Radar Programmable Signal Processor	1.7	6.5	10.6	7.0	30.3	56.1

8. Comparison with FY 1980 Budget Data: Additional funds were provided to accelerate testing preparation and provide for additional studies for common radar considerations. A radar/weapon system Operational Utility Evaluation is also planned as a task in this project.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64212F
DOD Mission Area: Interdiction/Naval Strike, #223

Title: Aircraft Equipment Development
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,200	7,900	4,200	4,500	Cont	N/A
1926	Acft Windshield Development	1,810	1,400	1,300	1,700	Cont	N/A
2098	Landing Gear Development	222	100	100	800	Cont	N/A
2145	Helmet Mounted Laser Acq Device	460	500				1,725
2228	Std Cryogenic Cooler	155					2,125
2229	F-111 Crew Restraint System	238					2,100
2377	Airdrop Systems Support	75	200	100	300	Cont	N/A
2470	Aerial Gunnery Fire Control Sys				500	7,600	8,100
2471	Midair Prevention Sys		500			1,600	2,100
2713	Acft Instruments & Displays	740	100	100	400	Cont	N/A
4366	Integrated Attack Avionics	400	300	600	300	Cont	N/A
5551	PAVE LOW III	200	400				3,900
2525	F100 Engine Diagnostic Sys (Transferred from PE 64229F)	3,900	4,400	2,000	500		19,300

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Due to changing threat scenarios, equipment obsolescence and technological advancements, a need exists to update and modernize the aircraft force. A need also exists to correct deficiencies that exist in operational aircraft in the areas of safety, and improved systems effectiveness. This program element represents a collection of different but related projects which develop, test, and evaluate a variet of aircraft subsystem equipment in response to these operational needs. Technological advancements in aircraft equipment are exploited and/or translated into operational hardware. This is the only engineering development program element which utilizes advanced state-of-the-art technology to develop windshield systems offering improved hazard resistance and reduced cost-of-ownership.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for projects that range in size and complexity from safety certification of equipment to be airdropped from Air Force cargo aircraft to development of an engine diagnostic system for the F100 engine. Of the six projects being funded in FY 81, the F100 engine diagnostic syste is the only one with an established end date, the rest being continuing efforts that apply latest technology in correcting operational aircraft deficiencies in several subsystem equipment areas (windshields, landing gear instruments and displays).

Program Element: #64212F
DOD Mission Area: Interdiction/Naval Strike, #223

Title: Aircraft Equipment Development
Budget Activity: Tactical Programs, #4

OTHER APPROPRIATION FUNDS: N/A

Program Element: #64212F
DOD Mission Area: Interdiction/Naval Strike, #223

Title: Aircraft Equipment Development
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Deficiencies in operational force aircraft due to changing threat scenarios, equipment obsolescence and advancements in technology are documented by command required operational capability documents (ROCs). Various ROCs addressed by this program element are as follows: Tactical Air Command (TAC) ROC 26-71, Improved F-111 Transparency Windshield; TAC ROC 23-72, Laser Designation Search/Track Capability; Air Force Logistics Command ROC 2-74, Airborne Cryogenic Cooler, TAC ROC 306-75, Supersonic Weapons Delivery; Military Airlift Command ROC 19-70, Night/Adverse Weather Rescue System; Department of Defense Directive 3224.1 and Air Force Regulation 80-19, Engineering for Transportability. The objective of this program element is to develop, test, and evaluate a wide variety of aircraft subsystem equipments in response to these operational needs. The equipments involved are characterized by their installation on or within the aircraft. Following is a brief description of each of the projects within the program element which will be on-going in FY 81. Project 1926, Aircraft Windshield Development applies the latest technology to achieve bird impact resistance while maintaining high optical quality and light weight. F-111 bird impact resistant windshields have been developed in this project and effort will now be concentrated on the F-16 and T-38 aircraft. Project 2098, Landing Gear Development, applies landing gear technological improvements in the areas of high temperature wheels and brakes and carbon disc brakes in an effort to improve performance, decrease acquisition costs, and reduce operation and support costs. Project 2377, Airdrop Systems Support, provides the method by which the United States Air Force carries out its responsibilities as executive agent (designated by the Joint Technical Coordinating Group on Air Drop) for development and testing of on-board airdrop systems. Project 2713, Aircraft Instruments and Displays, maintains cognizance of new technologies in this area and exploits these advancements to improve/solve operational deficiencies of currently operational controls and displays systems. Project 4366, Integrated Attack Avionics, integrates and tests the latest developments in the avionics/weapons areas to develop interface techniques which will assure optimum weapon delivery in high performance aircraft. Project 2525, F100 Engine Diagnostic System, is to determine the most appropriate engine diagnostic system for the F100 engine with emphasis on defining the level of technology and specific sensors/location required to enhance maintenance supportability and reduce life cycle cost of the engine.

RELATED ACTIVITIES: Program Elements 62201F, Aerospace Flight Dynamics; 63211F, Aerospace Structural Materials; 63246F, Aircraft Subsystems Technology; and 63203F, Advanced Avionics for Aircraft, are related to this program element in that this element provides a means for completing the Engineering Development required to introduce equipment into the operational inventory. Appropriation 3080 funds for procurement of production quantities of the Helmet Mounted Laser Acquisition Device (developed under Project 2145) are programmed for FY 80 - 84. Appropriation 3010 funds for installation of the improved F-111 Crew Restraint System (developed under Project 2229) are programmed for FY 80 and FY 81. Appropriation 3010 funds for installation of the F100 engine diagnostics system (being developed under Project 2525) in the F-15/F-16 aircraft are programmed beginning in FY 82.

WORK PERFORMED BY: Program management is provided by the Air Force Aeronautical System Division and Wright Aeronautical Laboratories, Wright-Patterson AFB, OH. In-house test facilities involved in projects under this program element include the Wright Aeronautical Laboratories (Flight Dynamics, Materials, Structure, and Avionics Labs) at Wright-Patterson AFB, OH; the Air Force Flight Test Center, Edwards AFB CA; Armament Division,

Program Element: #64212F
DOD Mission Area: Interdiction/Naval Strike, #223

Title: Aircraft Equipment Development
Budget Activity: Tactical Programs, #4

Test Track Division, Holloman AFB, NM; El Centro Naval Air Facility, El Centro, CA; Arnold Engineering and Development Center, Tullahoma, TN; Tactical Fighter Weapons Center, Nellis AFB, NV; and the Armament Development and Test Center, Eglin AFB, FL. Contractors include McDonnell Douglas Corp, Long Beach, CA; and St. Louis, MO; General Dynamics, Fort Worth, TX; Hughes Aircraft Company, Culver City, CA; B.F. Goodrich, Akron, OH; Sierracin Corp, Sylmar, CA; Pittsburgh Plate Glass Company, Pittsburgh, PA; Honeywell Inc, Minneapolis, MN; Bendix Corp., South Bend, IN; Cryogenics Technology Inc., Boston, MA and others.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The following are examples of prior accomplishments under this program element. A second source/alternate design (lightweight) bird impact resistant windshield has been qualified and is being procured and retrofitted into F-111 series aircraft. Emphasis in windshield development shifted to F-16/T-38 applications to develop canopies with increased birdstrike capability while maintaining lightweight and high optical qualities. Test and evaluation of titanium wheel/carbon brake assemblies was completed as was service testing of carbon disc brakes supplied by multiple vendors. Qualification testing and initial operational test and evaluation of the Helmet Mounted Laser Acquisition Device were completed. A preproduction model of the standard cryogenic cooler completed contractor testing and was delivered for in-house Air Force testing. The F-111 Crew Restraint System Modification design was completed, prototype hardware fabricated, and development testing completed. Development and testing of PAVE LOW III, the night/adverse weather/all terrain search and rescue modification of the HH-53 helicopter, have been completed. Aircraft retrofit is underway. An air drop systems support project designed to insure safety certification of all equipment to be air dropped from Air Force cargo aircraft was initiated. The competitive preproduction development of a charge coupled device gun camera to replace film type gun cameras in tactical aircraft was completed. Procurement was initiated for a newly modified tow plate for installation in C-130 aircraft equipped with the Low Altitude Parachute Extraction System.

2. FY 1980 Program: During this period development/evaluation of an F-16 canopy with a 350 knot bird impact capability will be completed. Retrofit of F-111 series aircraft with lightweight bird impact resistant windshields will be completed. Initial procurement of production quantities of the Helmet Mounted Laser Acquisition Device will be accomplished. In-house testing of the cryogenic coolers will be completed. Testing of the prototype modification to the F-111 crew resistant/seat system will be completed resulting in an engineering change proposal for aircraft retrofit. Production of Cockpit Television Sensors (CTVS) will be initiated. Initiation of development of a split screen capability for the CTVS will be initiated. The PAVE LOW III modification program will be completed. PAVE LOW III follow-on test and evaluation support will be concluded. The F100 engine diagnostic system will begin flight test evaluation.

3. FY 1981 Planned Program: Development of a stronger bird impact resistant windshield for the T-38 aircraft will continue. Windshield development efforts will also include evaluation of coatings and the effects of rain erosion and in-service wear on impact resistance. Landing gear systems projects will continue to investigate materials and

manufacturing techniques to improve gear component service life while reducing acquisition costs and operation and support costs. The F100 engine diagnostic system (EDS) will complete flight testing and any design refinements necessary as a result of that testing will be initiated prior to military specification qualification testing. Also, the F100 EOS will begin an F-16 compatibility program. Oevelopment of a split screen capability for the Cockpit Television Sensor will be completed. First production article deliveries of the Helmet Mounted Laser Acquisition Device will occur.

4. FY 1982 Planned Program: Ouring this period windshield development efforts will continue evaluating coatings and the effect of in-service wear on impact resistance. Production deliveries of the Helmet Mounted Laser Acquisition Device will continue. The F100 engine diagnostic system will complete military specification qualification testing and the F-16 compatibility program. Landing gear improvement efforts will concentrate on material and manufacturing techniques investigations which improve service life and reduce costs. The development of digital flight instruments and cockpit displays will be initiated.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7,750	6,800	7,900	6,700	Cont	N/A
1926	Acft Windshield Development	230	1,600	1,400	1,700	Cont	N/A
2098	Landing Gear Oevelopment	350	600	100	700	Cont	N/A
2145	Helmet Mounted Laser Acq Oevice	815	500	500			1,725
2228	Standard Cryogenic Cooler	350	100				2,125
2229	F-111 Crew Restraint System	715	200				2,100
2342	F-111 Weapon System Improvements	2,600	(Transfered to PE 27129F in FY 79)				
2377	Air Drop Systems Support	20	100	200	300	Cont	N/A
2470	Aerial Gunnery Fire Control Sys					5,400	8,100
2471	Midair Prevention Systems		600	500	700	700	2,100
2713	Acft Instruments & Oisplays	140	600	100	600	Cont	N/A
4366	Integrated Attack Avionics	2,335	200	300	700	Cont	N/A
5551	PAVE LOW III	195	200	400			3,900

Program Element: #64212F
DOD Mission Area: Interdiction/Naval Strike, #223

Title: Aircraft Equipment Development
Budget Activity: Tactical Programs, #4

2525	F100 Engine Diagnostic System (Transferred from PE 64229F)	2,100	4,400	2,000

FY 81 funding was reduced by 2.5 million. This results in a delay in starting Project 2470, Aerial Gunnery Fire Control System, and Project 2471, Midair Prevention Systems.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64218F
DOD Mission Area: Counter Air #221

Title: Engine Model Derivative Program (EMDP)
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	35,900*	39,300	48,600	23,100	Continuing	Not Applicable

*NOTE: $33 million was transferred from Navy to Air Force in FY 1979 to initiate joint Air Force/Navy alternate engine program. This is consistent with Congressional direction in FY 1979 Appropriations bill.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Engine Model Derivative Program (EMDP) is aimed at filling a void which existed in the engine management and acquisition process for 10 years. This program will conduct efforts to provide improvements in the specification characteristics (i.e., performance, durability/life, reliability/maintainability, and reduced risk of development) of in-service engines or those engines which have passed the equivalent of a military qualification test. This capability, when combined with new engine developments, will ensure that the Air Force has propulsion alternatives for near term and far term needs. The only means today to provide this capability is through full scale weapon system development. The EMDP will conduct the early engineering development leading to a prototype engine. Full scale development will continue in a weapon system development program after validation of the requirement for increased capability.

BASIS FOR FY 1981 RDT&E REQUEST: Three efforts previously initiated will be continued in this fiscal year and two new start efforts will be initiated. The F101X limited development program will be completed in this time period. The second 1000 equivalent mission hour accelerated mission test will be completed and the flight cleared engine test will be concluded. Flight testing on the F-16 will be conducted in the January-April 1981 time period, and Navy flight tests on the F-14 aircraft will be conducted in the August-November 1981 time period. T56 hardware fabrication will be completed. The new compressor, combustor, and turbine will undergo rig testing to characterize the individual component characteristics. Fabrication of the digital electronic engine control and augmentor hardware will be completed for the derivative F100 engine. Component rig testing will be completed to assess improvements inherent in these improved designs. New starts will focus on a competitive derivative cruise missile engine which will provide 15 20 percent increase in thrust and 5-10 percent decrease in cruise specific fuel consumption when compared to the curre engine, and a derivative TF34 engine to provide 10 percent improvement in specific fuel consumption; 15 percent improvement in thrust and improved hot section durability. The approach will be to demonstrate a derivative engine which would fit an existing trainer aircraft and provide at least 50 percent decrease in specific fuel consumption, increase durability, and a 50 percent reduction in cost of ownership when compared to current systems.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #64218F
DOD Mission Area: Counter Air #221

Title: Engine Model Derivative Program (EMDP)
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: The Engine Model Derivative Program (EMDP) fills a void which existed in the engine development process for 10 years by permitting the demonstration of growth potential for current operational engines. This function had been accomplished under the Component Improvement Program until 1968 when Congress directed that the Air Force discontinue the practice. Aircraft have historically increased in gross weight at the rate of 2 percent per year following their development. This historical factor, resulting from changes in roles and missions, increased threat, and the incorporation of more on-board equipment, demands that higher engine performance be available to maintain the system thrust to weight necessary to maintain weapon system performance. Until 1979, the only method to accomplish this growth engine performance was through a full scale development program. Under the current concept, promising advanced component and engine technologies proven under Air Force advanced development programs will be transitioned to the EMDP and applied to practice. Early engineering development will be accomplished through prototype engine demonstration. Full scale development will continue under the specific weapon system program after the requirement for increased performance has been validated. This process will greatly enhance the Air Force ability to respond quickly to changing system needs. Propulsion has always been a pacing factor in aircraft system development. EMDP will permit the Air Force to selectively pursue derivative engine demonstrations early in the development process. Component technologies chosen for demonstrating desired increased capability will focus on improved durability and life, reduced cost, and improved performance. The EMDP will perform the engineering development of the upgraded components, integrate it into the derivative engine, and conduct the proof test. The program will demonstrate prototype engines to a point that prototype new concepts and designs can be incorporated into a follow-on full scale weapon system development. The overall objective of this effort is to maximize long range benefits in cost and system requirements. It will provide for the major design changes in Air Force engines to achieve performance improvements for future programs including F-16, F-15, A-10, air launched cruise missile, and next generation trainer aircraft.

RELATED ACTIVITIES: For the requisite technology, this program draws gas generator "core" engine technology (high pressure compressor, combustor, and high pressure turbine) from Program Element (PE) 63216F, Advanced Turbine Engine Gas Generator. Fan, low pressure turbine, and limited engine test data are provided by PE 63202F, Aircraft Propulsion Subsystems Integration (APSI). Advanced component technology is also obtained from PE 62203F, Aerospace Propulsion. Other principle inputs including materials processing and component fabrication demonstration come from PE 78011F, Manufacturing Technology Program. Activities conducted by the Navy, National Aeronautics and Space Administration, Army, and the propulsion industry in-house programs also constitute significant sources of technology. The Air Force and the Navy have a broad Memorandum of Understanding for joint cooperative propulsion programs in areas of common interest. Component Improvement Program efforts directed toward engine flight safety problems, service revealed difficulties, and the achievement of durability goals also complement the long term EMDP development process.

WORK PERFORMED BY: The program is managed by the Aeronautical Systems Division, Deputy for Propulsion, Wright-Patterson AFB, OH. the T56 program is being performed by Detroit Diesel Allison Division, Indianapolis, IN. The F101X program is being conducted by the General Electric Company, Evendale, OH. The growth F100 engine program is run by Pratt and Whitney Aircraft, Government Products Division, West Palm Beach, FL. Potential contractors for future efforts include: General Electric company, Lynn, MA; Williams research Corporation, Walled Lake, MI; AiResearch (Garrett), Phoenix, AZ; and Teledyne CAE, Toledo, OH.

Program Element: #64218F
DOD Mission Area: Counter Air #221

Title: Engine Model Derivative Program (EMDP)
Budget Activity: Tactical Programs #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Efforts were initiated to significantly enhance the performance of the T56 engine for the C-130 aircraft. New "core" engine components providing a 20-25 percent improvement in the hot day take off thrust of the engine and a 10 percent reduction in the cruise specific fuel consumption of the engine were designe and their fabrication was initiated. Gas generator design improvements include new compressor aerodynamics, improved turbine materials application, and an improved combustor fuel injection design. The limited development program for the Alternate Fighter Engine/F101X was initiated following Congressional direction to transfer funds previously authorized and appropriated for reengining the Navy F-14 aircraft to a joint Air Force/Navy engine development effort. The program is aimed at a limited development program which will take the F101X engine through a flight cleared engine demonstration, and subsequent limited flight tests in an F-16 and F-14 aircraft. Initial efforts are directed toward fabrication of new low pressure spool hardware (i.e., fan and fan turbine); fabrication of a new augmentor; and refurbishment of three engine cores from the B-1/F101 engine program. A fan stress test will also be completed to verif the design of that component. A parallel effort was initiated to demonstrate growth capability for the F100 engine. Efforts are centered around improvement in the fuel control and augmentor components at the engine which will produce improved operability, survivability, and perhaps durability/life characteristics. These large engine efforts will assure that competition will be maintained in the high thrust fighter engine area both in the near term and far term.

2. FY 1980 Program: Those efforts begun in FY 1979 will be continued. T56 efforts will focus on hardware fabricatio of the core components and initiation of testing. Fabrication of the hardware is expected to be completed toward the end of the fiscal year. The components will then be assembled and rig testing will be initiated to verify individual component performance characteristics prior to proceeding with integrated testing. The F101X will enter into its firs phase of critical tests. A 1000 equivalent mission hour System, Mechanical, Performance test will be initiated on the engine to verify engine characteristics under a wide range of operating conditions including both steady and transient operations. Emphasis will be placed on mission oriented test envelopes. The low pressure turbine and the fan will be integrated and a low spool stress test will be conducted to verify structural design and durability. Hardware fabrica tion will be completed for the improved augmentor and engine control components for the F100 growth engine. Component testing will be conducted to verify both design and performance characteristics.

3. FY 1981 Planned Program: Three major engine efforts will be in their critical stages. Integrated core engine tes for the T56 engine will be conducted. Accelerated life testing on the T56 will verify the durability aspects of the hardware, and accelerated mission oriented testing will cycle the hardware under simulated system operational conditio The F101X engine will complete the 1000 equivalent mission hour test begun in FY 1979 and a second 1000 equivalent mission hour System, Mechanical, Performance test which will clear the engine for flight testing will be completed. Upon successful completion of this severe ground testing, the F101X will undergo 100 hours of flight testing on an F-1 aircraft. During this time period, a follow-on effort to continue development with this engine will be considered. T program would focus on additional extensive ground testing to verify engine durability and cost of ownership aspects o the F101X. F100 growth engine efforts will be continued with the conduct of extensive integrated engine ground tests.

Program Element: #64218F
DOD Mission Area: Counter Air #221

Title: Engine Model Derivative Program (EMDP)
Budget Activity: Tactical Programs #4

The new augmentor and full control components will be installed on a flight engine, and comprehensive mission oriented cyclic testing will be conducted. Derivative cruise missile engine efforts will be initiated. Design of new fan, combustor, and turbine components will be completed. Fabrication of these components will be initiated. A new fan, combustor, and high pressure turbine will be fabricated for the derivative TF34 engine.

4. FY 1982 Planned Program: Efforts will be continued on the derivative F100 engine, derivative T56 engine, derivative cruise missile engine, and derivative trainer engine. F100 derivative engine efforts will be oriented toward continued sea level/altitude ground tests to verify the durability, operability, and reliability aspects of the engine. A flight cleared engine test will be completed, and flight test engine modifications prerequisite to limited flight validation of the engine design improvements will be initiated. Derivative cruise missile engine efforts will include completion of component fabrication and initiation of rig testing. Rig testing will validate individual component characteristics including performance and durability, and verify design margins. T56 engine efforts will culminate with a flight cleared engine test and subsequent modification of an engine for flight verification tests. A limited flight test program will be conducted on a C-130 aircraft. Successful flight demonstration could lead to purchase of a limited number of engine modification kits for further in-service evaluation. Derivative TF34 engine efforts will include completion of component rig testing and initiation of integrated engine performance testing.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	—	1,000*	26,000	51,000	Continuing	Not Applicable

*NOTE: $33 million was transferred from the Navy to the Air Force in FY 1979 to initiate joint Air Force/Navy alternate engine program.

Congress added $13.3 million in FY 1980 to ensure completion of the limited development program on the F101X engine in FY 1981. Prior approval reprogramming of $1.9 million for the derivative F100 engine was received in FY 1979. FY 1981 reduction due to rebalance of program in FY 1980-1981.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64219F
DoD Mission Area: Counter Air, #221

Title: Integrated Digital Avionics (IDA)
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	2,500	1,000	2,000	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force has initiated a concerted effort to contain the rising cost, complexity, and proliferation of airborne electronic equipment (avionics) through a comprehensive program of avionics planning, standardization, and control. The Air Force issued a new regulation, AFR 800-28, in September 1978, and established a Deputy for Avionics Control at Wright-Patterson AFB, OH, to enforce the new policies. AFR 800-28 requires the Air Force to develop a standard avionics architecture, with the objectives of maximizing the reusing or sharing of avionics systems and minimizing the cost of retrofit. This standard architecture will serve as a basis from which the Air Force will develop and evaluate future avionics architectures, systems, and subsystems. AFR 800-28 requires the Air Force to develop families of functional standards for avionics equipment which are compatible with the standard architecture and to establish and use an Air Force in-house, systems-oriented avionics engineering capability to define, design and implement every new and modified avionics program. The Integrated Digital Avionics (IDA) program will develop the standard architecture based on the Digital Avionics Information System (DAIS) concept, provide the manpower and facilities needed to maintain the specifications and standards, and will assist program managers in using these standards on future avionics programs.

BASIS FOR FY 1981 RDT&E REQUEST: This request provides funds to continue the engineering development required to establish and maintain the avionics equipment and avionics architecture standards that are evolving from the Digital Avionics Information System program (PE 63243F) and other programs. It supports the efforts needed to define the requirements for, and the design of, an avionics architecture standards validation and control facility. The IDA program will fund conversion of the DAIS software to the Air Force standard Higher Order Language (HOL) JOVIAL J73, completion of the AN/AYK-15A computer demonstration which implements the MIL-STD-1750 instruction set architecture (ISA), and the upgrade of the DAIS multiplex terminals to be compatible with the current tri-service MIL-STD-1553B.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element #64219F
DoD Mission Area: Counter Air, #221

Title: Integrated Digital Avionics (IDA)
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Air Force is spending in excess of $500 million (M) a year on the development of airborne electronic systems (avionics). Avionics equipment costs thirty percent of the total flyaway costs in some modern aircraft. Avionics support costs are equally high, approaching seventy-five percent of total support costs for some of our older aircraft. Costs to make what appear to be simple avionics changes such as replacing an unreliable radio system can cost in excess of $50,000 per aircraft. In all, it has been estimated that the Air Force avionics related expenditures exceed $3.5 billion annually. These cost figures, together with the realization that avionics provide the technological edge needed by our forces to meet the challenge of a numerically superior and sophisticated enemy, have led the Air Force to adopt a new strategy for avionics. The objectives of this strategy are to provide required avionics for the total USAF mission and to achieve a twenty-four-hour-a-day all-weather, all-threat, all-target capability across the full combat spectrum. The Air Force intends to meet this objective with minimum development, acquisition and support costs by combining our many avionics systems into a core architecture and set of standardized sensors. These will be used as a baseline for all Air Force systems. Air Force plans and policies for implementing this new strategy for avionics are set forth in a new regulation, AFR 800-28, published in September 1978. In addition, a Deputy for Avionics Control (DAC) was established at Wright-Patterson AFB, OH, in April 1978 to provide a focal point to coordinate the planning, acquisition, maintenance and modification of all avionics under an Air Force wide master plan. The DAC will develop and maintain this master plan, and strive to achieve force-wide definition, development and application of avionics standards. The IDA program supports this new strategy and the Deputy for Avionics Control by providing the resources, facilities and in-house expertise needed to complete the development of standards that are evolving through advanced development programs to keep them ready for use by weapon system program offices. The IDA program will be primarily concerned with the engineering development and maintenance of avionic architecture and interface standards such as those being developed under the Digital Avionics Information System (DAIS) program (PE 63243F). IDA will provide the capabilty to confirm that new avionics systems comply with the standards, and that individual sensors will work when they are connected to the standard architecture. IDA will also provide technical assistance to program offices to help specify and use standard avionics in future aircraft development and modification programs. IDA is a critical requirement in our overall strategy to standardize avionics in future weapon systems.

RELATED ACTIVITIES: Advanced development, proof of concept, and life cycle cost savings verification of the core architecture concept were accomplished under the Digital Avionics Information System (DAIS) program, PE 63243F. Support equipment interface requirements are being defined under the Modular Automatic Test Equipment (MATE) program, PE 63247F. Specifications for standard sensors and software are evolving through programs, such as Aerospace Flight Dynamics, PE 62201F: Aerospace Avionics, PE 62204F: Advanced Computer Technology, PE 63728F: and Aircraft Avionics Equipment Development, PE 64201F. IDA will support the Night Attack program, PE 63249F, and all future aircraft development and avionics update programs.

WORK PERFORMED BY: The work will be managed by the Aeronautical Systems Division (ASD) at Wright-Patterson AFB, OH.

Program Element: #64219F
DoD Mission Area: Counter Air, #221

Title: Integrated Digital Avionics (IDA)
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: This program is a FY 1980 new start. Advanced development was accomplished under PE 63243F, Digital Avionics Information System (DAIS). Initial program definition and planning for IDA was conducted during FY 1979 under PE 64201F, Aircraft Avionics Equipment Development.

2. FY 1980 Program: Program definition studies and application plans will be completed. Funding will be provided to the Air Force Avionics Laboratory to complete the conversion of DAIS software to JOVIAL J73,to complete the development of the AN/AYK-15A computer to demonstrate the feasibility of competitively procuring a computer by specifying government owned instruction set architecture (ISA), and to upgrade the DAIS multiplex terminals to be compatible with the current tri-service MIL-STD-1553B.

3. FY 1981 Planned Program: Definition of an avionics architecture validation facility will be started. Existing facilities such as the Avionics Laboratory's Avionics Simulation and Integration Laboratory, the DAIS software test stand and the Aeronautical Systems Division (ASD) computer center will be connected to avionics development computer facilities currently being used by ASD. Support will be provided to program offices to help them apply the specifications and standards which define the avionics architecture baseline.

4. FY 1982 Planned Program: Definition of the avionics architecture validation facility will be completed, and design will be started. Aircraft development and aircraft avionics update program offices will be supported in their application of the avionics standards/specifications developed and controlled by the Integrated Digital Avionics (IDA) program. Life-cycle cost studies and other cost trade studies directed toward specific weapons systems will be conducted.

5. Program to Completion: IDA will continue to maintain an Air Force in-house capability to control avionics specifications and standards, validate candidate sensors/software/avionics architectures developed by contractors, and assist aircraft/avionics program offices. IDA will assist Air Force Logistics Command (AFLC) and Air Training Command (ATC) in developing avionics maintenance and training capabilities compatible with a standard avionics architecture. Life-cycle cost and other trade studies will be performed in support of new aircraft and avionics update programs on a continuing basis.

6. Milestones: Not Applicable

7. Resources: Not Applicable

Program Element: #64219F
DoD Mission Area: Counter Air, #221

Title: Integrated Digital Avionics (IDA)
Budget Activity: Tactical Programs, #4

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	2,500	7,000	Continuing	Not Appplicable

Due to higher priority programs and the resulting funding constraints, the capability to validate that new avionics meet the required interface standards nas been slipped from FY 1982 to FY 1985. The FY 1981 funding request reflects this change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64222F — Title: Nuclear Weapons Support
DOD Mission Area: Defensive Theater Nuclear Warfare, #243 — Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	*	1,100	1,600	1,600	Continuing	N/A

*This Program Element, PE 64222F, was formerly Project 5708 within Program Element 64602F

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides technical guidance to the US Department of Energy (DOE), and direction to the North Atlantic Treaty Organization (NATO), USAF, and Canadian Armed Forces to fulfill USAF responsibilities related to the development and support of nuclear weapon systems.

BASIS FOR FY 1981 RDT&E REQUEST: Includes funds to continue work begun in prior years and documented in PE 64602F, Armament/Ordnance Development Funds are used primarily to pay civilian professional salaries, fund bomb dummy units for B83 bombs, pay for flight test support for the B83 program, procure the F-16 electronic simulator, and provide TDY in support of all USAF nuclear weapon development programs.

OTHER APPROPRIATION FUNDS: None.

Program Element: #64222F
DoD Mission Area: Defensive Theater Nuclear Warfare, #243

Title: Nuclear Weapon Support
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The objective in 64222F is to provide technical guidance to the Department of Energy (DOE), and direction to the North Atlantic Treaty Organization (NATO), USAF, and Canadian Armed Forces to achieve safe and effective nuclear weapons delivery. Three generic efforts are conducted under the program: nuclear weapon development support efforts, weapon/carrier compatibility and equipment support efforts, and nuclear weapon data development and evaluation support efforts.

Efforts related to nuclear weapon development support include: providing the USAF technical focal point and coordination point, as appropriate, with DOE during development of new weapons and major modification of stockpiled weapons; preparing Military Characteristics (MCs) and Stockpile-to-Target Sequence (STS) for Air Force weapons and maintaining these documents throughout the life of the weapon and providing technical guidance (as required) to support stockpiled weapons.

Efforts related to weapon/carrier compatibility and equipment support activities include: providing the Air Force liaison with DOE during development or modification of aircraft designed to be nuclear capable, the nuclear weapons themselves and/or nuclear weapons related support equipment; providing requirements, criteria, and guidance to DOE for nuclear weapon integration with specific aircraft; providing for nuclear certification efforts on the F-16 and the B-52 Offensive Avionics System; maintaining nuclear certification of all operational USAF systems and the North American Air Defense (Canadian) CR-101/F-106/AIR-2A systems; providing the Lead Program Officer for the Aircraft Monitor and Control (AMAC) project officer's group; providing technical assistance in certification efforts for non-US NATO systems, especially the Tornado. A second effort related to weapon/carrier compatibility and equipment activities is having Air Force responsibility for nuclear weapon loading and training shapes (Bomb Dummy Units and minature bomblets), for electronic simulators for flight crew and load crew training, and for designing, developing, and conducting when required, weapon/carrier compatibility tests. A third effort relates to cargo, loading, and handling equipment, and suspension and release equipment for nuclear weapons. Activities include conducting nuclear weapon cargo tiedown testing and tiedown evaluation as part of the nuclear certification process for the airborne logistic transport of DOD nuclear weapon cargo in USAF cargo aircraft; performing engineering evaluations of weapon handling and transport equipment, and of suspension and release equipment; and employing an in-house AMAC evaluation facility to complete assigned nuclear weapon/aircraft compatibility engineering responsibilities for specific aircraft/weapon systems.

Nuclear weapon data development and evaluation activities include gathering and maintaining technical data for nuclear weapon loading, delivery, and transport Technical Orders (TOs); supporting F-16 and other program offices in development of data to meet operational requirements; providing for the development of data for non-US (F-16 and other) aircraft; and maintaining nuclear weapon data for operational US and non-US NATO systems using data contract funded by Air Force Logistics Command and Foreign Military Sales funds.

Program Element: #64222F
DoD Mission Area: Defensive Theater Nuclear Warfare, #243

Title: Nuclear Weapon Support
Budget Activity: Tactical Programs, #4

RELATED ACTIVITIES: These activities were in FY 1979 and earlier a part of PE 64602F (Armament/Ordnance Development), project 5708 (Nuclear Weapon Support).

WORK PERFORMED BY: Work is managed and primarily performed by personnel at the Air Force Weapons Laboratory, Kirtland AFB N.M. 87117. F-16 simulator development is being performed by the Naval Weapons Facility, Dahlgren, Virginia. Flight tesing in conjunction with the B83 and B61 programs is performed bythe Air Force Flight Test Center, Edwards AFB, CA. An Air Force Weapons Laboratory Operating Location at Ramstein AB, FRG (AFWL-OL/AD) monitors all work on the Tornado.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Year Accomplishments: W80, W84, B61-34, W78, B83, and MX warheads programs were initiated and continue into FY 1980; certification/compatibility efforts for F-16, B-52 Offensive Avionics System and Tornado continued; certification of operational USAF and North American Air Defense systems was maintained; tiedown testing of MAC Priority III nuclear weapon requirements for nuclear airlift was completed; NATO F-104 G/S technical order (TO) revisions were completed; F-16 TO development continued; TOs for operational nuclear systems were maintained; Aircraft Monitor and Control (AMAC) evaluation capability was built up; design of model for AMAC System Demonstration Unit was completed; Advanced Strategic Air Launched Missile (ASALM) phase 2 study was completed; B83 bomb dummy unit development was initiated.

2. FY 1980 Program: Program includes continuing present nuclear weapon support activities; continuing F-16 simulator development; continuing support of W80, B83, W84, M-X and ASALM warhead efforts; applying in-house AMAC capability to F-16 and F-111E aircraft; continuing Tornado, B-52 OAS/Air Launched Cruise Missile certification; continuing TO development for Tornado, B-52, and F-16 aircraft; supporting DOD stockpile modernization efforts.

3. FY 1981 Planned Program: On-going nuclear weapons support activities as detailed in FY 1979 and 1980 will be continued; the F-16 centerline station will be certified; and W78 project officer support will continue as required; MX warhead phase 3 engineering development will be initiated.

Program Element: #64222F
DoD Mission Area: Defensive Theater Nuclear Warfare, #243

Title: Nuclear Weapon Support
Budget Activity: Tactical Programs, #4

4. FY 1982 Planned Program: Nuclear weapon support activities will continue.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data ($ in Thousands): Not Applicable, No Change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 64228F (63236F)
DOD Mission Area: Airlift, #26

Title: Advanced Medium STOL Transport (AMST)
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	400	1,700*	0	N/A	N/A	N/A

*$1.5M will be reprogrammed into Program Element #63104 - Airlift Planning

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Advanced Medium STOL Transport (AMST) program responded to a Military Airlift Command Required Operational Capability to modernize the tactical airlift force with an aircraft capable of jet speeds and operations from 2100 foot unimproved dirt runways, while also having the capability to carry heavy outsized cargo into improved runways. Two contractors built two prototypes each for test and evaluation of propulsive lift technology. Testing was completed in mid 1977 and source selection proceedings initiated to select a contractor to begin engineering development of an aircraft which would provide a replacement for the current operationally limited and aging tactical airlift force. Source selection was placed in a hold status for two years while the Office of the Secretary of Defense, the Joint Chiefs of Staff and the services reevaluated our mobility requirements. As a result of decisions to place increased emphasis on enhancement of our strategic airlift capability, the Air Force is terminating AMST source selection and the program. The Air Force is restructuring our airlift modernization plans to define a new airlift aircraft, the C-X. The C-X program will be open to competition from all responsible contractors and may include derivatives of the two AMST designs.

BASIS FOR FY 1981 RDT&E REQUEST: The AMST program is being terminated and funding is not requested for FY 1981.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #64228F (63236F)
DOD Mission Area: Airlift, #261

Title: Advanced Medium STOL Transport (AMST)
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The Advanced Medium STOL Transport (AMST) program was selected for prototyping as a result of an Air Force prototype study completed in August 1971. The purpose of this advanced development program was to verify "Powered Lift" technology of the two prototype designs and provide an option for modernization of our aging tactical airlift force. The prototype phase provided data on costs associated with a wide-bodied STOL aircraft. This phase also provided performance data, and defined the operational rules, safety margins, and related design criteria for STOL transports including characteristics which could reduce maintenance support requirements.

Design, performance, and associated cost goals, rather than rigid specifications, were established to permit the contractors flexibility and tradeoffs in order to achieve the best overall capability. The prototype design and performance goals were based essentially on a 1970 Tactical Air Command Required Operational Capability (ROC) for a C-130 replacement. After airlift consolidation under the Military Airlift Command this ROC was updated.

Modified versions of the AMST could be used as an aerial refueling tanker, drone launcher, gunship, or for special missions such as rescue, ice cap operations, satellite retrieval and weather reconnaissance. The AMST designs were studied as an air mobile MX carrier and a Cruise Missile Carrier Aircraft (CMCA).

RELATED ACTIVITIES: The Air Force and National Aeronautics and Space Administration (NASA) worked in close coordination during the Advanced Development program to prevent duplication and to provide a technology base with minimum consumption of resources. NASA provided additional test instrumentation on the prototypes, and their pilots and engineers have participated in the flight testing program. The Army had full time representation at the Program Office and participated in the prototype testing. The Marines also had representation at the test site and have evaluated the operational utility of the prototypes. One and a half million dollars of FY 1980 funding will be reprogrammed from the AMST program into Program Element (PE) 63104 - Airlift Planning.

WORK PERFORMED BY: Contracts were awarded to the Boeing Company, Seattle, WA and McDonnell Douglas Corporation of Long Beach, CA to design and build Advanced Medium STOL Transport (AMST) prototypes. The AMST prototype program was managed by the AMST Program Office, Aeronautical Systems Division, Wright-Patterson AFB, Dayton, OH. Air Force Flight Test Center and Air Force Test and Evaluation Center had primary responsibility for the actual conduct of the flight tests. General Electric and Pratt Whitney provided the engines used on the advanced development prototypes.

Program Element: #64228F (63236F)
DOD Mission Area: Airlift, #261

Title: Advanced Medium STOL Transport (AMST)
Budget Activity: Tactical Airlift, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 AND FUTURE PROGRAMS: Source selection evaluation resulted in the awarding of contracts for performance/cost trade analyses in November 1972. Additional contracts with Boeing and McDonnell Douglas to design, build, and flight test the prototypes were signed in January 1973. Preliminary designs were frozen, wind tunnel and flight simulator testing were completed and mockups built. A congressional reduction in FY 1974 funding forced renegotiation and amendment of the basic contracts.

McDonnell Douglas completed fabrication of both prototypes with #1 flying in late August 1975 and #2 flying in early December. The major portion of the basic flight testing on the McDonnell Douglas prototypes was completed in August 1976. Wing/engine modifications were initiated on these prototypes in late 1976 at the Douglas Long Beach plant. The McDonnell Douglas #1 prototype was modified with a larger wing and a high by pass ratio engine (CFM56) installed in one of the engine positions. The #2 prototype was also refitted with a higher thrust engine (JT8D-209) in one engine position. During the 796 hour flight test program, both of the YC-15 prototypes proved to be highly reliable.

Boeing began final assembly in July 1975 with the #1 prototype flying in August 1976 and the #2 prototype flying two months later. Both Boeing prototypes moved to Edwards AFB in November 1976 and completed a 601 hour flight test program in August 1977. The flight test results of both the YC-14 and YC-15 indicated either aircraft had the potential of making a significant improvement in our tactical airlift forces. Source selection was initiated in September 1977; however, when program funding was deleted from the FY 1979 Budget Request, source selection was placed in a suspended status.

2. FY 1980 PLANNED PROGRAM: The Air Force is restructuring our airlift modernization plans to place increased emphasis on enhancement of our strategic airlift capability. As a result, the Air Force will terminate the AMST program and proceed with the definition of a new airlift aircraft, the C-X. The C-X program will be open to competition from all responsible contractors and may include derivatives of the two AMST designs.

3. FY 1981 PLANNED PROGRAM: The AMST program is being terminated and funding is not requested in FY 1981.

4. FY 1982 PLANNED PROGRAM: Not Applicable.

5. PROGRAM TO COMPLETION: Not Applicable.

Program Element: #64228F (63236F)
DOD Mission Area: Airlift, #261

Title: Advanced Medium STOL Transport (AMST)
Budget Activity: Tactical Airlift, #4

6. MILESTONES:

A. Prototype Program

	Boeing Date	McDonnell Douglas Date
Start Design/Build	Jan 1973	Jan 1973
Start Major Assembly	Sep 1974	Oct 1973
Start Final Assembly	Jul 1975	Jul 1974
First Flight	Aug 1976	Aug 1975
Flight Test Complete	Aug 1977	Aug 1977

B. AMST Source Selection

Initiated	Sep 1977*
Terminated	Dec 1979

* Placed in "hold" status when funding deleted from FY 1979 Budget Request in Jan 1978.

7. RESOURCES: Not Applicable

8. COMPARISON WITH FY 1980 BUDGET DATA: Not Applicable. Program will be terminated in FY 1980.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64231F
DOD Mission Area: Airlift, #261

Title: C-X Program
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	0*	80,700	253,300	TBD**	TBD**

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Airlift is required to project and sustain combat forces in a time urgent manner. Specific tasks associated with the airlift mission area include deployment, employment (airland, airdrop and extraction), sustaining support, retrograde, and combat redeployment. Additional airlift capability is needed for rapid interthcater deployment of combat forces to support national objectives and for timely intratheater movement to meet the forward area mobility requirements. This new C-X program addresses that need. Airlift is vital to a NATO or Korean conflict as well as for the mobility requirements of a Rapid Deployment Force tailored to respond to worldwide contingencies.

BASIS FOR FY 1981 RDT&E REQUEST: A major initiative to improve our rapid deployment capability is the development and production of the C-X, an aircraft capable of carrying outsized cargo over intercontinental distances into small, austere airfields. In addition, the C-X will provide the capability to move this heavy mechanized Army equipment within the theater of operation. Several potential options are being considered in structuring the C-X program. One is relatively minor modifications to existing designs, which offers the benefit of earliest availability. Another is the development of a new design, possibly incorporating some powered lift technology, which would offer the benefit of better adaptability to smaller, austere airfields. As such, derivatives of the Advanced Medium STOL Transport (AMST) designs would be considered. The FY 1981 request is to initiate Full Scale Engineering Development on the selected C-X design.

OTHER APPROPRIATION FUNDS:

	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Procurement 3010	152,610	TBD**	TBD**

* FY 1980 efforts for source selection preparation and source selection will be funded from the $1.5M reprogrammed into Program Element #63104 - Airlift Planning.

** To Be Determined upon the completion of Source Selection.

Program Element: #64231F
DOD Mission Area: Airlift, #261

Title: C-X Program
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The global challenge to US national interests continues to grow. The cornerstone of US ability to protect its interests is our capability to project and sustain military power as an instrument of national policy. Execution of this force projection strategy demands greater emphasis on airlift as a means of timely force projection. Airlift is vital to a NATO or Korean conflict as well as to a Rapid Deployment Force tailored to respond to worldwide contingencies. A new aircraft program is needed to enhance our intercontinental airlift capability, while also providing the capability to carry heavy, outsized cargo into small, austere airfields. This program element provides for initiation of a program to develop and procure a new airlift aircraft, the C-X.

The C-X program is a major initiative to improve our rapid deployment capability and also provide the lift capability to move heavy mechanized Army equipment in-theater. Several options for the C-X program are being considered. One would be to modify existing designs, such as C-5s or 747s; this offers the benefit of earliest availability. Another is the development of a new design, possibly incorporating powered lift technology, which would offer the benefit of increased operational flexibility into smaller austere airfields. As such, derivatives of the AMST design would be considered. The Air Force is planning to initiate source selection for the C-X program in the last half of FY 1980. The FY 1981 request for funding is to initiate Full Scale Engineering Development (FSED) on the selected C-X design after completion of source selection and a Milestone II review.

RELATED ACTIVITIES: This program is a new start in FY 1981. The FY 1980 efforts for source selection preparation and source selection will be funded from Program Element #63104, Airlift Planning. Variants of the C-X may have application in meeting other mission requirements including cruise missile carrier, a variety of C^3I missions, and as a tanker aircraft.

WORKED PERFORMED BY: A Program Office will be established in the Aeronautical Systems Division of Air Force Systems Command at Wright-Patterson AFB, Dayton, OH. The Program Office, with participation from the Military Airlift Command and the Army will take the lead in those activities necessary for initiation of this new airlift program in FY 1981. The major contractors will be identified upon completion of source selection. The Air Force Flight Test Center and the Air Force Test and Evaluation Center will conduct developmental and operational flight testing in the FSED program.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable.

2. FY 1980 Program: Activities required for source selection preparation and source selections will be accomplished under Program Element #63104, Airlift Planning. Program #64231F, C-X Program, will be a new start in FY 1981.

3. FY 1981 Program: After a Milestone II review, Full Scale Engineering Development will be started on the selected C-X design. Funds will be used for final configuration design, system and component development,

engineering design and design releases. Wing tunnel aerodynamic evaluations will be conducted for final wing/nacelle interfacing. Manufacturing and tooling planning will be integrated with production design effort. Subcontractor specifications will be issued and designs reviewed/evaluated. Planning for developmental and operational flight testing will be initiated.

4. FY 1982 Program: Funds will be used for completion of design specifications on long lead procurement items, engine/airframe/avionics integration, production readiness and critical design reviews, detailed production design effort and fabrication of durability/static test articles. Funds will also be used for initiation of subsystem and component development, wind tunnel testing, initiation of flight simulator design, tooling and parts fabrication. Flight test and systems evaluation planning will be completed.

5. Program to Completion: Funds will be used for completion of production design effort, assembly and test of durability/static test articles, completion of design specifications on procurement items, completion of support equipment design. Funds will also be used for completion of subsystem and component development and flight simulator testing, tooling and parts fabrication. Manufacturing assembly, flight test and systems evaluation will be completed on the Full Scale Engineering Development flight Test articles.

6. Milestones:

Complete Source Selection	1st Qtr	FY 1981
Initiate Full Scale Engineering Development	2nd Qtr	FY 1981
Delivery of First Production Aircraft		FY 1984
Initial Operating Capability		FY 1986

7. Resources: Not Applicable.

8. Comperison with FY 1980 Budget Data: Not Applicable, New Program.

Budget Activity: Tactical Programs
Program Element: 64231, C-X Program

Test and Evaluation Data

1. Development Test and Evaluation: Combined Development Test and Evaluation (DT&E) and Initial Operational Test and Evaluation (IOT&E) will be conducted by a combined test force on Full Scale Engineering Development (FSED) flight test articles of the selected C-X design. A Test and Evaluation Master Plan will be developed to identify the test organizational relationships and describe the testing to be accomplished during FSED. The C-X Request for Proposal (RFP) will require the offerors to describe in their proposal a test program that will flight qualify the aircraft and quantitatively establish the performance of the system. The DT&E and IOT&E programs of the selected C-X design will be thoroughly examined at the Milestone II review. Initial airworthiness testing of the C-X will be conducted at Edwards AFB, CA under the combined test force with the Air Force Flight Test Center (AFFTC) taking the lead in the Development Test and Evaluation. Development tests will include stability, control and performance as well as testing of reliability, availability and maintainability.

2. Operational Test and Evaluation: Initial Operational Test and Evaluation will be accomplished under a combined DT&E and IOT&E test program. Air Force Test and Evaluation Center (AFTEC) will take the lead in operational testing which will be conducted by a combined test team with AFTEC, AFFTC, Military Airlift Command, U.S. Army and U.S. Marine Corps participation. The testing during FSED will consist of evaluations in the following areas: aircraft procedures and handling characteristics during preflight, engine start, pretaxi, and compatibility of any special procedures/techniques applicable to aircraft operations at high gross weights; aircraft potential to perform airdrop operations including heavy equipment, container delivery system, low altitude parachute extraction system, and personnel; flight characteristics during slow flight, cruise, high speed, low level, and airdrop configurations; formation characteristics required for inflight refueling; capability of the aircraft to operate at night and during simulated instrument meteorological conditions; suitability of the cargo compartment design to layout and field of view, crew and life support provisions, and workload functions; aircraft potential payload and range capabilities for deploying worldwide; aircraft reliability, maintainability, and logistics supportability. In addition, a period of dedicated operational testing will be conducted to assess operational suitability.

3. Systems Characteristics: To be determined.

Reliability/Availability/Maintainability: To be specified in the RFPs and addressed in the offeror's response.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64362F
DOD Mission Area: 242, Theater-Wide TNW

Title: Ground Launched Cruise Missile
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	33,100	60,900	67,500	30,600	8,200	219,028

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of the Ground Launched Cruise Missile (GLCM) is to provide increased nuclear firepower for theater forces. This program element provides for full scale engineering development to adapt the TOMAHAWK cruise missile into a tactical mobile ground launched system. This requirement is in response to Tactical Air Forces Required Operational Capability 304-77, dated 23 February 1977, and validated by the Air Force in August 1977.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for the continuation of weapon system Full Scale Engineering Development which began in FY 1978. Specifically, this effort includes cruise missile integration, launch canister, transporter/erector/launcher, launch control center, and system software development. Major milestones during this period include delivery of the first test system and the start of development flight testing. The TOMAHAWK missile development, funded under the Navy's Sea Launched Cruise Missile Research and Development appropriation supports the GLCM missile development.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
Missile Procurement (3020)	20.2	8.2	97.2	260.1	1415.1	1800.8
(Quantity)		(0)	(11)	(54)	(495)	(560)
Military Construction (3300)			23.1	6.2	20.0	49.3

Department of Energy costs

Program Element: #64362F
DOD Mission Area: 242, Theater-Wide TNW

Title: Ground Launched Cruise Missile
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The Ground Launched Cruise Missile (GLCM) is an adaptation of the TOMAHAWK cruise missile as a ground mobile weapon system to increase theater firepower. Faced with numerical increases and advanced technology of enemy forces, a cost effective weapon is required to sustain theater capability. GLCM can satisfy this need for a system with a high single-shot probability of destruction of tactical targets and with coverage of a large percentage of the theater target system. The GLCM, with a nuclear warhead, preprogrammed targeting; and quick reaction, all weather capability can provide increased firepower and improve the non-nuclear force levels by releasing quick reaction alert aircraft for other than nuclear tasking. In effect, this provides increased conventional firepower without additional aircraft.

Technology developed in the TOMAHAWK advanced development program supports the development of a GLCM weapon system capable of 2500 Kilometers operational range and terminal accuracy of less than Circular Error Probable. Pre-launch survivability is enhanced through system mobility which allows dispersal from main operating bases to random locations during periods of increased tension or actual hostility. Because of the missile's range, the weapon system can be located well behind the Forward Edge of the Battle Area (FEBA), further complicating the enemy's prelaunch attack problem.

The GLCM program will integrate the TOMAHAWK cruise missile into an air transportable, ground mobile unit. The missiles are transported four to a launch platform and are controlled by a launch control center. Four transporters, with sixteen missiles, and two launch control centers constitute a fire control unit. The design of the launch control center, transporter, and associated electronics comprise the bulk of the program. System integration and testing make up the balance of the effort. The weapons control system development including the fiber optics cable design is a pacing item in the development program.

RELATED ACTIVITIES: The Ground Launched Cruise Missile as a weapon syatem is a new development, but it will incorporate technologies previously developed in command, communication, and control subsystems and carrier vehicles. Program Elements 64367N, TOMAHAWK and 64361F, Air Launched Cruise Missile are closely related.

WORK PERFORMED BY: The Joint Cruise Misailes Project Office (JCMPO) located in Washington, D.C. has overall responsibility for the Ground Launched Cruise Missile development and testing. The January 1977 Cruise Missile Defenae System Acquisition Review Council II direction established the JCMPO with the Navy as lead Service to manage current cruise misaile development with special emphasis placed on commonality between programs. The Air Force GLCM Project Office is staffed by the Air Force within the overall auspices of the Director, JCMPO who is the Program Manager. Air Force Systems Command, Andrews AFB, MD and Aeronautical Systems division, Wright-Patterson AFB, OH interface and support this development activity. Air Force Test and Evaluation Center, Kirtland AFB, NM will be responaible for GLCM operational testing. The Utah Test and Training Range has been selected

as the Ground Launched Cruise Missile (GLCM) primary test site. General Dynamics, San Diego, CA is contractor for the TOMAHAWK missile airframe. McDonnell Douglas, St Louis, MO is the navigation/guidance contractor. Williams Research, Walled Lake, MI is the contractor for the engine. General Dynamics is the GLCM weapon system integration contractor. GTE Sylvania is the communications subcontractor. Vitro, Silver springs, MD is the weapon control system software and integrating contractor with McDonnell Douglas, St Louis, MO providing the hardware.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The program began funded activities in October 1977 with a contract go-ahead to General Dynamics, Convair Division to begin system development and integration. Contract definitization of efforts for the transporter/erector/launcher (TEL) and launch control center (LCC) developments were initiated. Development activities on these subsystems along with supporting hardware were started and will lead to first article deliveries in FY 1981.

2. FY 1980 Program: This year continues development of subsystems which began in FY 1978. The FY 1980 activities are highlighted by detailed design of subsystems and integration of these subsystems into a total weapon system. Fabrication of the first full scale engineering development articles are scheduled for delivery beginning the first quarter of FY 1981. An engineering test unit of the TEL will be completed for use in the first contractor test flight in April 1980 and preparation will start for combined Air Force Development Test and Evaluation/Initial Operation Test and Evaluation which is scheduled to begin in FY 1981. Production tooling startup of the production line, and long lead items will be funded during this period.

3. FY 1981 Planned Program: FY 1981 activities will include the fabrication of pre-production articles to support the Air Force Test and Evaluation (AFT&E). Planned test assets will include nine missiles and their canisters, four TELs, and three LCCs. Guidance sets, engines, and warhead flight test articles are also to be delivered to support the contractor and AFT&E programs. Preparations throughout this period for systems testing will culminate with initial full-up weapon system contractor flight test in February 1981. The AFT&E will begin in April 1981. Eleven missiles, six TELs, six LCCs, and associated support equipment will be funded for production in order to meet the planned December 1983 Initial Operational Capability (IOC).

4. FY 1982 Planned Program: The AFT&E which begins in April 1981 will be completed in May 1982. The flight test and ground evaluation which began in FY 1980 will lead to a Defense System Acquisition Review Council III in July 1982. Fifty-four missiles, sixteen TELs, eleven LCCs and associated support equipment will be funded in FY 1982 in order to meet the planned IOC and planned force structure buildup.

Program Element: #64362F
DOD Mission Area: 242, Theater-Wide TNW

Title: Ground Launched Cruise Missile
Budget Activity: Tactical Programs, #4

5. Program to Completion: The planned flight test program will end in FY 1982. The Defense System Acquisition Review Council (DSARC) III is scheduled for July 1982. If the DSARC III provides for production go-ahead, final development activities will involve resolution of any deficiencies identified during the test program. These final activities will end in FY 1983.

6. Milestones:

			CY Date
A.	DSARC II		Jan 1977
B.	Program Initiation		Oct 1977
C.	First Full Scale Engineering Development Flight	*(Dec 1979)	Apr 1980
D.	Critical Design Review	*(Dec 1979)	Apr 1980
E.	First Test Article Delivered	*(Jul 1980)	Feb 1981
F.	Complete Development/Initial Operational Test & Evaluation	*(Dec 1981)	May 1982
G.	DSARC III	*(Feb 1982)	Jul 1982
H.	Initial Operational Capability (IOC)	*(Mar 1983)	Dec 1983

* Date presented in FY 1980 Descriptive Summaries

EXPLANATION OF MILESTONE CHANGES: The milestone changes were necessitated by a slower than expected design process on the Ground Launched Cruise Missile (GLCM) support systems and the prohibition on discussion with Allies to establish basing requirements and locations.

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data:

FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
33,000	44,100	49,900	22,700	168,428

Total estimated costs have increased from $168,428K (FY 1980 Descriptive Summary) to $219,028M. An increase of $10.5M reflects a grass roots re-estimate of the costs, $6.3M is for inflation, $17.0M is for the delayed IOC, and $16.8M reflects the transfer of funds from Missile Procurement Appropriation to Research, Development, Test and Evaluation Appropriation in FY 1980 for the Extended Storage Program.

BUDGET ACTIVITY: Tactical Programs, #4

PROGRAM ELEMENT: 64362F GLCM

Test and Evaluation Data

1. Development Test and Evaluation: The Ground Launched Cruise Missile (GLCM) Test Program will be managed by the Joint Cruise Missiles Project Office (JCMPO). General Dynamics, San Diego, CA is the prime integrating contractor. GLCM development testing of the TOMAHAWK Missile will incorporate test results from the Sea Launched Cruise Missile (SLCM) and Air Launched Cruise Missile (ALCM) programs to reduce GLCM test requirements. A total of 31 flights have been conducted (with SLCM vehicles) which provided generic cruise missile data applicable to GLCM. The SLCM land attack (nuclear) program includes a total of 29 flights with the missile configuration that most closely corresponds to GLCM. The SLCM land attack (conventional) and anti-ship test program and the ALCM test program will also provide data applicable to the GLCM development in the areas of engine performance qualification, airframe, navigation/ guidance and missile performance. Initial inflight survivability testing was accomplished during the Cruise Missile Survivability Flight Test Evaluation. The first GLCM test launch will be from an engineering test unit of the Transporter Erector Launcher (TEL) in March 1980. Full system testing will begin in February 1981 using preproduction prototype missiles, TELs, and Launch Control Centers (LCCs). Two contractor flights and eight Air Force flights are planned from Feburary 1981 to May 1982. The Air Force testing will be combined Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E). The Air Force Flight Test Center is the development test agency and the Air Force Test and Evaluation Center is the operational test agency. The DT&E program has objectives to provide data in the areas of flight test, environmental test and operations and maintenance demonstrations. Flight test objectives are to provide W84 warhead flight test data to Department of Energy (DOE), investigate launch environment effects on the TEL, and provide data to evaluate system performance for compliance with the system specification. Environmental test objectives address the adequacy of the GLCM system to function throughout its specified range of environments. The operations and maintenance demonstrations will focus on maintenance of the GLCM ground systems since the GLCM maintenance concept provides for only limited maintenance on the missile. The primary test site will be the Utah Test and Training Range (UTTR) with tests also conducted at Aberdeen Proving Ground, MD; Eglin AFB, FL; and Kirtland AFB,NM. Tests will be conducted using a total of three LCCs, four TELs, and nine missiles. Recovery and refurbishment of flight-tested missiles will enable multiple test launches of a single missile. An Extended Storage Program (ESP) during the DT&E/IOT&E will use a TEL with four missiles and an LCC to help assess the GLCM system's reliability. An Effectiveness Verification Improvement Program (EVIP) will continue to monitor system reliability for the life of the GLCM system.

2. Operational Test and Evaluation:

a. No formal operational test and evaluation (OT&E) programs have yet been accomplished on the Ground Launched Cruise Missile (GLCM) weapon system; however, the Joint Cruise Missiles Project Office (JCMPO) conducted an initial phase of survivability testing between January and October 1978. Seven test flights were flown with the Tomahawk Sea Launched version against various simulated airborne and ground defensive threats to obtain generic detection and tracking data. Further test data will be obtained from Phase II survivability flights during Air Launched Cruise Missile (ALCM) initial operational test and evaluation (IOT&E), Sea Launched Cruise Missile (SLCM) technical evaluation/operational evaluation (TECHEVAL/OPEVAL) and GLCM combined development test and evaluation/initial operational test and evaluation (DT&E/ IOT&E). Applicable results will be applied to the GLCM design and the planning of survivability objectives for the initial operational test and evaluation.

b. The combined DT&E/IOT&E is scheduled for April 1981 through May 1982. Those aspects of SLCM mission reliability and performance which reflect GLCM operational requirements will be used in conjunction with formal GLCM OT&E flight test data.

c. The purpose of IOT&E will be to provide a valid estimate of the operational effectiveness and suitability of the GLCM Weapon System for Defense System Aquisition Review Council (DSARC) III, scheduled for July 1982. The Air Force Test and Evaluation Center (AFTEC) will manage IOT&E. The Tactical Air Command (TAC), US Air Forces Europe (USAFE), Air Training Command (ATC), Air Force Logistics Command (AFLC), Military Airlift Command (MAC), and Electronic Security Command (ESC) will participate. Personnel from Commander in Chief Europe (CINCEUR) may participate in IOT&E of the Mission Planning Subsystem.

d. The principal test location will be the Utah Test and Training Range (UTTR). IOT&E will also include one month of testing of the weapon system (except actual launch) at a European site representative of planned operational conditions near the end of the combined DT&E/IOT&E program.

e. Excepting depot level and decentralized maintenance facility equipment, the GLCM weapon system will be available for IOT&E in at least preproduction prototype form. All test air vehicles will have telemetry packages and most will have a recovery package in place of one fuel tank. Service personnel will operate and maintain the weapon system during IOT&E. Availability, reliability, maintainability, and logistic supportability are major operational suitability test objectives. A system approach to the evaluation of availability will be conducted. Both mission and logistics reliability will be evaluated. Quantitative (critical, high interest, and desirable maintenance and operational demonstrations which will be accomplished by Air Force personnel) and qualitative maintainability evaluations will be performed. A qualitative logistics supportability evaluation will be conducted with emphasis on AFLC capability to support the system. Mature system evaluation criteria (thresholds, standards, and goals) will be established for significant areas of evaluation. The system effectiveness data system (SEDS) will be used to collect reliability and maintainability test data. Service reports (SRs) will be submitted IAW Section V, T.O. 00-35D-54 (USAF Material Deficiency Reporting and Investigating System). Data emanating from the ALCM program will be used as appropriate.

f. The management, timing, and extent of follow-on operational test and evaluation (FOT&E) have not been determined. FOT&E will include those objectives not fully evaluated during development test and evaluation/ initial operational test and evaluation (DT&E/IOT&E). Deficiencies and areas of concern surfaced during prior testing will be emphasized.

3. System Characteristics:

ITEM	OBJECTIVES	DEMONSTRATION PHASE
TOMAHAWK (BGM-109)		
Length (without booster)	219 in	N/A
Weight	2700 lbs	N/A
Warhead		DOE Verification
Speed		DT&E
		DT&E
Operational Range	2500 KM	IOT&E
CEP		DT&E/IOT&E
TEL	- 10 ton Heavy Enhanced Mobility Tactical Truck	N/A
	- Four Missiles per launcher	N/A
	- Weight Approximately 70,000 pounds	N/A
	- Air transportable (C-130, C-141, C-5)	IOT&E
LCC	- Contains both comm and launch control systems	N/A
	- Controls four TELs	
	- 10 ton Heavy Enhanced Mobility Tactical Truck (HEMTT)	N/A
	- Weight approximately 70,000 pounds	N/A
	- Air transportable	IOT&E
SYSTEM RELIABILITY	.85	IOT&E
OPERATIONAL AVAILABILITY		IOT&E
MEAN TIME TO REPAIR (NON-MISSILE)	30 Minutes	IOT&E
PLANNED DT&E/IOT&E FLIGHTS		
Contractor Test Flights	3	
Air Force Test Flights (combined DT&E/IOT&E)	8	
TOTAL	11	

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: PE64412F
Title: Common Multimode Radar
DOD Mission Area: Close Air Support/Battlefield Interdiction #222
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): (Dollars in thousands)

Project Number Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Total for Program Element	0	0	4,500	9,200	83,300	97,000

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Current intelligence indicates that the Warsaw Pact countries are actively pursuing significant increases in all weather air superiority capabilities. In addition, they continue to improve their capability to conduct large scale armored operations during night all weather conditions (which are predominate for the climate and latitude of Europe.) Significant improvements in the number and sophistication of the defensive threat requires penetrators to fly at the lowest possible altitude. Safe terrain following radar operation over snow, in jamming and in rain is required. Radar electronic counter-counter measures characteristics are needed to make fighter and bomber aircraft less susceptible to airborne and ground electronic countermeasures.

Warsaw Pact forces display the capability for round-the clock armor attack which requires all weather interdiction operations and provide for multiple kills per-pass to enhance survivability and provide for cost effective weapon delivery. All weather Beyond-Visual-Range Identification, Track While Scan, and raid assessment features are needed to aid pilots to make optimum missile launch decisions at extended range which increases the effectiveness of the limited number of Air Force fighter aircraft against more numerous ones in the Warsaw Pact. Many of the tactical and strategic aircraft radars in the Air Force inventory use systems with low meantime between failure (MTBF) that are becoming increasingly costly to support and suffer high failure rates. This engineering development effort will design, fabricate test and qualify a production multi-mode radar which satisfies tactical and strategic needs. The radar will be designed to address the fundamental underlying causes of high costs, poor reliability, equipment proliferation and complex unique support equipment as well as provide the required performance. Multiple aircraft applications will be examined.

BASIC FOR FY 81 RDT&E REQUEST: During FY 80-81 design and trade analysis will be performed to optimize cost of owner ship for multiple aircraft application. Several aircraft will receive consideration during this period. Detailed design of the radar for air-to-air and air-to-ground application will proceed. Fabrication of radar will begin. System software development for air-to-air operations will begin.

OTHER APPROPRIATION FUNDS: N/A

Program Element: PE64412F Title: Common Multimode Radar
DOD Mission Area: Close Air Support/Battlefield Interdiction #222 Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: The all weather strike radar (AWSR) program will establish a production radar component program for multiple applications for air-to-air and air-to-ground operations which takes advantage of the technological opportunity of the radar programmable signal processor and advanced radar architecture. The radar will perform air-to-air, air-to-surface terrain following and avoidance and doppler velocity measurement functions as required. The radar will be able to adapt to various tactical and strategic missions and aircraft. The design will provide for multiple aircraft application such as the B-52, F-4, F-111 and other fighter and bomber aircraft. In some aircraft the entire existing radar will be replaced, in others only high failure components or components which restrict the performance of the existing radar will be replaced. Some unique components will be used in each application to insure optimum performance and operation on separate frequencies. Commonality will be maintained primarily in software intensive components. The program will capitalize on the technology of previous DOD radar investments such as the electronically agile radar, F-15 radar, and F-18 radar. The AWSR program has been structured to provide incremental risk reduction and management control. Two contractors will be selected to compete for intitial flight tests in FY 82. Each contract will provide detailed design, fabrication and test of two radar systems to verify performance, reliability, maintainability and cost. AWSR studies will address multiple aircraft application to determine the optimum component application to candidate aircraft to reduce proliferation, increase reliability, and reduce support costs. These study efforts will provide DOD with the necessary planning information for implementation decisions on candidate aircraft. Preliminary AWSR studies indicate that support cost savings will pay back costs on the candidate aircraft while providing the needed performance to support combat operations in the post 1985 time frame. The AWSR can be used in the air superiority role to provide air-to-air detection and track of multiple airborne targets or in the penetration role to support interdiction strikes or precise nuclear weapon delivery. The terrain following mode will permit combat operations at lower altitudes through severe weather conditions and in a severe electronic countermeasures environment.

RELATED ACTIVITIES: The technology for this engineering development program is based on several past efforts; the F-15, APG-63 radar programmable signal processor, the F-18 APG-65 radar programmable signal processor, and Electronically Agile Radar programs provided the basic air-to-air, terrain following, and high resolution ground map technology as well as built in test fault isolation test and balanced design for the radar. Preliminary design and analysis will be completed in FY 80 under program element 64201F, Project 2519. Close coordination with the Navy all weather standoff acquisition and control system program will be maintained.

WORK PERFORMED BY: The project will be managed by the Aeronautical Systems Division, Wright-Patterson Air Force Base, OH., an organization of Air Force Systems Command. Air Force Logistics Command will provide close coordination efforts to insure that the specific support and installation needs of the aircraft under AFLC control are addressed during the development and production effort.

Program Element: PE64412F Title: Common Multimode Radar
DOD Mission Area: Close Air Support/Battlefield Interdiction #222 Budget Activity: Tactical Programs #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. FY 79 and Prior Accomplishments: Not applicable.

2. FY 80 Program: During FY 80 PE 64201 will provide planning funding to structure the initial all weather strike radar (AWSR) studies and preliminary design of the common multimode radar. Maximum use of previous air-to-air and air-to-ground algorithms from ongoing DOD radar programs will be made. A balanced design will be employed to reduce life cycle cost.

3. FY 1981 Planned Program: During FY 1981 design, fabrication and integration of two candidate radars will begin. AWSR studies will be completed. The production proposals will be finalized. Test aircraft modification will begin. Source selection preparations will begin.

4. FY 1982 Planned Program: During FY 1982 flight test of the air-to-air modes of the radar will began. Algorithms will begin development for the air-to-ground modes of operation.

5. Program to Completion: During 1982-1985, the AWSR will be flight-tested in the air-to-air and air-to-ground environment. Qualification of the radar will be completed for multiple aircraft application as required.

6. Milestones: N/A

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64601F
DOD Mission Area: Air Warfare Support, #225

Title: Chemical/Biological Defense Equipment
Budget Activity: Tactical Programs, #4

RESOURCES/PROJECT LISTING: ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5,000	3,800	7,000	8,600	Continuing	Not Applicable
3320	Biological Agent Detection				1,200		
3321	Chemical Agent Detection	951	1,500	3,400	3,600		
3337	Individual Protection	2,896	1,900	2,300	2,700		
3762	Collective Protection	43	100	400	300		
3764	Decontamination	610	200	600	600		
5171	BIGEYE	500	100	200	100		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A marked imbalance in Chemical Warfare (CW) capabilities favoring the Warsaw Pact over the North Atlantic Treaty Organization (NATO) raises a significant threat of CW employment. The objective of this program is to develop chemical and biological warfare defense equipment to ensure survival and to enable operations in a toxic environment. The program encompasses six projects: Biological Agent Detection; Chemical Agent Detection; Individual Protection; Collective Protection; Decontamination; and the BIGEYE retaliatory, binary chemical munition.

BASIS FOR FY 1981 RDT&E REQUEST: This fiscal year's funding will enable contract starts on an area chemical-agent detector and single-layered aircrew protective clothing. Contracts for development of the surface-contamination monitor and improved aircrew eye/respiratory protective systems continue. Studies of chemical agent ingestion by aircraft environmental control systems continue. A study of overall base functioning in a toxic environment will be completed. Evaluations will continue for collective protection schemes for fixed and mobile facilities and for proposals to modify current equipment for decontamination service.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #64601F
DOD Mission Area: Air Warfare Support, #225

Title: Chemical Biological/Defense Equipment
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: This program element was initiated in 1971. Efforts at that time centered on monitoring Army development. With recognition of a significant threat increase in 1974-75, Air Force requirements were expanded. Near-and long-term programs were approved. Near-term objectives stressed acquisition of available equipment. The long-term program develops a full spectrum of equipment required to sustain operations in a chemical/biological warfare envirionment. Part of the long-term program is dedicated to correcting limitations of the near-term equipment; ultimate goals are to provide protection against the threat into the 1990s. The program element develops protective ensembles for aircrews, ground crews and special teams; personnel shelters; detection and warning devices; decontamination systems; and casualty-care equipment. The BIGEYE binary weapon is certified compatible with Air Force aircraft through test work conducted with the Navy, the executive developer.

RELATED ACTIVITIES: DOD Directive 5160.5 establishes the Department of the Army as Executive Agent for all research, exploratory development, and advanced development. Air Force programs: Program Element (PE) 27593F, Chemical Warfare Defense Equipment, the procurement element for equipment developed in PE 64601F; PE 62202F, Aerospace Biotechnology, some research into medical problems of chemical warfare. Army programs: PE 62706A, Chemical/Biological Defense and General Investigation; PE 63271A, Chemical/Defense Concepts; PE 64725A, Chemical Defense Materiel. Navy Program: PE 62764N, Chemical/Biological Defense Technology. Tasks are coordinated with the other Services.

WORK PERFORMED BY: The Aeronautical Systems Division (AFSC), Wright-Patterson AFB, OH manages the defensive program. Principal contractors are: Honeywell, Inc., St. Petersburg, FL; Sierra Engineering, Sierra Madre, CA; Gentex Corporation, Carbondale, PA; Bendix Corporation, Towson MD; ILC Dover, Frederica DE; and Quest, Incorporated, McLean, VA. The Armament Division (AFSC), Eglin AFB, FL manages Air Force certification of the BIGEYE weapon.

PROGRAM ACCOMPLISHMENTS AND FUTURE PLANS:

1. FY 1979 and Prior Accomplishments: Components of the near-term aircrew and ground crew protective ensembles were selected, evaluated, produced and delivered to the field. Design criteria for collective-protection shelters at fixed installation were developed; additionally the KMU-450 shelter-modification kit was operationally tested and acquired. An automatic point-sampling chemical-agent detector completed evaluation was produced, and entered the inventory. Technical approaches to area detection were formulated; Army and Navy projects were investigated and monitored for applicability. A review of biological agent detection methods was completed. An evaluation of available decontaminants and dispensing equipment was accomplished. Air Force joined with the

Navy in the BIGEYE binary chemical weapon development program. A prototype chemical casualty decontamination shower was developed; a casualty patient wrap was evaluated. An integrated systems analysis of United States Air Force (USAF) chemical defense requirements was started. Studies to determine ingestion of chemical agents into aircraft cockpits through the environmental control systems were initiated. Improved aircrew eye/respiratory systems approached development-test stages.

2. FY 1980 Program: Of immediate concern will be to engineer fixes for deficiencies discovered in the near-term equipment that was rushed to the field to provide initial survival and operational capabilities. The program office will initiate studies to accurately determine the storage life of filters currently employed in our protective systems. Four of five eye/respiratory systems remain in competition to provide long-term protection to aircrews without degrading their performance in a toxic environment. Additionally, protective systems for firefighters in chemical warfare situations will be investigated. The surface contamination monitor effort advances this year with two contractors developing competitive designs. Broad collective protection and decontamination evaluations continue. An integrated systems analysis of present USAF chemical warfare defense capabilities will near completion, with a final goal to determine what future systems should be developed. Aircraft environmental control systems continue test analyses with chemical-agent simulants.

3. FY 1981 Planned Program: The effort to develop a rapid, accurate electronic detection device for surface contaminants (surface contamination monitor) will reach a first-hardware-delivery stage. Contracts will be let for development of a basewide area-detection system and single-layered aircrew protective fabrics. Evaluations of four candidate aircrew eye/respiratory systems will nearly be completed thus preparing a production decision. Filter storage-life studies will be completed. Contractual efforts for development of modular collective protection facilities and concepts for other fixed facilities' and mobile systems' protection will proceed. More work on finding contamination avoidance and decontamination systems will be undertaken.

4. FY 1982 Planned Program: First item hardware deliveries on advanced decontamination equipment will be evaluated. Production decisions are scheduled for the follow-on aircrew eye/respiratory system and surface-contamination monitor. A biological-warfare agent detector selection/development program will be evaluated. Air Force operational tests of the new joint-Service groundcrew protective mask will take place. Other joint-Service developments under evaluation will be the automatic liquid-agent detector, simplified collective protection systems, and improved hand and footwear. The airbase area detector will reach the preliminary design review stage. The environmental control systems studies are completed.

Program Element: #64601F
DOD Mission Area: Air Warfare Support, #225

Title: Chemical/Biological Defense Equipment
Budget Activity: Tactical Programs, #4

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data: Not Applicable, no change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64602F
DOD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Armament/Ordnance Development
Budget Activity: Tactical Programs, #4

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	15,600	12,100	12,300	13,800	Continuing	Not Applicable
2586	Dispenser Munitions	3,600	6,400	7,800	7,700	Continuing	Not Applicable
3133	Bombs and Fuzes	1,700	2,000	2,500	3,000	Continuing	Not Applicable
4535	Fuel Air Explosives, Flame and Incendiary	300	200	600	400	Continuing	Not Applicable
5613	Munitions Handling, Carriage and Release Equipment	8,400	3,500	1,400	2,700	Continuing	Not Applicable
5708	Nuclear Weapon Support	1,600	Transferred to P.E. 64222F in FY 80				

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program is the primary development source for unguided air-to-surface conventional weapons and associated equipments. Included are bombs, fuzes, dispenser munitions, fuel air explosives, supersonic delivery hardware, and munitions handling equipment.

BASIS FOR FY 1981 RDT&E REQUEST: The FY 1981 program is a continuation of work started in prior fiscal years. Specifically, this program element supports eight conventional weapons development tasks, in four projects.

OTHER APPROPRIATION FUNDS:	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Aircraft Procurement (3010)	12,209				12,209
Aerial Stores Lift Truck (Quantity)	(133)				(133)

Program Element: # 64602F Title: Armament/Ordnance Development
DOD Mission Area: Close Air Support/Battlefield Interdiction, #222 Budget Activity: Tactical Programs, #4

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimate Costs
Other Procurement (3080)						
FMU-112/B Fuze		9,900	9,200	26,200	TBD	TBD
(Quantity)		(9,000)	(13,000)	(35,000)	(TBD)	(TBD)
BSU-49/B; Air Inflatable Retarder for MK-82		3,600	4,700	15,000	TBD	TBD
(Quantity)		(3,500)	(6,420)	(30,000)	(TBD)	(TBD)
BSU-50/B; Air Inflatable Retarder for MK-84			2,000	9,500	13,000	24,500
(Quantity)			(500)	(7,232)	(12,000)	(19,732)
FMU-130/B Fuze					26,000	26,000
(Quantity)					(50,000)	(50,000)

Program Element: # 64602F
Title: Armament/Ordnance Development
DOD Mission Area: Close Air Support/Battlefield Interdiction, #222
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: This program is the primary development source for aerial delivered conventional weapons. The objective of the program is to provide the tactical and strategic operational forces with an effective conventional weapon operational capability at minimum cost. Activities involve the engineering design, development, test and evaluation of a variety of conventional weapons and weapons handling equipment. The program includes the following types of weapons/equipment: bomb fuzes; bomblets optimized for use against personnel, materiel, armored and other vehicles; dispensers for these bomblets; fuel air explosive weapons; munitions handling equipment; standardized aircraft release equipments; and devices to permit supersonic carriage and delivery. The efforts underway or planned in this program can be divided into two categories: those aimed at providing the operational forces with new capabilities to fill operational voids, and those aimed at eliminating deficiencies in current capabilities. For example, in the first category are fuel air explosive weapons which will provide capability to destroy targets previously invulnerble to conventional weapons; and equipment which will permit full utilization of aircrft capabilities in terms of low altitude supersonic delivery. In the second category are programs such as bomb fuzing, standardized bomb racks, and munitions handling equipment which will use current technology to provided improved capabilities in terms of safety, reliability, operational flexibility and ease of maintenance. Efforts in this program are completed with formal standardization of the munitions/equipment and with independent assessments by the development and operations communities to the effect that the item has successfully commpleted development, demonstrated operational utility and suitability, and is ready for production.

RELATED ACTIVITIES: Items from the advanced development program, Program Element (PE) 63601F Conventional Weapons, are selected for continuation into a Full Scale Engineering Development under this PE. Close liaison is maintained between the Services through Joint Technical Coordinating Group (JTCG) such as the JTCG For Munitions Development (JTCG/MD) and through formal coordination with the Department of Defense Armaments/Munition Requirements and Development (AMRAD) Committee. There are three efforts in this PE which are multi-Service. The Air Inflatable Retarder (AIR), the High Speed Fuel Air Explosive (FAE II) Weapons, and the Multiple Stores Ejector Rack (MSER) programs are joint Air Force/Navy developments. The Air Force is lead development Service for the AIR and MSER and the Navy is lead on the FAE weapons.

WORK PERFORMED BY: This program is managed by the Armament Division at Eglin AFB, FL. Most of the hardware effort is contracted with industry, the major FY 81 contractors being Aerojet, Downey, CA (Combined Effects Bomblet); General Motors (DELCO), Santa Barbara, CA, (FMU-112 Fuze); Goodyear Aerospace Corporation, Akron, OH (Air Inflatable Retarder); Standard Manufacturing Company, Dallas, TX (Aerial Stores Lift Truck); Dayron Corporation, Orlando, FL (FMU-130 Fuze); Western Gear, Jamestown, MD (MSER); and Honeywell Incorporated, Hopkins, MN (Tactical Munitions Dispenser). The FAE II joint development is managed by the Naval Weapons Center, China Lake, CA.

Program Element: # 64602F
DOD Mission Area: Close Air Support/Battlefield Interdiction, #222

Title: Armament/Ordnance Development
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments:

The FY 1979 program was a continuation of on-going work. Engineering modification testing of the Tactical Munitions Dispenser was completed and a Critical Design Review was conducted in October 1979. A contract was let on the Combined Effects Bomblet (CEB) for engineering development of the bomblet fuze. The FMU-112/B fuze and the BSU-49/B and BSU-50/B, Air Inflatable retarders for the MK-82 and MK-84 general purpose bombs started the combined Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) phase of their respective programs. The FMU-130/B fuze program was approved for the final phase of development. Air Force participation in the Joint Navy/Air Force (Navy lead) Fuel Air Explosive (FAE) program continued. Prototype fabrication of the Multiple Stores Ejector Rack (MSER) began and a Critical Design Review was conducted. Evaluation of munition containers will continue.

2. FY 1980 Program:

Project 2586: The Tactical Munitions Dispenser (TMD) will meet a Critical Design Review (CDR) and TMD's for the DT&E/IOT&E of the CBU-89/B, Gator mine system, and CBU-87/B, Combined Effects Munition (CEM) will be fabricated. Engineering verification and Military Standards (MIL-STD) testing will be initiated on the Combined Effects Bomblet (CEB). The CEB packaged in the TMD is the CBU-87/B (CEM).

Project 3133: The FMU-112/B fuze will complete IOT&E, and contracting for the initial production units will commence. The FMU-130/B fuze will complete engineering verification testing and meet a CDR.

Project 4535: Prototype models of the Navy/Air Force FAE weapons will be produced and ground tests completed.

Project 5613: The Air Inflatable Retarder program will complete IOT&E. MSERs will be delivered for initial DT&E. Evaluation of munition containers will continue.

3. FY 1981 Program:

Project 2586: The TMD will be used in the Combined DT&E/IOT&E of the Gator mine system. The CEM will complete engineering verification and MIL-STD testing.

Project 3133: FMU-130 engineering verification testing will continue.

Project 4535: IOT&E of the Navy/Air Force 500 pound FAE weapon will be conducted. Engineering verification and aircraft compatibility testing of the 2000 pound weapon will be completed.

Program Element: # 64602F — Title: Armament/Ordnance Development
DOD Mission Area: Close Air Support/Battlefield Interdiction, #222 — Budget Activity: Tactical Programs, #4

Project 5613: The Multiple Stores Ejector Rack (MSER) will be tested on the F-16 and A-10 aircraft. Evaluation of munitions containers will continue.

4. FY 1982 Planned Program:

Project 2586: Development of the Tactical Munitions Dispenser and the Combined Effects Bomblet (CEB) will be completed with the completion of the Initial Operational Test and Evaluation (IOT&E) of the Combined Effects Munition. Evaluation of a potential new development program for a Diesel Fuel Defeat Munition will be conducted.

Project 3133: IOT&E of the FMU-130/B will be completed. Evaluation of a potential new development program for a joint service digital electronic modular fuze will be conducted.

Project 4535: IOT&E of the 2000 pound Navy/Air Force Fuel Air Explosive weapon will be conducted.

Project 5613: Development of the MSER will be completed, and development of a new parent station rack will be initiated.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimates Costs
	TOTAL FOR PROGRAM ELEMENT	11,689	15,600	12,100	12,200	Continuing	Not Applicable
2586	Dispenser Munition	3,185	3,600	6,400	7,800	Continuing	Not Applicable
3133	Bombs and Fuzes	1,896	2,000	2,000	2,500	Continuing	Not Applicable
4535	Fuel Air Explosives, Flame, and Incendiary	450	300	200	600	Continuing	Not Applicable
5613	Munitions Handling, Carriage & Release Equipment	5,148	8,100	3,500	1,300	Continuing	Not Applicable
5708	Nuclear Weapon Support	1,010	1,600	Transferred to PE 6422F in FY 1980			

There is an increase of $100K in FY81 to adjust for increased inflation.

Project: 2586 Title: Dispenser/Munitions
Program Element: # 64602F Title: Armament/Ordnance Development
DOD Mission Area: Close Air Support/Battlefield Interdiction, #222 Budget Activity: Tactical Programs, #2

DETAILED BACKGROUND AND DESCRIPTION: The objective of this continuing project is to develop cost effective dispensers and submunitions for use by tactical/strategic forces in attacking targets which are most prone to destruction by area coverage munitions. The efforts under this project are being conducted in response to operational command requirements. The Tactical Munitions Dispenser (TMD) will eliminate deficiencies in current Air Force dispenser munition capabilities by providing a low altitude, wide area coverage capability and by eliminating high speed delivery restrictions. The TMD is being developed in two configurations: a non-spin configuration for self-dispersing submunitions and a spin configuration to provide force dispersion to non-dispersing submunitions. The Combined Effects Bomblet (CEB) is a companion general purpose bomblet for the TMD. The CEB contains three kill mechanisms: fragmenting case, incendiary, and shaped charge. The CEB has the capability to defeat a wide spectrum of targets from personnel through medium armor. CEB'S packaged in a TMD is called the Combined Effects Munition (CEM), CBU - 89/B.

RELATED ACTIVITIES: Items from the advanced development program, PE 63601F, Conventional Weapons continue into engineering development under this project. Close liaison between the Services and the Department of Defense Armament/Munitions Requirements and Development Committee (AMRAD) is evident in two major project tasks.

WORK PERFORMED BY: This project is managed by the Armament Division, Eglin AFB, FL. The major FY 1981 contractors are Honeywell Incorporated, Hopkins, MN, (Tactical Munitions Dispenser) and Aerojet, Downey, CA. (Combined Effects Bomblet).

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In FY 1978, the Combined Effects Bomblet (CEB) program was restructured to reduce technical risk and to eliminate potential safe escape problems for the delivery aircraft. The Tactical Munitions Dispenser (TMD) program was revised to reduce risk and to establish a program schedule that parallels the development schedules of planned submunitions. In FY 1979, engineering verification testing of the TMD was completed, and a contract was let on the CEB program development efforts to finalize the design and testing of the bomblet fuze.

2. FY 1980 Program: Engineering verification and Military Standards testing of the CEB will be initiated. After a successful Critical Design Review, fabrication of Development Test and Evaluation (DT&E) Tactical Munitions Dispensers will be initiated for the DT&E of the GATOR mine system (CBU-87/B).

3. FY 1981 Planned Program: DT&E) will be conducted on the Tactical Munitions Dispenser. Fabrication of the CEB will be approved for DT&E of the Combined Effects Munition.

Project: 2586 Title: Dispenser/Munitions

Program Element: # 64602F Title: Armament/Ordnance Development

DOD Mission Area: Close Air Support/Battlefield Interdiction, #222 Budget Activity: Tactical Programs, #4

4. FY 1982 Planned Program: Development of the Tactical Munitions Dispenser and Combined Effects Bomblet will end with the Initial Operational Test and Evaluation of the Combined Effects Munitions. Planning for new developments will be initiated.

5. Program to Completion: This is a continuing project.

6. Milestones: Not applicable

7. Resources: ($ in thousands)

Report Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimate Costs
2586	Dispenser Munitions	3,600	6,400	7,800	7,700	Continuing	Not applicable

8. Comparison with FY 79 Budget Data: No change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64604F
DoD Mission Area: Counter Air, #221

Title Low Altitude Airfield Attack System
Budget Activity Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	27,999	25,300	56,000	31,800	54,500	218,900

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for United States (US) participation in the joint US/United Kingdom (UK) development of specialized munitions capable of being delivered from low altitude high speed attack aircraft against Warsaw Pact airfields. The system being developed under this program, known as JP-233, includes submunitions with dispensers unique to each. This program will provide a common weapon system for use by the two developing countries in meeting a common operational requirement. Other North Atlantic Treaty Organization countries will be urged to procure the system.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for the US share of the fourth year of Full Scale Development of the joint US/UK JP-233 program. Development goals for this period focus on finalizing submunitions and dispenser designs.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Procurement (3080)				TBD	TBD	TBD
Quantity (JP-233 Systems)					(1,828)	(1,828)

Program Element: #64604F
DoD Mission Area: Counter Air, #221

Title Low Altitude Airfield Attack System
Budget Activity Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The offensive capability of Warsaw Pact tactical air forces poses a formidable threat to North Atlantic Treaty Organization forces. Although the Pact air threat can be countered with air-to-air and surface-to-air systems either currently available or under development, a most effective counter is to deny the enemy his sortie generation capability.

RELATED ACTIVITIES: This is a joint program with the United Kingdom (UK) which has as an objective the standardization and interoperability of an air-to-surface munition. The program is being executed under a Memorandum of Understanding between the United States (US) Department of Defense and the UK Ministry of Defence (MOD). The program is being managed from the UK/MOD in London with US personnel incorporated into a joint program office. A United States Air Force (USAF) System Program Director is the associate manager of the program.

WORK PERFORMED BY: The work will be primarily performed in the United Kingdom with Hunting Engineering Limited as prime contractor. The USAF agency with prime cognizance and through which direction and funds will be channeled is the Armament Division at Eglin AFB, FL.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The UK conducted feasibility studies and the program transitioned to the Project Definition Phase in 1975. Considerable preliminary design work and advanced development of the submunitions and dispensers were accomplished by the UK. The USAF became a participant in the program in August 1976 for the purpose of evaluating the system and determining the feasibility of becoming a full partner. A joint Project Definition Phase was followed by a Validation Phase which led to a joint US/UK full scale development decision in October 1977. Early full Scale Development activities have focused on design of dispensers that are suitable for use on both the US F-111 and the UK Tornado aircraft and providing submunition designs. This led to a selection of a dispenser design for use with the submunition after successful wind tunnel testing which confirmed the compatibility of this design with the F-111. The submuniton dispenser design was also selected and has completed similar testing. Arena and other ground tests were conducted on the submunitions warheads culminatin in successful dynamic tests of full-up submunitions. Unilateral US development of an submunition commenced in FY 1978 following studies which showed that such a could provide a significant improvement in overall capability of the entire JP-233 system.

Program Element: #64604F
DoD Mission Area: Counter Air, #221

Title Low Altitude Airfield Attack System
Budget Activity Tactical Programs, #4

In FY 1979, Full Scale Enginering Development continued with fabrication and test of both Development Standard munition dispensers. Warhead and fuzing design, checkout, test and refinement continued in an iterative fashion. A firm Development Cost Plan was finalized in January 1979 with the United Kingdom (UK) contractor and Ministry of Defence.

2. FY 1980 Program: Manufacture of submunitions and dispensers will commence for flight test on the F-111 and Tornado aircraft. Flight trials of Development Standard dispensers will start on the Buccaneer test aircraft to evaluate flutter and jettison characteristics. submunition drops will commence using the Buccaneer. Ground trials with Development Standard dispensers will prove adequacy of design and interface with test aircraft and pave the way for live full-up weapon system trials. Development and evaluation of the submunition will be on-going.

3. FY 1981 Planned Program: Flight testing of full-up submunitions will commence with live weapons deliveries from the Buccaneer aircraft. Tests will commence with single submunitions being dispensed and will build towards demonstrating the capability to dispenser full dispenser loads. F-111 and Tornado aircraft will be prepared for full-up system flight trials.

4. FY 1982 Planned Program: Flight trials of the Development Standard system will be completed using the Buccaneer aircraft. Flight trials of the engineering standard system will commence with initial tests from the Buccaneer aircraft. Preproduction drawings will be issued on the preproduction standard system.

5. Program to Completion: During the remainder of the program the all-up system will experience Development Test and Evaluation and Initial Operational Test and Evaluation using the F-111 and Tornado aircraft. Producibility efforts will be undertaken and, depending on a decision to enter a joint preproduction phase with the UK, long lead items and tooling for production will be undertaken. Full scale engineering development is scheduled to end in the

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
20,500	26,000	25,300	40,400	78,500	193,500

Program Element: #64604F
DoD Mission Area: Counter Air, #221

Title Low Altitude Airfield Attack System
Budget Activity Tactical Programs, #4

Fiscal year differences (+$1,999K in FY 79, +$15,600K in FY 81) as well as the increase in total estimated costs (+$25,400K) are the result of an actual change in the dollar/pound exhange rate (FY 1979), an upward revision of out-year United Kingdom inflation indicies, and projection of less favorable dollar to pound exchange ratios.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64607F — Title: Wide Area Anti-Armor Munitions
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222 — Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT		20,600	20,300	17,700	Continuing	Not Applicable
2579	Anti-Armor Cluster Munition (ACM)		20,600	20,300	4,100		45,000
2581	Extended Range Antiarmor Munition (ERAM)				13,600	41,300	54,900
2582	Mini-Missile (Wasp)					Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Wide Area Anti-Armor Munitions (WAAM) program was initiated to develop in the earliest possible time munitions capable of multiple armor kills per pass. The existing and future threat dictates this capability which is currently nonexistent. The WAAM Program is a competitive multiple concept approach to reduce risk and acquisition time. One or more of the 3 weapon concepts--the Anti-Armor Cluster Munition (ACM), Mini-Missile (WASP), or the Extended Range Antiarmor Munition (ERAM) -- will transition to this Program Element (PE from PE 63609F Advanced Attack Weapons, depending on their payoff and ability to complement each other.

BASIS FOR FY 1981 REQUEST: The effort to be conducted in this program in FY 1981 will include system design, fabrication, test and qualification of the ACM. A significant portion of Initial Operational Test and Evaluation will be conducted during FY 81 to measure the probable number of armored kills-per-pass, estimate operational reliability, and estimate the effect of target location error. Operational suitability will be determined, including availability, maintainability, and logistics supportability of the ACM. One hundred and two ACM's will be tested. Producibility studies will be continued this year. The ACM weapon will be the first WAAM option available to accomplish the WAAM goal to provide a force effectiveness multiplier with multiple kills per pass capability.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimate Costs
Procurement (3080)						
ACM				58,875	391,525	450,400
ERAM					TBD	TBD
Wasp					TBD	TBD
Quantity						
ACM				1,000	15,938	16,938
ERAM					TBD	TBD
Wasp					TBD	TBD

Program Element: #64607F
Title: Wide Area Anti-Armor Munitions
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The Wide Area Anti-Armor Munitions (WAAM) Program is responsive to the Mission Element Need Statement for Improved Wide Area Anti-Armor Capability, dated 14 Sep 79. It will satisfy the Tactical Air Forces' need for a multiple armor kills per pass capability in adverse weather conditions against rear echelon armored forces and for delivery from aircraft at minimum altitudes. This capability is required to blunt the Soviet massed armor threat by interdicting Soviet rear echelon armored forces before they can reinforce first echelon forces and achieve a breakthrough. The major goal of the WAAM Program is to demonstrate the system's capability to achieve multiple kills per pass under realistic test conditions. These tests will then form the basis for a production decision.

RELATED ACTIVITIES: WAAM technology base advancement is ongoing in Program Element (PE) 62602F, Conventional Munitions, and PE 63601F, Conventional Weapons Technology. Validation of concepts is ongoing in PE 63609F, Advanced Attack Weapons. Warhead, sensor, seeker, and dispenser technology projects in these programs provide the basis for the WAAM concepts. Other related Air Force programs (E.G. F-16 and A-10) will be integrated with WAAM to provide a total wide area anti-armor system capability.

WORK PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command, Andrews AFB, MD and its subordinate organization, Armament Division, Eglin AFB, FL. Additional contractor support will be provided but specific contractors have not been selected at this time.

PROGRAM ACCOMPLISHMENTS & FUTURE PROGRAMS:

1. FY 1979 & PRIOR ACCOMPLISHMENTS: Not Applicable.

2. FY 1980 PLANNED PROGRAM: The final phase of validation for the Anti-Armor Cluster Munition (ACM) will be completed in FY 1980 with system development and validation tests. ACM will advance in mid FY 1980 into this PE to begin subsystem design, fabrication, and testing.

3. FY 1981 PLANNED PROGRAM: The effort to be conducted in this program in FY 1981 will include system design, fabrication, test and qualification of the ACM. A significant portion of Initial Operational Test and Evaluation will be conducted during FY 81 to measure the probable number of armored kills-per-pass, estimate operational reliability, and estimate the effect of target location error. Operational suitability will be determined, including availability, maintainability, and logistics supportability of the ACM. One hundred and two ACM's will be tested. Producibility studies will be continued this year. An Air Launched Assault Breaker demonstration in FY 81-82 will use ACM as the demonstration weapon.

4. FY 1982 PLANNED PROGRAM: ACM will complete Full-Scale Engineering Development (FSED) in mid-FY 1982. Low Rate Rate Initial Production will begin in early FY 82, leading to a full rate production decision in May 1983. The Extended Range Antiarmor Munition (ERAM) will complete validation in PE 63609F in the third quarter of FY 1982. If selected for FSED, ERAM will transition into this program element in late FY 1982.

Program Element: #64607F Title: Wide Area Anti-Armor Munitions
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222 Budget Activity: Tactical Programs, #4

5. PROGRAM TO COMPLETION: The Third WAAM Concept -- the Wasp minimissile -- will complete validation in PE 63609F in FY 84, and will transition into this program at that time, following a Milestone II decision.

6. MILESTONES:

		Date
A. Anti-Armor Cluster Munition (ACM) Milestone II (Full Scale Engineering Development) Review	(Feb 1980)*	May 1980
B. ACM Low Rate Initial Production (LRIP)	(Mar 1981)*	Oct 1981
C. ACM Milestone III (Production Decision) Review	(Aug 1982)*	May 1983
D. Extended Range Antiarmor Munition (ERAM) Milestone II Review		Apr 1982
E. WASP Minimissile Milestone II Review	(Apr 1982)*	FY 1984
F. ERAM Milestone III		FY 1985
G. WASP Milestone III	(FY 1986)*	FY 1987

* Date presented in FY 1980 Descriptive Summary

EXPLANATION OF MILESTONE CHANGES:

A. and C. above: Previous dates did not allow for decision time at review council levels.

B. and C. above: Initiation of ACM LRIP deferred until FY 82 by Department of Defense to preclude concurrency of development and production. Results in later decision to begin full rate production (Milestone III).

E. above: Wasp program restructured to accommodate reduction of funds in FY 81 in Program Element (PE) 63609F.

7. RESOURCES: Not Applicable

8. COMPARISON WITH FY 1980 BUDGET DATA:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT			20,600	19,000	216,100	255,700
2579	Anti-Armor Cluster Munition			20,600	19,000	4,000	43,600
2581	Extend Range Antiarmor Munition					41,000	41,000
2582	Wasp Minimissile					171,000	171,000

ACM changes are due solely to new OSD inflation indices. ERAM reflects latest engineering cost estimates. Wasp validation phase (PE 63609F) funding reductions in FY 81 cause delay of Wasp program start to FY 84; Wasp total costs TBD.

Project: 2579 Title: Anti-Armor Cluster Munitions
Program Element: #64607F Title: Wide Area Anti-Armor Munitions
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The Anti-Armor Cluster Munition (ACM) Project will satisfy the Tactical Air Forces (TAF) need for a mltiple armor kill per pass capability in all weather conditions against rear echelon wide area armored forces and for delivery from aircraft at minimum altitudes. This capability is required to blunt the Soviet massed armor threat by interdicting Soviet rear echelon armored forces before they can reinforce first echelon forces and achieve a breakthrough. The major goal of the ACM Project in this Program Element (PE) is to demonstrate the system capability to achieve multiple kills per pass under realistic test conditions. These tests will then form the basis for a production decision.

RELATED ACTIVITIES: Wide Area Anti-Armor Munitions (WAAM) technology base advancement is ongoing in PE 62602F, Conventional Munitions, and PE 63601F, Conventional Weapons Technology. Validation of WAAM weapon concepts is on going in PE 63609F, Advanced Attack Weapons. Warhead, sensor, seeker, and dispenser technology programs in these PEs provide the basis for the WAAM concepts. Other related Air Force programs (E.G. F-16, and A-10) will be integrated with WAAM to provide a total wide area anti-armor system capability. An Air Launched Assault Breaker demonstration in FY81-82 will use ACM as the directed weapon.

WORK PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command (AFSC), Andrews AFB, MD and its subordinate organization, Armament Division (AD), Eglin AFB, FL. Additional contractor support will be provided by contractors to be selected from among those accomplishing the validation phase.

PROGRAM ACCOMPLISHMENTS & FUTURE PROGRAMS:

1. FY 1979 & PRIOR ACCOMPLISHMENTS: Not applicable.

2. FY 1980 PROGRAM: The final phase of concept validation for the Anti-Armor Cluster Munition (ACM) will be completed in FY 1980 with system development and validation tests. ACM will advance in mid FY 1980 into the into this PE to begin subsystem design, fabrication, and testing.

3. FY 1981 PLANNED PROGRAM: ACM will continue Full Scale Engineering Development (FSED) with fabrication of test items for Development Test and Evaluation. Initial Operational Test and Evaluation will begin.

4. FY 1982 PLANNED PROGRAM: ACM will complete FSED in mid FY 1982 and reach a decision point for entry into production. Low rate initial production will begin in early FY 82.

5. PROGRAM TO COMPLETION: Full rate production will begin in FY 83.

Project: 2579 Title: Anti-Armor Cluster Munitions
Program Element: #64607F Title: Wide Area Anti-Armor Munitions
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222 Budget Activity: Tactical Programs, #4

6. MILESTONES:

		DATE
A. Anti-Armor Cluster Munition (ACM) Milestone II (Full Scale Engineering Development) Review	(Feb 1980)*	May 1980
B. ACM Low Rate Initial Production	(Mar 1981)*	Oct 1981
C. ACM Milestone III (Production Decision) Review	(Aug 1982)*	May 1983

* Dates presented in FY 1980 Descriptive Summary

EXPLANATION OF MILESTONE CHANGES:

A. and C. above: Previous data did not allow for decision time at review council levels.

B. above: Initiation of ACM production deferred until FY 82 by Department of Defense to preclude concurrency of development production.

7. RESOURCES: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
2579	Anti-Armor Cluster Munition		20,600	20,300	4,100		45,000

8. COMPARISON WITH FY 1980 BUDGET DATA:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
2579	Anti-Armor Cluster Munition			20,600	19,000	4,000	43,600

Increased estimates are due to new Department of Defense inflation indices.

Budget Activity: Tactical Programs, #4

Program Element: 63609F/64607F - Wide Area Anti-Armor Munitions (WAAM)

1. Development Test and Evaluation (DT&E):

a. Validation Phase: Testing for the Anti-armor Cluster Munition (ACM) will be conducted in early to mid FY80 by the two competing ACM contractors, Honeywell, Inc. and Martin Marietta Corp. Development testing for the other two WAAM concepts, the Extended Range Antiarmor Munition (ERAM) and the Wasp minimissile will be conducted by their respective contractors in FY82-83. Honeywell Inc. and Avco Inc. are the competing ERAM contractors; Hughes Aircraft Corp., and Boeing Aerospace Co., are competing Wasp contractors. DT&E tests will be conducted by contractor development engineers and technicians at contractor facilities and other appropriate test ranges. These tests will be supported and evaluated by Air Force Systems Command (AFSC) personnel. Common DT&E objectives for the validation phase are: (1) Demonstrate achievement of satisfactory pattern and kill mechanism performance, (2) Demonstrate the use of WAAM weapons in a variety of battlefield and countermeasure environments, (3) Demonstrate launch concepts and (4) Demonstrate the ability of Wasp and ERAM seekers to discriminate between real and false targets. An objective unique to ACM is demonstration of the orientation/stabilization device. Contractors will conduct extensive tests of critical subsystems: seekers, orientation and stabilization devices, and warheads. Dispenser drops of inert ACM's and ERAM's, and launch of instrumented Wasps will be accomplished to establish footprints and CEP. Live-round tests of individual submunitions will be conducted. Contractor development engineers and technicians will conduct development testing at Eglin AFB and other appropriate test ranges. The Air Force Test and Evaluation Center (AFTEC) will actively participate in this testing. Air Force Armament Division, Eglin AFB FL, will manage the DT&E program.

b. Full Scale Engineering Development (FSED): DT&E will be combined with Initial Operational Test and Evaluation (IOT&E). The majority of DT&E testing in FSED will be conducted by AFSC System Program Office and 3246th Test Wing personnel. Some remaining tests of subsystems will be accomplished by the contractors at their facilities. DT&E will be accomplished during (1) ACM - FY 81-82, (2) ERAM - FY 83-85 and (3) Wasp - FY 85-87. Common test objectives for this phase are to establish baseline performance characteristics for each concept and kill mechanism, to verify the predicted number of kills per pass against specified targets and to determine the effect of probable countermeasures on system performance. An assessment of the system support concept in meeting logistic requirements will be made. AFTEC will have overall management responsibility for the IOT&E program. The combined DT&E/IOT&E test program will include 170 ACM units, 116 ERAM units, and 46 Wasp pods. Specific test locations are yet to be determined.

2. Operational Test and Evaluation (OT&E):

a. The WAAM concept will require operational test and evaluation for each of the three munition concepts: ACM, ERAM, and Wasp.

b. No WAAM OT&E has been accomplished to date.

c. Demonstration and Validation Phase. Only critical component and submunition tests are planned to be conducted during this phase. AFTEC will actively participate in the Demonstration and Validation (D&V) testing to determine, as much as possible, the projected operational effectiveness and suitability of each concept tested; however, no separate OT&E will be conducted. The specific objective of this phase is to determine the expected kills per pass of each concept when it is used in a realistic environment. This will be accomplished primarily by the evaluation of computer simulation and component test data. The majority of tests will be conducted by contractor personnel at contractor facilities. The remaining tests will be conducted by AFSC personnel at Eglin AFB FL.

d. Full Scale Engineering Development (FSED). OT&E conducted during this phase will be combined with DT&E when possible. Separate Initial Operational Test and Evaluation (IOT&E) will be conducted to accomplish OT&E objectives which cannot be combined with DT&E. Combined and separate IOT&E testing for each concept will be conducted during: (1) ACM - FY 81 and FY 82, (2) ERAM - FY 84, and (3) WASP - FY 85 and FY 87. Common IOT&E objectives for operational effectiveness during this phase are: (1) Measure the expected number of kills per pass against armored company arrays, (2) Estimate WAAM performance in various battlefield and countermeasures environments, (3) Estimate the ability of ERAM and WASP to accurately discriminate between real and false targets, (4) Estimate operational reliability, and (5) Estimate the effect of target location error. An objective unique to Wasp is to measure its ability to lock on after launch. The operational suitability objectives include determining the availability, maintainability, reliability, and logisitcs supportability of the systems. No unique suitability problems are anticipated. Test assets used during FSED DT&E/IOT&E will be soft tooled items. These assets will be representative of production items. Test assests programmed for separate IOT&E are: ACM - 102, ERAM -54, and Wasp - 12. At this time specific subsystems and support equipment requirements have not been identified. The requirements for each concept's test program will be defined as more data becomes available.

e. AFTEC will have the overall management responsibility for each of the three WAAM IOT&E programs.

f. Specific test locations have not been determined; however, it is likely that the Eglin AFB land range will be the primary test site. Due to the large expected footprint required by the three WAAM kill mechanisms, safety will probably be a prime consideration in test range selection. Specific test ranges will be selected when warhead characteristics are defined.

g. Preliminary IOT&E planning including a Test and Evaluation Master Plan (TEMP) and Test and Evaluation Objectives Annex (TEOA) have been accomplished to date. A plan has been developed that will provide sufficient system IOT&E.

h. US Air Force personnel will operate and maintain each WAAM muniton throughout each IOT&E program. Specific manpower will be drawn, as required, from Tactical Air Command, Air Force Logistics Command, and Air Training Command.

3. Systems Characteristics: Characteristics for each of the concepts will be definitized during validation. The objective of the program is to develop a system that can achieve multiple kills per pass of massed armor targets. The development goal is kills per pass.

Budget Activity: Tactical Programs, #4

Program Element: 63609F/64607F - Wide Area Anti-Armor Munitions (WAAM)

1. Development Test and Evaluation (DT&E):

a. Validation Phase: Testing for the Anti-armor Cluster Munition (ACM) will be conducted in early to mid FY80 by the two competing ACM contractors, Honeywell, Inc. and Martin Marietta Corp. Development testing for the other two WAAM concepts, the Extended Range Anti-tank Mine (ERAM) and the Wasp minimissile will be conducted by their respective contractors in FY82-83. Honeywell Inc. and Avco Inc. are the competing ERAM contractors; Hughes Aircraft Corp., and Boeing Aerospace Co., are competing Wasp contractors. DT&E tests will be conducted by contractor development engineers and technicians at contractor facilities and other appropriate test ranges. These tests will be supported and evaluated by Air Force Systems Command (AFSC) personnel. Common DT&E objectives for the validation phase are: (1) Demonstrate achievement of satisfactory pattern and kill mechanism performance, (2) Demonstrate the use of WAAM weapons in a variety of battlefield and countermeasure environments, (3) Demonstrate launch concepts and (4) Demonstrate the ability of Wasp and ERAM seekers to discriminate between real and false targets. An objective unique to ACM is demonstration of the orientation/stabilization device. Contractors will conduct extensive tests of critical subsystems: seekers, orientation and stabilization devices, and warheads. Dispenser drops of inert ACM's and ERAM's, and launch of instrumented Wasps will be accomplished to establish footprints and CEP. Live-round tests of individual submunitions will be conducted. Contractor development engineers and technicians will conduct development testing at Eglin AFB and other appropriate test ranges. The Air Force Test and Evaluation Center (AFTEC) will actively participate in this testing. Air Force Armament Division, Eglin AFB FL, will manage the DT&E program.

b. Full Scale Engineering Development (FSED): DT&E will be combined with Initial Operational Test and Evaluation (IOT&E). The majority of DT&E testing in FSED will be conducted by AFSC System Program Office and 3246th Test Wing personnel. Some remaining tests of subsystems will be accomplished by the contractors at their facilities. DT&E will be accomplished during (1) ACM - FY 81-82, (2) ERAM - FY 83-85 and (3) Wasp - FY 85-87. Common test objectives for this phase are to establish baseline performance characteristics for each concept and kill mechanism, to verify the predicted number of kills per pass against specified targets and to determine the effect of probable countermeasures on system performance. An assessment of the system support concept in meeting logistic requirements will be made. AFTEC will have overall management responsibility for the IOT&E program. The combined DT&E/IOT&E test program will include 170 ACM units, 116 ERAM units, and 46 Wasp minimissiles. Specific test locations are yet to be determined.

2. Operational Test and Evaluation (OT&E):

a. The WAAM concept will require operational test and evaluation for each of the three munition concepts: ACM, ERAM, and Wasp.

b. No WAAM OT&E has been accomplished to date.

c. Demonstration and Validation Phase. Only critical component and submunition tests are planned to be conducted during this phase. AFTEC will actively participate in the Demonstration and Validation (D&V) testing to determine, as much as possible, the projected operational effectiveness and suitability of each concept tested; however, no separate OT&E will be conducted. The specific objective of this phase is to determine the expected kills per pass of each concept when it is used in a realistic environment. This will be accomplished primarily by the evaluation of computer simulation and component test data. The majority of tests will be conducted by contractor personnel at contractor facilities. The remaining tests will be conducted by AFSC personnel at Eglin AFB FL.

d. Full Scale Engineering Development (FSED). OT&E conducted during this phase will be combined with DT&E when possible. Separate Initial Operational Test and Evaluation (IOT&E) will be conducted to accomplish OT&E objectives which cannot be combined with DT&E. Combined and separate IOT&E testing for each concept will be conducted during: (1) ACM - FY 81 and FY 82, (2) ERAM - FY 84, and (3) WASP - FY 85 and FY 87. Common IOT&E objectives for operational effectiveness during this phase are: (1) Measure the expected number of kills per pass against armored company arrays, (2) Estimate WAAM performance in various battlefield and countermeasures environments, (3) Estimate the ability of ERAM and WASP to accurately discriminate between real and false targets, (4) Estimate operational reliability, and (5) Estimate the effect of target location error. An objective unique to Wasp is to measure its ability to lock on after launch. The operational suitability objectives include determining the availability, maintainability, reliability, and logisitcs supportability of the systems. No unique suitability problems are anticipated. Test assets used during FSED DT&E/IOT&E will be soft tooled items. These assets will be representative of production items. Test assests programmed for separate IOT&E are: ACM - 102, ERAM -54, and Wasp - 12. At this time specific subsystems and support equipment requirements have not been identified. The requirements for each concept's test program will be defined as more data becomes available.

e. AFTEC will have the overall management responsibility for each of the three WAAM IOT&E programs.

f. Specific test locations have not been determined; however, it is likely that the Eglin AFB land range will be the primary test site. Due to the large expected footprint required by the three WAAM kill mechanisms, safety will probably be a prime consideration in test range selection. Specific test ranges will be selected when warhead characteristics are defined.

g. Preliminary IOT&E planning including a Test and Evaluation Master Plan (TEMP) and Test and Evaluation Objectives Annex (TEOA) have been accomplished to date. A plan has been developed that will provide sufficient system IOT&E.

h. US Air Force personnel will operate and maintain each WAAM muniton throughout each IOT&E program. Specific manpower will be drawn, as required, from Tactical Air Command, Air Force Logistics Command, and Air Training Command.

3. Systems Characteristics: Characteristics for each of the concepts will be definitized during validation. The objective of the program is to develop a system that can achieve multiple kills per pass of massed armor targets. The development goal is kills per pass.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64608F
DoD Mission Area: Close Air Support/ Battlefield Interdiction, #222

Title: Close Air Support Weapon Systems
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	58,455	60,000	40,300	14,300	6,000	282,255
	Scene Magnification MAVERICK						4,500
2550	Laser MAVERICK	3,300	1,200				64,500
2551	Imaging Infrared	43,500	46,000	36,300	13,900	6,000	165,100
2552	Alternate Warhead	9,900	3,100	400			21,400
2553	Siugle Rail Launcher	1,700					9,600
2555	Common Test Equipment		2,300	3,100	400		5,800
2556	Aircraft Integration	055	1,400	500			5,355
2676	Infrared Attack Weapon System (IRAWS)		6,000				6,000

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: There is a requirement to expand the AGM-65A/B TV MAVERICK utility to night and adverse weather conditions, to broaden the target spectrum, and to provide for employment on new aircraft. Modular guidance units and an alternate warhead for MAVERICK will provide these capabilities in close air support, defense suppression and interdiction roles. The Air Force is: (1) developing a laser guided MAVERICK for Marine Corps use; (2) developing an Imaging Infrared (IIR) Guidance Unit for the GBU-15 and WALLEYE data link weapons and for Air Force/Navy direct attack missiles; (3) developing an alternate warhead to expand the MAVERICK target spectrum; and (4) acquiring contractor support to accomplish aircraft integration and test of the MAVERICK missile systems.

BASIS FOR FY 1981 RDT&E REQUEST: Funding requested provides for completion of residual tasks associated with the contractor support for aircraft integration, Alternate Warhead development and development of common test equipment. Funding requested will continue IIR Guidance Unit development for GBU-15, WALLEYE, and the Air Force and Navy Direct Attack Weapons. Air Force Development Test and Evaluation (DT&E) and Initial Operational Test and Evaluation (IOT&E) of the IIR Maverick missile, started during FY1980, will be completed in FY1981. Milestone III review of the IIR Maverick is planned for last quarter FY1981 leading to a production Decision in early FY1982.

Program Element: #64608F
DoD Mission Area: Close Air Support/ Battlefield Interdiction, #222

Title: Close Air Support Weapon Systems
Budget Activity: Tactical Programs, #4

OTHER APPROPRIATION FUNDS:	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
Missile Procurement (3020)						
Laser MAVERICK	2,400					2,400
TV MAVERICK	34,300	8,400				465,200*
Quantity						20,100
IIR MAVERICK				195,957	2,098,627	2,294,584*
Quantity				490	32,030	32,520

* Includes initial spares

Program Element: #64608F
DoD Mission Area: Close Air Support/ Battlefield Interdiction, #222

Title: Close Air Support Weapon Systems
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Program Element (PE) 64608F was established to develop improved capability for air-to-surface missiles for use primarily against the massive armor threat of the Warsaw Pact forces in Central Europe. The Laser MAVERICK development provides a common laser seeker for a 24 hour attack capability against designated targets. The Imaging Infrared (IIR) MAVERICK will provide a common seeker subassembly for Air Force/Navy use with the Infrared Attack Weapon System (IRAWS)*, WALLEYE, MAVERICK and GBU-15 systems. The imaging seeker extends MAVERICK capability to night and adverse weather employment while retaining the launch and leave flexibility associated with the television guided MAVERICK. The advanced warhead development will expand the target spectrum of the MAVERICK family of weapons to make them effective against earth burden, structures and ship targets. Funding is also provided to support development of common test equipment for all MAVERICK variants and for MAVERICK aircraft integration.

RELATED ACTIVITIES: The Tri-Service laser seeker being developed under this program may be used in the Army's HELLFIRE missile program, and the Marine Corps Laser MAVERICK missile program. Management responsibilities are delineated in a Joint Development Plan which has been approved by the Office of Secretary of Defense. A common infrared seeker subassembly is being developed for GBU-15, WALLEYE, IRAWS and MAVERICK. Management responsibilities are contained in Memoranda of Agreements between the system program offices. The Navy currently plans to employ the MAVERICK with their A-4, A-6, F/A-18 and AV-8B and will use the developed MAVERICK single rail launcher. The Air Force plans to employ the IIR MAVERICK with A-7, A-10, F-4, F-16, and F-111 aircraft. The IIR MAVERICK missile has also been designated as the primary anti-armor weapon system to be employed with the Low Altitude Navigation and Targeting Infrared System (LANTIRN).

WORK PERFORMED BY: This program element is managed by the Aeronautical Systems Division, Wright-Patterson AFB, OH. The Armament Division, Eglin AFB, FL is the Responsible Test Organization and the Air Force Test and Evaluation Center, Kirtland AFB, NM serves as the Operational Test Agency. Prime contractors are Hughes Aircraft Corporation, Canoga Park, CA, and Rockwell International Corporation, Anaheim, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Full-scale engineering development of Laser MAVERICK was initiated in July 1975. Contractor flight testing was initiated with Block I laser seeker hardware in January 1976 and consisted of five successful free flight launches. A cost reduction effort was initiated to drive the laser seeker cost toward an Army design to cost goal of $4300 (FY 1975), for the HELLFIRE application. Phase I of the cost reduction effort which was completed in Jan 1978 identified seeker changes that offer significant possibility for cost savings through engineering changes. Contractor flight test of missiles with Block II seekers was initiated in September 1977 and was completed during April 1978 after launching 10 missiles. Combined DT&E/IOT&E was initiated during May 1978. Testing was suspended in August 1978 to save the remaining test assets for Navy/Marine Corps peculiar

* Navy version of IIR MAVERICK.

test requirements. Of the 22 missiles launched, impacted the intended target.

Also, during August 1978, the Air Force terminated plans to procure Laser MAVERICK, and the program was restructured to initiate configuration changes peculiar to Marine Corps/Navy use. The changes included the low cost laser seeker, the alternate warhead and an out of line safety device for the rocket motor. A Defense Systems Acquisition Review of the Imaging Infrared (IIR) MAVERICK advanced development program in September 1976 led to a decision by the Deputy Secretary of Defense to transition the program to full-scale engineering development. A Joint Operational Test and Evaluation (JOT&E) during Jan and Feb 1977 assessed the system's utility in a scenario representative of Central Europe. The Joint Operational Test and Evaluation demonstrated the Air Force concept of deductive target recognition. This concept allows target detection and recognition and missile launch with stand-off ranges and exposure times which will result in acceptable attrition rates from Warsaw Pact defenses. The House Armed Services Committee in August 1977, concurred with expenditure of FY 1977 funds to continue advanced development of the IIR seeker and to support testing of the digital centroid tracker. These tests were initiated in November 1977 at Ft Polk and were completed in February 1978 in West Germany. The IIR European tests again demonstrated the capability of flight crews, using normally available target information, to navigate to designated geographic locations, locate the target area, transition to the attack phase of flight and successfully attack armor targets. The capability of the digital centroid tracker to maintain lock-on to valid targets against a thermally cluttered background was demonstrated with a success rate. Office of the Secretary of Defense/Under Secretary of Defense Research and Engineering reviewed the IIR program and the previous Defense Systems Acquisition Review Council II decision during October of 1978. This review led to the release of FY 1979 funds to initiate the full-scale development program. The contract was awarded on October 30, 1978. The initial design efforts were completed and the IIR MAVERICK Preliminary Design Review was conducted in June 1979. Engineering drawings for missile fabrication have been released. Contractor support for MAVERICK integration on the F-16 and F-111 was initiated in FY 77, and on the Navy A-4M in FY 78. Engineering development of the MAVERICK Single Rail Launcher and the MAVERICK Alternate Warhead were initiated during 1977. Development of the MAVERICK Alternate Warhead was incorporated into the Laser development program for the Marine Corps. The Single Rail Launcher completed full scale engineering development and a production contract for 1400 launchers was awarded in August 1979.

2. FY 1980 Program: Engineering development of Laser MAVERICK for the Marine Corps will be completed with FY 1980 funds. Current planning is to complete development testing, and Navy/Marine Corps Operational Evaluation so that production for the Marine Corps could be initiated with FY 1982 funds. FY 1980 funds requested will complete the Alternate Warhead development with some residual activity remaining in FY 1981. Delay in the completion of the Alternate Warhead from FY 1979 to FY 1980 is attributed to problems associated with the warhead fuze structural design. F-16 and F-111 integration efforts will be continued through FY 80. IIR MAVERICK full-scale development will continue. The IIR MAVERICK Critical Design Review is scheduled for Jun 1980 and hardware will be delivered to initiate full-scale development flight testing commencing in July 1980. The contractor flight testing Program will be completed

during the last quarter of the fiscal year as government flight testing is phased in. Development of common ground support equipment for all MAVERICK variants will be initiated in 1980 after conduct of a MAVERICK maintenance concept and support equipment requirements study.

3. FY 1981 Planned Program: FY 81 funding will complete residual tasks associated with the Alternate Warhead development. Additionally, this funding will complete the basic IIR MAVERICK engineering development and flight test program. At this time, 33 flight launches are planned for a combined Development Test and Evaluation (DT&E)/ Initial Operational Test and Evaluation (IOT&E). During FY 1981, the IIR missile components and full-up missile systems will undergo engineering qualification testing, electromagnetic interference testing, and reliability testing. Where possible and as planned, the GBU-15, Walleye, and Infrared Attack Weapon System (IRAWS) unique systems will be tested and qualified with the IIR Maverick system and components. A production readiness review and a functional configuration audit will occur in the forth quarter of FY 1981. Upon completion of the DT&E/IOT&E, a milestone II (review) will be conducted leading to a production decision and production contract award in early FY 1982. Efforts to develop common ground support equipment will continue and encompass the system qualification and reliability testing efforts. Efforts will also be undertaken to initiate a verification and proofing program for the IIR Maverick reprocurement data package.

4. FY 1982 Planned Program: The funds requested for FY 1982 will continue the effort required to verify and proof the IIR MAVERICK reprocurement data package. This effort is planned in preparation for competitive procurement starting with the third production increment.

5. Program to Completion: FY 1983/1984 funds are required to complete proof of the IIR MAVERICK procurement data package.

6. Milestones: (See Milestones for Project 2551, IIR MAVERICK)

7. Resources: (See Resources for Project 2551, IIR MAVERICK)

8. Comparison with FY80 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	19,900	58,500	54,000	30,000	110,500	356,200
	Scene Magnification MAVERICK						4,500
2550	Laser MAVERICK	10,000	4,500				64,500
2551	Imaging Infrared		38,900	50,500	27,900	11,700	148,400
2552	Alternate Warhead	4,800	11,800	2,000	1,000		22,900

Program Element: #64608F
DoD Mission Area: Close Air Support/ Battlefield Interdiction

Title: Close Air Support Weapon Systems
Budget Activity: Tactical Programs, #4

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2553	Single Rail Launcher	3,600	1,000				8,900
2554	All WX Guidance					98,800	98,800
2555	Common Test Equipment		1,300	1,000	500		2,800
2556	Aircraft Integration	1,500	1,000	500	500		5,400

The FY 1980 R&D (3600) request has increased $6.0M due to Congressional action to provide for Navy-peculiar modification to the Maverick missile for Infrared Attack Weapon System (IRAWS). The total R&D (3600) request decreased by $74.0M from the FY 1980 to the FY 1981 budget due to an Air Force decision not to pursue the Maverick all weather guidance effort and rephasing of the IIR Maverick reprocurement data package validation. The missile procurement (3020) request for FY 1981 decreased by $149.0M from FY 1979 to FY 1980 due to a delay in the planned production start for the IIR Maverick from FY 1981 to FY 1982. The total missile procurement (3020) request has increased $585M. This increase is due primarily to escalation and production cost estimating changes that reflect TV Maverick experience.

Project: # 2551
Program Element: #64608F
DoD Mission Area: Close Air Support/ Battlefield Interdiction, #222

Title: Imaging Infrared (IIR) MAVERICK
Title: Close Air Support Weapon Systems
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Development under this project will provide a common imaging infrared (IIR) seeker subassembly for Joint Navy and Air Force use with the WALLEYE, Infrared Attack Weapon System (IRAWS), Maverick and GBU-15 systems. The technology developed may be transferable to other infrared efforts. Imaging Infrared seeker/ guidance technology will provide 24 hour adverse weather capability across a wide target spectrum for both direct and indirect attack weapons. The imaging approach provides for maximum system flexibility and utility with the largest number of attack aircraft because it is not dependent on a Forward Looking Infrared acquisition device. It can be used autonomously or with any acquisition device which will provide an azimuth and an elevation signal. The IIR seeker when integrated with MAVERICK will provide a direct attack capability for the 1980s that no other system currently planned or in inventory can offer.

RELATED ACTIVITIES: IIR has been a Joint Air Force/Navy development since 1973. Program management has been accomplished through a formal Memorandum of Agreement between the MAVERICK Program Office and the Naval Avionics Center at Indianapolis, IN. Management of the effort necessary for the GBU-15 application is being accomplished through a formal agreement with the GBU-15 Program Office at Eglin AFB, FL. A formal charter between the Aeronautical Systems Division (AFSC) and the Naval Air Systems Command is being pursued for the development of Joint Air Force/Navy Maverick developments. The IIR seeker/guidance unit is designed to be compatible with any target acquisition system which can provide azimuth and elevation signals. These currently include the Navy TRAM POD and the Air Force's PAVE TACK, PAVE PENNY and Wild Weasel APR-38 systems. The IIR Maverick missile has also been designated as the prime Anti-Armor weapon system to be employed with the Low Altitude Navigation and Targeting Infrared System.

WORK PERFORMED BY: The IIR MAVERICK Program is managed by the Aeronautical Systems Division, Wright-Patterson AFB, OH, and the Naval Air Systems Command, Wash, DC. The Armament Division, Eglin AFB, FL, is the responsible Test Organization and the Air Force Test and Evaluation Center, Kirtland, AFB, NM, serves as the Operational Test Agency. Navy peculiar system tests will be performed by the Naval Avionics Center and the Naval Weapons Center, China Lake, CA. Hughes Aircraft Corp, Canoga Park, CA, who had won three separate competitive source selections as the program evolved to the Advanced Development stage, is the prime weapon system contractor.

Project: # 2551
Program Element: #64608F
DoD Mission Area: Close Air Support/ Battlefield Interdiction

Title: Imaging Infrared (IIR) MAVERICK
Title: Close Air Support Weapon Systems
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Imaging Infrared (IIR) MAVERICK advanced development was completed in December 1975 under Program Element (PE) 63601F (Conventional Weapons). Preliminary engineering development planning and studies were initiated under PE 64608F in FY 1975. This effort included aircraft interoperability testing on the F-4 Wild Weasel, F-4 PAVE TACK, and A-7 aircraft in operational scenarios, and has included night and autonomous visual operations. The IIR guidance unit was evaluation side-by-side with the TV MAVERICK guidance unit in Germany during February and March 1976. This test demonstrated the utility of IIR MAVERICK in the winter European weather environment. An extensive producibility effort was initiated to insure that critical guidance unit components could be manufactured at high rates and would meet shelf-life requirements. Accelerated life cycle testing on key components has demonstrated that 10-year shelf-life requirements can be met. A Milestone II Program Review was accomplished by Office of the Secretary of Defense (OSD) in September 1976 and resulted in a Deputy Secretary of Defense decision to transition the program into full-scale engineering development. A Joint Operational Test & Evaluation (JOT&E) was accomplished during January and February 1977. This JOT&E demonstrated the capability of crew members in single seat aircraft to detect and recognize valid targets and launch a missile at slant ranges which would result in acceptable attrition from ground based defenses. The JOT&E was accomplished using advanced development hardware with edge tracking logic which is susceptible to break locks due to thermal clutter. This fact was recognized by the Air Force in early 1975 and design efforts were started by Hughes Aircraft to develop a digital centroid tracker. The digital tracker was captive flown with a helicopter during 1976 and the test results were reviewed by the OSD Deputy Director for Test and Evaluation during the Milestone II Program Review process. The digital tracker was tested in Europe during January and February 1978. The tracker maintained lock-on to valid targets against operationally realistic thermal background clutter with a success rate. Prior to the European tests, the Air Force had identified computer software changes to be made to the engineering development guidance unit which we estimate will improve the lock-on tenacity success rate to Analysis of the European test results further indicated that, even with a perfect tracker, there would have been an break lock rate. OSD/Under Secretary of Defense Research and Engineering reviewed the IIR program and the previous Milestone II decision during October 1978. This review led to the release of FY 1979 funds to initiate the full scale development program and the contract was awarded on October 30, 1978. Since contract award, long lead hardware has been procured to support delivery of test missiles starting in FY 1980, engineering design efforts have been completed and a Preliminary Design Review (PDR) was held in June 1979. Additionally, fabrication and testing of prototype tracking algorithms and tracking gate changes are being combined with countermeasures hardening techniques in prototype hardware and are being tested via helicopter captive flight testing. Efforts to complete the special test equipment have concluded and laboratory tests to verify tracker sensitivity and detector scanning improvements are presently being conducted. The Navy and Air Force initiated the engineering definition of changes needed to satisfy Navy Infrared Attack Weapon System (IRAWS) requirements.

Project: # 2551 — Title: Imaging Infrared (IIR) MAVERICK
Program Element: #64608F — Title: Close Air Support Weapon Systems
DoD Mission Area: Close Air Support/ Battlefield Interdiction, #222 — Budget Activity: Tactical Programs, #4

2. FY 1980 Planned Program: Testing of full up guidance units will be started during the first quarter of the fiscal year. This will be the first time that all the proposed changes will be incorporated in a single unit for systems engineering testing and flight simulations. The second series of helicopter captive flight test and aircraft captive flight test of all up missiles will begin during the third quarter of the fiscal year. The IIR Maverick Critical Design Review will also be conducted during the third quarter of the fiscal year followed by the initiation of contractor flight testing. Contractor flight testing is planned to be completed during the last quarter of the calendar year as government flight testing is phased in.

3. FY 1981 Planned Program: Delivery of test missiles will be completed during the second quarter of FY 1981. Ground testing, to include Systems Qualification, Electromagnetic Interference (EMI), and Reliability testing, and contractor flight testing will be completed early in the third quarter leading to a production readiness review late in the third quarter of the fiscal year. A functional configuration audit will follow the producting readiness review. Combined Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) will be completed in July/September 1981 leading to a Milestone III review and production decision during the last quarter of the fiscal year. FY 81 funding completes the basic full scale development program. Efforts to initiate a verification and proofing program for the IIR Maverick reprocurement data package will also be conducted.

4. FY 82 Planned Program: The funds requested for FY82 will be used to continue verification and proof of the IIR Maverick reprocurement data package. This effort is planned in preparation for competitive procurement starting with the third production increment.

5. Program to Completion: FY 1983/1984 funds are required to complete proof of the IIR Maverick reprocurement data package. This effort will determine suitability of the package for competitive procurement from industry.

6. Milestones:

A.	Defense Systems Acquisition Review Council II	September 1976
B.	European Test Complete	February 1978
C.	Full-Scale Development initiated	October 30, 1978
D.	Initiate Helicopter Flight Tests (Changes to tracker algorithms)	June 1979
E.	Initiate Full-up Guidance Unit Lab Testing	September 1979
F.	Engineering Development Model Delivery	June 1980
G.	Critical Design Review	June 1980
H.	Initiate DT&E/IOT&E	July 1980
I.	Complete DT&E/IOT&E	July/September 1981
J.	Readiness Review Production	June - July 1981
K.	Milestone III & Production Decision	Last Quarter FY 1981

Project: 2551
Program Element: #64608F
DoD Mission Area: Close Air Support/ Battlefield Interdiction, #222

Title: Imaging Infrared (IIR) MAVERICK
Title: Close Air Support Weapon Systems
Budget Activity: Tactical Programs, #4

7. Resources:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
RDT&E (3600)						
Funds	43,500	46,000	36,300	13,900	6,000	165,100
Quantity						35
Missile Procurement (3020)						
Funds (Includes Initial Spares)				195,957	2,098,627	2,294,584
Quantity				490	32,030	32,520

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
RDT&E (3600)						
Funds		38,900	50,500	27,900	11,700	148,400
Quantity						35
Missile Procurement (3020)						
Funds (Includes Initial Spares)				149,000	1,560,700	1,709,700
Quantity				490	32,030	32,520

Project: # 2551
Program Element: #64608F
DoD Mission Area: Close Air Support/ Battlefield Interdiction, #222

Title: Imaging Infrared (IIR) MAVERICK
Title: Close Air Support Weapon Systems
Budget Activity: Tactical Programs, #4

The total IIR Maverick research and development funding requirement was increased from $148.4M in the FY 1980 request to $165.1M in the FY 1981 request. This increse reflects funds needed to offset the FY 1980 $7.0M OMB cut, to procure test hardware for the reprocurement data package verification and to offset escalation rate changes. The procurement request increased from $1,709.7 M in the FY80 request to $2,294.6M in the FY81 request. The increase is due primarily to escalation associated with a one year delay in IIR Maverick production start and production cost estimating changes that reflect TV Maverick experience.

Budget Activity: Tactical Programs, #4

Program Element: #64608

TEST AND EVALUATION:

1. Development Test and Evaluation: The IIR MAVERICK advanced development program was conducted by the Avionics Lab, the MAVERICK System Program Office, Wright-Patterson AFB, OH, and Hughes Aircraft Company, Canoga Park, CA. This program was completed in Dec 1975. The advanced development program consisted of over 250 hours of captive flight tests against a wide spectrum of tactical targets, 4 free flight, powered launches against armor targets, and an extensive producibility study for critical guidance unit components.

a. The success of the producibility studies has given the Air Force a high degree of confidence that IIR [illegible]ar components can be produced in high-volume and will meet shelf life requirements.

b. Since Dec 1975, additional testing has been accomplished to broaden the data base and provide a smooth transition into full-scale engineering development. This testing includes:

- Accelerated life cylce testing of critical components
- Helicopter captive flight test of the digital centroid terminal correlation tracker (Feb-Mar 1976)
- Additional countermeasures testing at White Sands Missile Range (Mar 1976)
- Static evaluation of the IIR guidance unit in the European winter weather environment (Feb-Mar 1976)
- Operational capability test using the F-4/IIR in day/night simulated single seat and autonomous attack roles (May-Jun 1976)
- Wild Weasel/IIR interoperability tests (Aug-Sep 1976)
- PAVE TACK/IIR interoperability tests (Sep 1976)
- A-7/IIR single seat day/night interoperability test (Nov 76)
- Navy A-4/Night WALLEYE interoperability tests using the IIR MAVERICK guidance unit (day/night single seat operation with Data Link update - (Jul 1976)
- A-10/PAVE PENNY/IIR interoperability tests (Jan-Feb 1977)
- Joint Operational Test and Evaluation (JOT&E) (Feb-Mar 1977)
- IIR European Tracker Test (Jan-Feb 1978)
- Wild Weasel FOT&E testing (May-Jun 1978)

c. This follow-on captive flight testing of the IIR MAVERICK weapon system in operational scenarios provides the Air Force a high degree of confidence in the operational capability and flexibility provided by the system in direct attack roles during day/night/adverse weather operations against a wide spectrum of tactical targets. A JOT&E which was directed by OSD demonstrated that the flight crewmember of single seat attack aircraft could successfully transition from the navigation to the attack phase of flight, detect and recognize valid targets and fire the missile at stand-off ranges and with exposure times which would yield acceptable attrition rates for the attack aircraft.

Budget Activity: Tactical Programs, #4

Program Element: #64608F

d. Additional testing of the digital centroid tracker was accomplished at Camp Greyling, MI, Ft. Polk , LA and in the Federal Republic of Germany during December 1977 to February 1978. This testing demonstrated the digital centroid tracker's capability to maintain lock on the intended target in the presence of realistic thermal clutter. The European testing also demonstrated the system's application to the GBU-15 and WALLEYE flight profiles and target spectrum using both lock-on before and lock-on after launch tactics.

e. The engineering developement seeker will contain improvements as a result of design iterations made as part of the extensive producibility efforts. The digital centroid tracker which was brassboarded and tested during Feb-Mar 1976 will be incorporated into the engineering development model. The digital centroid tracker improves rejection capability and provides guidance commands all the way to target impact. Further, the engineering development seeker will have a tracking gate as compared to the gate for the advanced development model. This change will provide better target resolution and improve clutter rejection.

f. Full scale engineering development (FSED) of the IIR seekers and IIR MAVERICK missile was initiated in October 1978. The IIR MAVERICK missile consists of an IIR guidance control section (GCS) mated to the existing MAVERICK airframe. The GCS to be evaluated is essentially identical to the system to be produced.

g. Development test and evaluation (DT&E) of the IIR MAVERICK. The FSED DT&E portion of a combined DT&E/IOT&E of the IIR MAVERICK should commence in July 1980 and last through July 1981. The DT&E is managed by AFSC with the Armaments Division, Eglin AFB, FL. designated as the responsible test organization. Tactical Air Command (TAC), Air Force Logistics Command (AFLC), Military Airlift Command (MAC), Air Training Command (ATC), and the U.S. Army will be participating organizations. The DT&E program will provide data to assess the weapon system performance compared to the specified requirements. Testing will be conducted at Eglin AFB, FL; the Utah test and training range (UTTR); and at least one, as yet undetermined, test location that is more representative of European weather and terrain. Testing to satisfy DT&E objectives will require approximately 44 captive missions and upwards to 23 missile launch missions from A-10 and F-4 aircraft. Seven of the 23 missile launches are designated for the contractor to demonstrate specified performance criteria. The remaining 16 missile launches will be used to demonstrate DT&E IR test objectives:

(1) Low visibility and night capabilities
(2) Target acquisition in the IR Spectrum
(3) Lock-on and tracking capability
(4) Accuracy and trajectory characteristics
(5) Reliability, maintainability, availability

Additionally, the DT&E test program will assess the following critical issues:

Budget Activity: Tactical Programs, #4

Program Element: #64608F

(1) adverse weather capabilities
(2) missile integration with aircraft and acquisition aids
(3) validation of missile performance
(4) validation of day/night single seat capabilities
(5) validation of PAVE PENNY cueing
(6) validation of PAVE TACK and Wild Weasel acquisition aids

Missiles flown during the DT&E will be identical to the missiles used for IOT&E.

h. DT&E helicopter captive testing will be conducted in two phases. Phase I was initiated in July 1979 and is designed to provide tracker algorithm design data. Phase I will continue into 2nd quarter fiscal year 1980. Phase II of the helicopter captive testing will be conducted from May 1985 to February 1981.

i. Planned DT&E missile launch missions are as follows (subject to change):

Mission	Aircraft	Day/Night	Target	Locations
1	A-10	Day	Truck	Eglin
2	F-4	Night	Static Tank	Eglin
3	F-4	Day	Cold Tank	Eglin
4	F-4	Night	Moving Tank	Eglin
5	F-4	Night	Inclined Plane	UTTR
6	F-4	Night	Moving Tank	Eglin
7	F-4	Day	Static Tank	Eglin
8	A-10	Night	Bunker	Eglin
9	A-10	-	Truck	Eglin
10	F-4	Day	APC	Eglin
11	F-4	Night	Hangarette	Eglin
12	F-4	-	Patrol Boat	Eglin
13	F-4	Night	Static Tank	winter site
14	F-4	Night	Moving Tank	winter site
15	F-4	Night	Radar Van	UTTR
16	F-4	Day	Moving Tank	UTTR
17-23	U N D E T E R M I N E D			

j. The support equipment being developed for the IIR Maverick will be largely improvements to existing WS-319 support equipment already fielded. Adapters to the DSM-99, AN/ARN-136, and DSM-100 will be available for evaluation during the DT&E. Additional support equipment and launcher improvements in development but lagging the IIR DT&E will be individually evaluated as each is available.

k. Primary test objectives also include verification of the reliability and maintainability requirements stated in paragraph 3 below. Reliability testing will commence in December 1980 and continue through April 1981. Electromagnetic interference testing will be conducted from January to May 1981. Formal qualification testing will be conducted from November 1980 through April 1981.

l. During the course of the engineering development program, infrared target signature recording and analysis will be performed. Efforts will be made to establish and maintain a signature library.

2. Operational Test and Evaluation:

a. The IIR Maverick missile consists of an IIR Guidance Control Section (GCS), to be evaluated in this program, and the existing Maverick airframe. The IIR GCS mounts on the Maverick (AGM-65) airframe with existing mounting provisions. The GCS senses incident infrared (IR) energy and provides a video signal to a monitor in the cockpit via the missile, launcher, and aircraft wiring. The GCS consists of a seeker and an electronics section. The seeker section contains the optical system which collects and focuses the incident IR radiation and generates the IR image. The electronics section includes circuits for signal processing and scan conversion to standard TV video format for [illegible] viewing. The GCS to be evaluated is essentially identical to the system to be procured. Hughes Aircraft Co[illegible] is the developer and will provide contract test support.

b. Ft Pol[illegible] Evaluation. IIR Maverick Joint Operational Test and Evaluation (JOT&E) was conducted during Feb 77 on the Ft Po[illegible] Military Reservation, LA. The Air Force as Executive Service by direction of the Director of Defense Research and Engineering, conducted the test jointly with the Army and Navy. The test was managed by the Air Force Test and Evaluation Center (AFTEC). The JOT&E consisted of captive carry and simulated launch of advanced development IIR Maverick guidance units against close air support and interdiction scenario armor target arrays. A-7 and A-10 aircraft provided by the Tactical Air Command (TAC) were utilized in an environment representative of mid-intensity confiict in Central Europe. This test was intended to be an effort to gather specific data required to address identified uncertainties. Accordingly, certain areas of operational effectiveness, maintainability, and reliability were not addressed. GCS maintenance was provided by the contractor.

c. Conclusions from the JOT&E indicated that:

(1) Valid targets can be selected from a target array containing substantial thermal clutter;

(2) Current tactics, procedures, onboard navigation systems, and visual battlefield activity provide sufficient cueing information for target area acquisition and target detection; and

(3) The IIR Maverick can be effectively employed from a single seat aircraft.

d. European testing. A second operational test program, the IIR Tracker European Test and Evaluation, was conducted by AFTEC in Jan-Feb 1978 to address congressional concerns on seeker deficiencies in the areas of target acquisition, lock-on, and discrimination that surfaced as a result of the JOT&E and to furnish more substantive data on the proposed centroid tracker.

(1) The overall objective of the test program was to provide data which would suport the evaluation of the IIR GCS with the digital centroid/thermal correlation (DCTC) tracker operating in European weather conditions with respect to the following issues:

(a) On-range testing.

1 Objective 1. Assess aircrew ability to transition from navigation to the attack mode, given initial point (IP) departure, using forward air controller, PAVE PENNY, inertial navigation system, or simulated PAVE TACK path-finder as target area cueing aids.

2 Objective 2. Assess the ability of the IIR tracker system to launch at a valid target, given attack mode.

3 Objective 3. Assess the capability of the IIR tracker to maintain lock after launch to point of minimum descent altitude.

(b) Off-range testing

1 Objective 4. Assess the capability of the IIR tracker system to intially lock on, given line of sight to the assigned target.

2 Objective 5. Assess the capability of the IIR tracker to maintain lock to minimum descent altitude after initial lock on or final relock after inadvertent breaklock against the assigned target.

(c) Both on and off range testing.

1 Objective 6. Assess the survivability of the A-10 and F-4 during weapon delivery.

2 Objective 7. Assess the effects of inadvertent infrared countermeasures on system effectiveness.

3 Objective 8. Compare thermal image appearance and thermal measurements of various vehicle targets.

(2) Since both of the DCTC trackers utilized in the test were hand-built, advance development models, and were entirely maintained by the contractor, no suitability objectives were addressed.

(3) The entire test was conducted in West Germany with TAC A-10 aircraft and aircrews and US Air Forces in Europe (USAFE) F-4 aircraft and aircrews operating out of Ramstein Air Base to the Baumholder Military Training Area. European test results:

(a) reinforced the JOT&E results.

(b) demonstrated that the IIR seeker, employed as the guidance medium for GBU-15 and WALLEYE weapons, is tactically feasible under both day and night conditions, and offers significant enhancement of the tactical performance of both weapons.

e. Initial operational test and evaluation (IOT&E) of IIR Maverick (IIR Mav). The IOT&E portion of a combined DT&E/IOT&E of the IIR Mav is scheduled to commence October 1980 and last through September 1981. The IOT&E will be managed by AFTEC with the participation of TAC, Air Force Logistics Command (AFLC), Military Airlift Command (MAC), Air Training Command (ATC), and the U.S. Army. The IOT&E program will provide data for an early, independent assessment of operational suitability and effectiveness of the weapon system by AFTEC. Testing to satisfy IOT&E objectives will require approximately 80 captive missions and at least 10 valid missile launch missions from F-4, A-7, F-16, A-10, and F-111 aircraft. Qualified aircrews and maintenance personnel from TAC will operate and maintain the system during IOT&E. Testing is to be conducted at Eglin AFB, Florida; the Utah Test and Training Range; and at least one as yet undetermined test location that is more representative of European weather and terrain. About one-half of all IOT&E missions will be flown at night. Nonavailability of Soviet armor for live launch targets will limit the test to launches against US built armored vehicles. IOT&E objectives are:

Budget Activity: Tactical Programs, #4

Program Element: #64608F

(1) Operational effectiveness objectives and methodology.

(a) Objective 1. Assess the operational performance capability of the IIR MAV against tactical type targets under day/night and battlefield conditions.

(b) Objective 2. Evaluate IIR MAV compatibility with other on-board aircraft systems.

(c) Objective 3. Assess IR MAV interoperability with other systems.

(d) Objective 4. Assess the survivability of the delivery aircraft during weapons delivery.

(2) Operational suitability objectives and methodology.

(a) Evaluate the reliability, maintainability, and determine the availability of the IIR Maverick missile.

(b) Evaluate the logistics supportability of the IIR Maverick and support equipment.

(c) Evaluate suitability of the IIR Maverick software.

f. Planned missile firings for IOT&E (subject to change).

Aircraft	Day/Night	Target
F-4D/E	Day	Mobile Artillery
F-4E (Pave Tack)	Night	APC in convoy
A-10	Day	Tank
A-10	Night	Tank
A-10	Night	Tank
A-7	Day	Oil Storage Facility
F-111F (Pave Tack)	Night	APC in convoy

Budget Activity: Tactical Programs, #4

Program Element: #64608F

F-4C	Night	Simulated ZSU-23-4
F-16	Day	Tank
F-16	Day	APC

g. A major portion of the IOT&E will be dedicated to reliability, availability, and maintainability (RAM) evaluation to include all associated support and test equipment. TAC and AFLC maintenance and handling personnel will perform pre- and post-flight checkout, uploading, downloading, and all maintenance possible using preliminary technical manuals provided by the Hughes Aircraft Company. A minimum of 144 hours of captive-carry flight time will be accumulated for RAM evaluation of the test items.

h. Current planning calls for all DT&E/IOT&E testing to be completed prior to the production decision. Follow-on Operational Test and Evaluation (FOT&E) test dates have not been established.

i. The DT&E and IOT&E missiles to be tested are in the same configuration. Warheads in eight of the ten operational test missiles have been replaced by telemetry units to facilitate missile data collection, but otherwise the missile configuration appears to be representative of procurement configuration.

3. System Characteristics	Objectives	Demonstrated
Missile Characteristics		
Minimum Slant Range (ft)		
Maximum Slant Range (ft)		
Probability of Hit		
Mission Reliability %		
Pre Launch		TBD
Launch		TBD

1/ Number derived from four Advanced Development firings where no attempt was made to demonstrate full launch envelope.

2/ Three successful hits, one broke lock on intended target, locked on to another target in the Field of View and hit it.

Budget Activity: Tactical Programs, #4

Program Element: #64608F

3. System Characteristics	Objectives	
Missile Maintainabbility		
Organizational/Intermediate	1.0 man hour/missile/month	TBD
Depot	0.75 man hour/missile/month	TBD
Seeker Characteristics		
Slew Angles		
Energy Spectrum	8-12 Micron	
Tracker Type	Digital Centroid with Aim Point Correlator	
Sensitivity Minimum Trackable Temperature		
Field of View		

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64610F
DoD Mission Area: Mine Warfare, #214

Title: Air Delivered Land Mines
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	8,908	4,000	4,900	500	Continuing	Not Applicable
2215	Gator	8,908	4,000	4,900	500		

BRIEF DESCRIPTION OF ELEMENT AND MISSIONN NEED: The objective of this program element is the engineering development of air delivered land mines to meet the needs of the operational forces to counter the full spectrum of enemy moving targets. It is a continuing program.

BASIS FOR 1981 RDT&E REQUEST: This request includes funds for the continuation of the full scale engineering development of the joint service Gator antipersonnel and antivehicular air delivered mine system.

OTHER APPROPRIATION FUNDS:

Other Procurement (3080)			
Gator			
(Quantity)		TBD	TBD

Project: #2215
Program Element: #64610F
DoD Mission Area: Mine Warfare, #214

Title: Gator
Title: Air Delivered Land Mines
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The purpose of this continuing program is to provide the tactical air forces with a family of air delivered mines capable of destroying or disrupting the enemy's movement of vehicular traffic, armored vehicles, and personnel. A primary mission of tactical air power is to destroy enemy mobile targets beyond the range of weapons organic to friendly ground forces. In many situations, this task can be accomplished by air delivery of mines in areas where it is essential that the enemy move personnel or vehicles to accomplish his objective. Mines are specifically designed to remain covert on ground impact, sense the approach of a target, and function when that target comes within lethal range. In this manner, the munitions employ mobility of the target as a means of overcoming the target acquisition and accuracy problems associated with direct attack. Previous mine systems have not achieved optimum effectiveness because of technical and operational inadequacies. Equipment developed within this program will be aimed at eliminating these inadequacies while maintaining minimum projected unit production cost. Efforts in this program are completed with formal standardization of the item and with independent assessment by the development and operational communities to the effect that development has been successfully completed, operational utility and suitability have been demonstrated, and that the item is ready for production.

RELATED ACTIVITIES: Advanced developments from Program Element (PE) 63601F, Conventional Weapons, are selected for continuation to engineering development under this program element. Close liaison is maintained between the Services through Joint Technical Coordinating Groups (JTCG) such as the JTCG for Munitions Development, through formal coordination with the Department of Defense Armaments/Munitions Requirements and Development Committee. The Gator is a joint service program with the Air Force as lead development Service.

WORK PERFORMED BY: This program is managed by the Armament Division, Eglin AFB, FL. The hardware effort is accomplished both in-house and on contract with industry. The Gator mine is being developed by the US Army Project Manager for Selected Ammunition, Picatinny Arsenal, Dover, NJ. The Naval Weapons Center, China Lake, CA, is developing the mine/dispenser interface.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Gator entered full scale development as a Joint Service Development Program in FY 1974 with the Air Force as lead Service. An unguided version of the SUU-54 dispenser was qualified for delivery of mines in FY 1976 and FY 1977. Technical problems involving setting self-destruct times into the individual mines were resolved and engineering verification testing continued.

2. FY 1980 Planned Program: Engineering verification testing of the Gator will be completed. After a successful critical design review, Gator hardware will be fabricated for the Development and Initial Operationnal Test and Evaluation phase.

Project: #2215 — Title: Gator
Program Element: #64610F — Title: Air Delivered Land Mines
DoD Mission Area: Mine Warfare, #214 — Budget Activity: Tactical Programs, #4

3. FY 1981 Planned Program: Development and initial operational testing of the Gator system will begin.

4. FY 1982 Planned Program: Initial operational test and evaluation will be completed and a production recommendation will be made.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimate Cost
	TOTAL FOR PROGRAM ELEMENT	9,210	9,800	4,000	200	0	Not Applicable
2215	Gator	9,200	9,800	4,000	200	0	39,500
2293	Piranha	10	0	0	0	Not Applicable	Not Applicable

Total program difference of +$5.4M is the result of cost increases created by technical problems involving setting self-destruct times into the individual mines. Funding adjustment, +$1,100K in FY 78 and -$892K in FY 79, was accomplished to accurately depict expenditures for work contracted for in FY 78. In FY 81, +$4,700K is requested to complete the program as planned.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64612F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: Low Level Laser Guided Bomb
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,735	8,000	9,000	4,500	0	25,235

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program will develop improvements to the Laser Guided Bomb (LGB) to extend its effective use down to feet altitude. The Tactical Air Forces require the capability to deliver general purpose bombs at very low altitudes with precise "hitting" accuracy. Below feet release altitude (depending on airspeed and weapon size) the present 500 pound LGB can only be released in a toss mode, with significant degradation in accuracy.

BASIC FOR FY 1981 RDT&E REQUEST: Includes funds for engineering design of changes to the Laser Guided Bomb necessary to satisfy the increased performance requirements and to fabricate prototype test units. Developments will be based on the proven characteristics of the present LGB and the feasibility of known types of design improvements demonstrated by concept studies completed in FY 1977.

OTHER APPROPRIATION FUNDS:

Procurement (3080) Laser Guided Bomb Kit (Quantity)	Procurement of the present LGB kit is programmed to continue through FY 1982 funded deliveries. A portion of the funds provided in the Five Year Defense Plan for FY 1982 will be applied to the improved kit when development is complete.

Program Element: #64612F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: Low Level Laser Guided Bomb
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: This program is to extend our Laser Guided Bomb (LGB) capability down to the feet altitude demanded by weather and defensive environments in Europe. The Tactical Air Forces need the versatile effectiveness of the LGB to attack the bridges, depot and airfield facilities, fixed radar installations, and structures of all kinds that are too large for the antitank munitions and too numerous for the GBU-15. The LGB showed in Southeast Asia an advantage of from to-one to as much as to-one increase in effectiveness over unguided weapons, at a very low cost. The Production Engineering Program (PEP) improved reliability, shelf life, handling, etc, but left performance essentially unchanged. Minimum release altitude required for specified accuracy is feet, dependig on airspeed and other parameters. Loft delivery tactics have been developed recently to provide some low altitude capability with the PEP LGB, but, under those conditions accuracy is degraded by a factor of The low altitude limitations are due to the "band-bang" guidance technique and the "flying qualities" of the LGBs. Two concept studies have shown that these factors can be overcome at a minor increase in unit cost using available technology. This program will determine the minimum engineering change to the LGB design (lowest cost implementation) that will satisfy the increased performance requirements, fabricate and test one or more prototype solutions, and accomplish the detailed engineering necessary to ready the selected approach for production.

RELATED ACTIVITES: Procurement of the present design PEP LGB kit is continuing under Program Element 28030F (War Readiness Material, Ammunition). A change of that procurement to the improved version is contemplated for FY 1982 based upon a successful outcome of this program.

WORK PERFORMED BY: The Armament Division (AD), Eglin AFB, FL is responsible for this program. The primary test facilities to be used are those of AD; a limited use of the Arnold Engineering Development Center facilities may also be required (less than 100 hours), depending upon the extent to which the selected approach(es) may be based upon aerodynamic rather than electronics changes. Bidders for this development include Texas Instruments, Inc., Dallas, TX (sole supplier of LGB Kits); Rockwell International Corp., Missile Systems Division, Columbus, OH; and Martin Marietta Corp., Orlando, FL.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Concept feasibility studies conducted under Program Element 63601F, Conventional Weapons Technology, were completed in January 1977. Those studies, performed by Texas Instruments, Inc., and Rockwell International Corp., indicated that substantial performance improvement could be realized by changing the seeker, adding a simple autopilot based on microprocessor technology, modifying the controls, and/or changing fin and wing design. The Air Force tactical operating commands examined those findings and determined that such an improved weapon would meet their requirements, as stated in Tactical Air Forces Required Operational Capability 315-77, published 31 August 1977. In FY 1979, the acquisition program plan calling for a competitive phase I limited test effort and selection of a single contractor to complete Initial Operational Test and Evaluation (Phase II) was finalized and contracting activities began.

Program Element: #64612F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: Low Level Laser Guided Bomb
Budget Activity: Tactical Programs, #4

2. FY 1980 Planned Program: The full scale engineering contract will be awarded. Basic design and prototype fabrication will be conducted. Design refinements will be made based on results of ground and flight testing of those items.

3. FY 1981 Planned Program: Manufacture of the development test and evaluation items will begin. Flight test of the competing designs will be completed and one contractor selected for phase II.

4. FY 1982 Planned Program: Initial Operational Test and Evaluation will be completed in FY 1982, along with producibility studies and other data needed to make a production decision in FY 1982.

5. Program to Completion: Initial production deliveries for Follow-on Operational Test and Evaluation will occur in FY 1983.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparision with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	3,900	12,000	12,700	0	28,600

Difference in total program (-3,365K) is the result of a revision in the program test plan.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64613F Title: Common NATO Munitions
DoD Mission Area: Close Air Suport/Battlefield Interdiction, #222 Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 ACTUAL	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,100	2,200				Not Applicable
2639	ATLIS II*						Not Applicable
2640	Aircraft Cross-Servicing**	1,100	2,200				Not Applicable
2641	STREBO MU-1***						Not Applicable

* ATLIS II funding transferred to Program Element (PE) 63249F, Night Attack Program in FY 1979 and 1980 per Congressional direction.
** A new PE (27216F) has been established in FY 1981 to accomplish Aircraft Cross-Servicing activities.
*** STREBO MU-1 project deleted per Congressional direction.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program was intended to provide funds for the initiation of weapons programs to be cooperatively developed with other North Atlantic Treaty Organization (NATO) nations to meet common NATO mission requirements for airborne laser target designator systems and area fire weapons. The program also provided funds for the determination of aircraft/store compatibility and the certification of NATO munitions on US aircraft in support of the NATO aircraft cross-servicing program. The latter task has been absorbed under a new Cross-Servicing program element starting in FY 1981 which contains no RDT&E funding.

BASIS FOR FY 1981 RDT&E REQUEST: Not Applicable

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #64613F
Title: Common NATO Munitions
DoD Mission Area: Close Air Support/Battlefield Interdiction, #222
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The members of the North Atlantic Treaty Organization (NATO) have recognized that standardization and/or interoperability of aerial munitions are desirable goals. The Principals of the Four Power Nations of NATO met in October 1977 and agreed to consider air-to-surface munitions as a first priority. Subsequent discussions by the Senior National Representatives (SNRs) for Air resulted in the expression of US intent to evaluate the French Airborne Tracker Laser Illuminator (ATLIS) II laser designator pod and the German STREBO MW-1 cluster munition bilateral programs. This program also collected the data required to determine the compatibility of, and certify NATO munitions on, United States aircraft. This function has now been assumed under a new Program Element (PE) (27216F) starting in FY 1981

RELATED ACTIVITIES: Continuing evaluation of promising foreign weapons is performed under PE 65111D, Foreign Weapons Evaluation. Items which produce favorable results during these limited evaluations are candidates for full certification on US aircraft which will enhance the interoperability and flexibility of NATO air forces. Close liaison is maintained with the Sub-Groups of the NATO Air Forces Armament Group which address NATO air-to-surface and air-to-air requirements, and the interoperability of tactical aircraft and their weapons systems. Particpation in these activities is fully integrated with the discussions by the Four Power National Armament Directors and SNRs for Air.

WORK PERFORMED BY: The Air Force Armament Division, Eglin AFB, FL.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments:

Project 2639: ATLIS II funding transferred to PE 63249F, Night Attack Program.

Project 2640: Test quantities of the French MATRA 250 kg bomb were acquired and the certification of this weapon on United States F-4, F-111 and A-7 aircraft was initiated. Actions necessary to certify the French MATRA 68mm SNEB rocket and the Canadian 2.75 inch CRV-7 rocket on the US F-4, A-7 and A-10 aircraft were initiated. The Norwegian 20mm Raufoss multipurpose ammunition will be qualified for use in US aircraft cannon.

Project 2641: Deleted per Congressional direction.

2. FY 1980 Planned Program:

Project 2639: Funding transferred to PE 63249, Night Attack Program per Congressional direction.

Project 2640: Certification efforts on the MATRA 250 kg bomb, the French MATRA 68mm SNEB rocket and the Canadian 2.75 inch CRV-7 rocket will continue as will the Norwegian Raufoss multipurpose ammunition qualification program. Updating

of the Aircraft Stores Interface Manual (ASIM) and Aircraft Stores Interface Data Systems (ASIDS) to incorporate physical and electrical interface data for NATO aircraft and munitions will be initiated.

Project 2641: Not Funded

3. FY 1981 Planned Program: Not Applicable

4. FY 1982 Planned Program: Not Applicable

5. Program to Completion: Not Applicable

6. Milestones: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 ACTUAL	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT		9,000	16,700	10,200	Not Applicable	Not Applicable
2639	ATLIS II		6,000	12,500	6,000	3,000	27,500
2640	Aircraft Cross-Servicing		3,000	2,200	2,200	Continuing	Not applicable
2641	STREBO MW-1			2,000	2,000	2,000	6,000

The $6M shown against ATLIS II in FY 1979 was contained in the FY 1979 Supplemental Budget request which was denied by Congress. $1.9M of the $3.0M Aircraft Cross-Servicing funding was subsequently identified against an ATLIS II funding requirement pending approval of a $13.7M reprogramming request which was sent to Congress on 23 March 1979 and subsequently approved specifically the purpose of a competition for the selection of a laser designator equipped pod for single seat aircraft. These funds will be managed under the Air Force Night Attack Program per Congressional direction. The $12.5M ATLIS II request in FY 1980 was transferred to the Air Force Night Attack Program element by Congress for the purpose of a competition for the selection of a laser designator equipped pod for single seat aircraft. The ATLIS II funding requested under this program element in FY 1981 has been deleted from this program element and transferred to the Night Attack Program. The STREBO MW-1 project has been deleted per Congressional direction. A new Aircraft Cross-Servicing program element (PE 27216F) was established in FY 1981 and all cross-servicing funding will now be requested under this program.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 64615F
DOD Mission Area: Interdiction/Naval Strike, #223

Title Guided Hard Structures Munition
Budget Activity Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands) Total

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Estimnated Costs
	TOTAL FOR PROGRAM ELEMENT			600	200	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides funds for the design of a weapon to defeat hard targets that are not vulnerable to current conventional weapons. The weapon will consist of the two-stage Hard Structures Munition warhead, with modified, off-the-shelf propulsion and guidance components.

BASIS FOR FY 1981 RDT&E REQUEST: These funds will be used to initiate definition of a powered guided hard target weapon.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: # 64615F
DOD Mission Area: Interdiction/Naval Strike, #223

Title Guided Hard Structures Munition
Budget Activity Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: This program will provide a weapon design capable of defeating extremely hard targets such as caves, bridge piers and underground facilities that are not vulnerable to current conventional weapons. The Hard Structures Munition (HSM) warhead has been proven effective against massive concrete and earth/concrete targets. This warhead will be integrated with a modified inventory propulsion system and an adapted guidance and control system. A flight demonstration is currently underway in Program Element (PE) 63609F, Advanced Attack Weapons, which is demonstrating the warhead with the laser guided bomb guidance and control kits. While this vehicle lacks the propulsion necessary for optimum warhead effectiveness, it is proving the concept of a Guided Hard Structure Munition. The current weapon design requires high altitude or dive delivery tactics which decrease delivery aircraft survivability. Future development is intended to provide a hard structures munition which is compatible with low altitude delivery tactics while retaining warhead effectiveness.

RELATED ACTIVITIES: Related Program Elements include: PE 63609F, Advanced Attack Weapons, and PE 64612F, Low Level Laser Guided Bomb. In addition, the fuze development has been accomplished by the Department of Energy's (DOE) Lawrence Livermore Laboratory. This development is therefore related to DOE fuzing technology efforts.

WORK PERFORMED BY: Program management is provided by Headquarters Air Force Systems Command, Andrews AFB, MD and the subordinate organization, Armament Division, Eglin AFB, FL. Contract relationships have not been finalized, although Texas Instrument Inc., Dallas, TX, and Thiokol Chemical Corp., Brigham City, UT, have developed components in previous efforts. The Department of Energy's Lawrence Livermore Laboratory will provide consulting and testing services for the warhead and fuzing system.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable.

2. FY 1980 Program: Not applicable.

3. FY 1981 Planned Program: Design analysis and studies leading to a future full scale development program will be initiated.

4. FY 1982 Planned Program: Continue concept definition and validation of a powered HSM weapon. Reprogram FY 82 effort to PE 63609F.

5. Program to Completion: Following a successful concept validation, initiate full scale development of powered HSM weapon system to include propulsion, fuzing, and warhead, in this PE.

Program Element: # 64615F
DOD Mission Area: Interdiction/Naval Strike, #223

Title Guided Hard Structures Munition
Budget Activity Tactical Programs #4

6. Milestones: Not applicable

7. Resources: Not applicable

8. Comparison with FY80 Budget Data: Not applicable. This is a new start

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64706F
DOD Mission Area: Air Warfare Support, #225

Title: Life Support System
Budget Activity: Tactical Programs, #4

RESOURCES/PROJECT LISTING: ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5,900	5,200	11,400	14,800	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to provide centralized management and development of life support equipment and subsystems necessary to assure maximum functional capability of aircrews throughout all mission environments and to enhance safe escape, descent, survival and recovery in emergency situations. Also provides for development, test, and standardization of emergency equipment and protective clothing and devices for non-flying personnel. This is the only United States Air Force (USAF) Program Element devoted to engineering development of life support equipment.

BASIS FOR FY 1981 RDT&E REQUEST: Funds are required for continuing efforts being made to develop equipment and subsystems necessary to maximize the functional capability of aircrews and non-flying personnel and to enhance their safe escape and recovery from emergency situations. Includes funds for development of a triservice Survival Avionics System, USAF/Canada Advanced Automatic Inflation Modulation Parachute, follow-on thermal flash blindness devices, USAF/United States Navy Open Loop Oxygen Generating System, lightweight helmet for high-acceleration aircraft, rocket fuel handlers' suit, aircrew restraint for high speed ejections, and faster-operating ballistic inertia reels. Smaller efforts will include low temperature life raft inflation devices and advanced fire retardant flight clothing.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Cost
Other Procurement (3080)						
Flashblindness Goggles	7,286	3,526	-	-	-	20,554
Quantities	1,425	658	-	-	-	4,000

Program Element: #64706F
DOD Mission Area: Air Warfare Support, #225

Title: Life Support System
Budget Activity: Tactical Programs. #4

DETAILED BACKGROUND AND DESCRIPTION: This program provides aircrews and non-flying personnel with equipment and subsystems necessary to maximize both their functional contribution to assigned missions and to enhance the probability of their survival during emergencies. It encompasses the integration of all life support equipment and subsystems throughout the design, development, test, acquisition and operational phases. Major efforts include an Open Loop Oxygen Generating System (OLOGS) for bomber aircraft, a joint United States Air Force (USAF)/United States Navy (USN) OLOGS for fighter aircraft, a Survival Avionics System for triservice use in locating and identifying downed aircrews and passengers, a standardized Advanced Concept Ejection Seat (ACES) for the A-10, F-15, F-16 and future aircraft requiring a high performance ejection seat, and Flashblindness Protective Devices for aircrew members. This program also provides for development of emergency and survival equipment for aircraft passengers. Approximately 30 separate efforts in aircrew related life support equipment, emergency escape and descent subsystems, survival and recovery and ground crew life support equipment are funded each year.

RELATED ACTIVITIES: Program Element (P.E.) 62201F, Aerospace Flight Dynamics; P.E. 62202F, Aerospace Biotechnology; P.E. 63205F, Flight Vehicle technology; P.E. 64601F, Chemical/Biological Defense Equipment, 62733A, Clothing, Equipment and Packaging; 63747A, Clothing and Equipment, Soldier Support/Survivability; 64204A, Air Mobility Support Equipment; 64713A Combat Feeding, Clothing and Equipment; 62241N, Ejection Seat Bio-Dynamics; 62758V, Biomedical Technology, Protective Clothing, Survival and Rescue; 63216N, Mission Oriented Clothing and Devices; 64264N, Life Support Equipment. Tasks are developed and coordinated with the other Services. Triservice working groups have been established and meet regularly to achieve standardization and to prevent duplication of efforts.

WORK PERFORMED BY: The Aeronautical Systems Division (AFSC), Wright-Patterson AFB, OH, provides program management. The ten major contractors in FY 78 were: AiResearch Manufacturing Company, Torrance, CA; American Safety Flight Systems, Inc, Hollywood, FL; McDonnell-Douglas Corp, Long Beach, CA; Essex Cryogenics, Inc, St Louis, MO; David Clark Co, Inc, Worcester, MA; Irvin Industries Canada, Ltd, Ft Erie, Ontario, Canada; Cubic Corp, San Diego, CA; Bendix Corp, Davenport, IO; General Dynamics, Ft Worth, TX; and Frost Engineering, Englewood, CO.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Prior accomplishments include the development of numerous personal equipment, escape and descent, and survival and recovery equipment items now used by aircrews. Some of these items include oxygen masks and regulators, life rafts and inflation systems, artic clothing and survival kits, fire retardant flight clothing, improved aircrew helmets, survival radios and beacons, parachute improvements, and ACES. In FY 79, the ACES continued to be delivered to the Tactical Air Command (TAC) for operational F-15, F-16 and A-10

aircraft. A study to investigate the possibility and feasibility of installing the Advanced Concept Ejection Seat (ACES) in other United States Air Force (USAF) aircraft was initiated. Development of the Survival Avionics System (SAS) PRC-112 survival radio, joint USAF-United States Navy (USN) Open Loop Oxygen Generating System (OLOGS) follow-on thermal flashblindness protection devices continued; test and evaluation of the OLOGS continued in B-1 aircraft #4 and other additional development test and evaluation of numerous smaller equipment items continued.

2. FY 1980 Program: Continued development effort on approximately 15 separate tasks, including the triservice SAS, follow-on thermal flashblindness devices, USAF/Canadian Automatic Inflation Modulation (AIM) Parachute, USAF/USN two-man OLOGS for fighter aircraft, lightweight helmet and high performance anti-g system for high acceleration aircraft, improved fire retardant flight clothing, low temperature flotation equipment inflation system, female aircrew life support equipment plus efforts for non-flying personnel protective equipment and other smaller life support efforts. Development of an improved rocket fuel handlers' suit will begin.

3. FY 1981 Planned Program: Development of the SAS, Joint USAF/USN OLOGS and USAF Canadian AIM Parachute will be completed. Work on personnel parachute improvements, improved rocket fuel handlers' suit will continue as will efforts to improve aircrew and non-flying personnel protective clothing and equipment. Development of an advanced aircrew arm and leg restraint system for high speed ejections will begin.

4. FY 1982 Planned Program: Development of the improved rocket fuel handlers' suit will be completed. The advanced aircrew arm and leg restraint system for high speed ejections will begin test and evaluation. Other efforts to improve aircrew and non-flying personnel protective clothing and equipment will continue.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 80 Budget Data: No Change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64707F
DOD Mission Area: Global Military Environmental Support #420

Title: Weather Systems (Engineering Dev)
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	900*	1100*	5800	5300	Continuing	Not Applicable

*This effort funded in project 2093, Weather Systems, Program Element 64708F, Other Operational Equipment, in FY 1979 and FY 1980.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Several requirements are addressed. First, Air Force Communications Command stated a requirement and the Air Force validated that need for an Automated Weather Distribution System. Second, Military Airlift Command stated requirements and the Air Force validated those needs for an Advanced Weather Radar, a Battlefield Weather Support System, a Wind Sounding Capability, and an Improved Weather Reconnaissance System. All of these needs relate to weather support provided by Air Weather Service to the Air Force and parts of the Army. The increasing emphasis on operations during night and bad weather periods makes the rapid and accurate determination of weather conditions of increasing importance.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for initial engineering development of the Automated Weather Distribution System. It also includes the Air Force share of development costs in FY 1981 for the joint Department of Commerce - Department of Defense - Department of Transportation next generation weather radar. Also included is continued development of capabilities to observe and predict the battlefield weather conditions which are crucial to the effective employment of electro-optical guided weapons. Finally, residual efforts will continue toward development of a low cost Wind Sounding Capability and limited Improved Weather Reconnaissance System in a cooperative effort with National Oceanic and Atmospheric Administration of the Department of Commerce.

OTHER APPROPRIATIONS: Not Applicable.

Program Element: #64707F
DOD Mission Area: Global Military Environmental Support #420

Title: Weather Systems (Engineering Dev)
Budget Activity: Defense-wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: The efforts in this program element will fund development of equipment and techniques bringing a long overdue upgrade of Air Force Air Weather Service (AWS) support. This upgraded weather support will make weather a force intensifier on the battlefield and will develop greatly improved severe storm detection and warning through joint agency efforts. The following are addressed:

AUTOMATED WEATHER DISTRIBUTION SYSTEM (AWDS): AWDS will automate most weather data handling tasks within the AWS weather station at most major Air Force Bases, some Army installations, and some tactical facilities. AWDS will automate the local weather observation to save manpower and will incorporate rapid forecast techniques. Once observations, forecasts, and weather warnings become available, AWDS will display them to the AWS forecaster and local users.

ADVANCED WEATHER RADAR (AWR): AWR will provide a greatly improved storm detection and warning capability through a Joint Department of Commerce - Department of Defense - Department of Transportation development and procurement program. A joint program office will be formed with representatives from each of the participating agencies during FY 1980. AWR will detect severe surface wind, hail, tornadoes, and turbulence using Doppler techniques; automate thunderstorm tracking; partially automate severe thunderstorm identification; and improve warning accuracy and timeliness through use of interactive warning-preparation techniques.

BATTLEFIELD WEATHER SYSTEMS: This program element contains funding for development of tactical decision aids to support employment of weapons using visible, infrared, and radar sensors. The AWS does not have the capability to provide projections of weapon system performance in current or forecast target weather conditions. Tactical decision aids will provide the needed capability.

WIND SOUNDING CAPABILITY (WSC) AND IMPROVED WEATHER RECONNAISSANCE (IWR): WSC and IWR will upgrade current hurricane and typhoon storm reconnaissance capabilities on WC-130 storm penetration aircraft. Ambitious programs envisioned in the past have been scaled down to more realistic consideration of off-the-shelf equipment and cooperative efforts with National Oceanic and Atmospheric Administration (Department of Commerce).

RELATED ACTIVITIES: Program Element (PE) 64707F begins in FY 1981 as an outgrowth of Project 2093, Weather Systems, PE 64708F, Other Operational Equipment. PE 63707F, Weather Systems (Advanced Development) accomplishes advanced development projects whose results feed into PE 64707F. Funds for procurement of systems developed in PE 64707F are included in PE 35111F, Weather Services.

WORK PERFORMED BY: Development of the Advanced Weather Radar will be pursued by the Joint System Program Office for Next Generation Weather Radar which is presently located within National Weather Service (Department of Commerce). Program management for other programs is provided by Electronic Systems Division, Hanscom Air Force Base, MA. In-House Laboratory work will be completed by Air Force Geophysics Laboratory, Air Force Avionics Laboratory, and Air Force Armament Test Laboratory. No contractors are involved at this time.

Program Element: #64707F
DOD Mission Area: Global Military Environmental Support #420

Title: Weather Systems (Engineering Dev)
Budget Activity: Defense-wide Mission Support #6

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not Applicable

2. FY 1980 Program: Not Applicable

3. FY 1981 Planned Program: Automated Weather Distribution System (AWDS) prototype development and testing will begin. Work on Advanced Weather Radar development will consist of system definition by either government experts or contractors. Work on development of a tactical decision aid will incorporate results from testing of a preliminary version. Air Weather Service and Air Force Systems Command representatives will test the preliminary tactical decision aid during weapon system tests by the Air Force Test and Evaluation Center. A cooperative effort with National Oceanic and Atmospheric Administration (Department of Commerce) will be pursued to establish low cost system candidates for Wind Sounding and Improved Weather Reconnaissance systems.

4. FY 1982 Planned Program: Automated Weather Distribution System development will continue with prototype testing. Advanced Weather Radar competitive development will begin. Tactical decision aid development will continue and a version to support employment of infrared systems will be completed.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: Not Applicable. This program element begins in FY 1981.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element (PE): #64708F
DOD Mission Area: Air Warfare Support #225

Title: Other Operational Equipment
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	10,420	9,900	10,800	19,300	Continuing	Not Applicable
1266	Microform Records System	200				0	1,500
2054	Aerospace Facilities Eng	2,300	4,200	985	3,800	Continuing	Not Applicable
2093	Weather Systems Development	700	1,100	TRANSFERS TO PE64707		in FY 81	
2173	Avionics Support Equipment	900				0	2,600
2479	Common Support Equipment	700	1,100	1,400	3,000	Continuing	Not Applicable
2482	HAVE QUICK	4,320	TRANSFERS TO PE27423 IN FY 1980				
2505	Aircraft Firefighting Equip	300	400	400	500	Continuing	Not Applicable
2536	Mobile Acft Arresting Equip		1,000	1,000		0	2,000
2621	Rapid Runway Repair*			5,000	9,000	22,480	41,900
2674	Mobile Tactical Shelters**		400	715	1,000	Continuing	Not Applicable
5973	Visually Coupled Systems	1,000	1,700	1,300	2,000	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Technological advancements and changing threat scenarios create a continuing need to improve operational forces support equipment. This program element contains a group of projects which develop, test, and evaluate a variety of support components and equipments in response to these needs. Modifications to existing systems and/or new subsystem equipments are qualified through projects in this element to satisfy operational needs.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funding for 8 individual projects in FY 1981. All projects are continuations of prior year initiations in the areas of Aerospace Facilities, Weather Systems, Common Support Equipment, Aircraft Firefighting Equipment, and Visually Coupled Systems. One project, Mobile Aircraft Arresting Equipment, the objective of which is to provide a contingency capability to recover tactical, tailhook equipped aircraft on otherwise unsuitable pavements, project should be completed in FY 1981. The Weather Systems project will transfer in FY 1981 to PE 64707. Rapid Runway Repair, currently a task in the Aerospace Facilities Engineering project, will become a separate project. All other projects will continue as established in FY 1980.

* Rapid Runway Repair has been a task in Project 2054 prior to FY 1981.
** Mobile Tactical Shelters was initiated under Project 2054 prior to FY 1980.

Program Element: #64708F
DOD Mission Area: Air Warfare Support #225

Title: Other Operational Equipment
Budget Activity: Tactical Programs #4

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Other Procurement (3080)						
2536 Mobile Acft Arresting Equip (Quantity)					22,600 (64)	22,600 (64)

Program Element: #64708F
DOD Mission Area: Air Warfare Support #225

Title: Other Operational Equipment
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: The projects in this program element address operational force deficiencies, the need to reduce proliferation of support equipment, and public law requirements dealing with environmental quality and protection. A brief description of these projects follows:

GROUND SUPPORT: Project 2054, Aerospace Facilities, provides research and development in six broad areas of Air Force Civil Engineering: Base Survivability, Air Mobility, Environmental Engineering, Aircraft Operational Surfaces, Energy Sources, and Weapons Effects Tests. Project 2479, Common Support Equipment, provides for opportunities to reduce the proliferation of non-standard support equipment. Equipments developed under this project will be applicable to many different weapons systems. Project 2505, Aircraft Firefighting Equipment, provides a continuing effort to improve the Air Force's capability to fight aircraft fires. Project 2536, Mobile Aircraft Arresting Equipment, will adapt an existing aircraft arresting cable to a portable mounting. With a rapid installation capability, this system will permit the recovery of fighter aircraft on short segments of usable runway. This improved recovery capability is a readiness issue. Project 2621 addresses the problems of rapidly restoring runways, or other aircraft operational surfaces, for service following an airfield attack.

AVIONICS SUPPORT: Project 5973, Visually Coupled Systems, provides for the development of helmet mounted sights and displays which will allow the slewing and aiming of various sensors throughout the pilot's visual field.

RELATED ACTIVITIES: Program Elements 63723F, Aerospace Facilities Technology, and 63203F, Advanced Avionics for Aircraft, provide advanced development in the Civil Engineering and Avionics Engineering areas. The helmet mounted sights developed under Project 5973 will be used in the RF-4C, PAVE TACK equipped aircraft.

WORK PERFORMED BY: Program Management is provided by the Aeronautical Systems Division, Wright-Patterson AFB, OH; Electronic Systems Division, Hanscom AFB, MA; and the Air Force Engineering and Services Center, Tyndall AFB, FL. In-house facilities include the Wright Aeronautical Laboratories (Avionics, Materials, and Flight Dynamics), Wright-Patterson AFB, OH; Rome Air Development Center, Griffiss AFB, NY; Air Force Flight Test Center, Edwards AFB, CA; and the Naval Air Engineering Center, Lakehurst, NJ. Contractors include Boeing, Brunswick, National Bureau of Standards, General America Trans, and the Army Waterways Experimental Station. Bidders on Project 2479 include Sperry Microwave, AAI Corporation, PRD Electronics, Martin Marietta Corporation, VA Products, Allied Electronics Corporation, and Regent Jack.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and prior accomplishments: Armed Forces Entrance Examining Station was developed for the Department of Defense as a standard for the future. Digital Radar Landmass Simulation technology was applied in a prototype modification to an F-111A analog simulator to improve simulation of low-level radar imagery. Video tape recorders have been qualified for airborne use in tactical aircraft to improve training and mission assessment. Prototype helmet mounted sights and displays have been developed.

Program Element (PE): #64708F
DOD Mission Area: Air Warfare Support #225

Title: Other Operational Equipment
Budget Activity: Tactical Programs #4

2. FY 1980 Program: Five projects will continue in FY 80. There will be one new start, and one project which had been a task within a different project. The bulk of Project 2054, Aerospace Facilities, will be devoted to Rapid Runway Repair. Surface roughness testing of F-4E aircraft will be completed. New bomb-crater repair techniques will be examined. Other efforts are aimed at Air Base Survivability, Tactical Shelters, Environmental Engineering, Aircraft Operational Surfaces, and Energy Sources. Project 2093 will attack the problem of observing and predicting the battlefield weather conditions which affect employment of electro-optical (EO) munitions. Project 2479 will continue the development of standardized support equipment. Project 2505 will continue the development of firefighting trainers, procedures, equipment, agents and vehicles. Project 2536, Mobile Aircraft Arresting Equipment, is a new start. It will make portable an existing arresting system (BAK-13). This will permit rapid use of short sections of suitable pavement for aircraft recoveries on a contingency basis. Project 5973 will emphasize development of helmet mounted displays to provide critical information to the pilot without reference to in-the-cockpit displays.

3. FY 1981 Planned Program: Project 2621 will develop and test flush runway patches for various size craters. Surface roughness criteria for F-15 and F-16 aircraft will be determined. An optimum repair plan for bomb damaged pavements will be developed. Battlefield weather prediction procedures for EO guided munition selection will be fielded. Battlefield weather observation systems will be studied. Specific common support equipment items will be developed along with management tools to reduce procurement of non-standard items. A Mobile Aircraft Arresting System will be developed and go into production. Development and acquisition of helmet mounted sights and displays will continue.

4. FY 1982 Planned Program: Planned funding for FY 82 is $19 million. The relatively large funding increase in FY 82 from FY 81 is due to increased activities in the Rapid Runway Repair, Aerospace Facilities Engineering (especially the Weapons Effects Test task) and Common Support Equipment projects. The work on the Aircraft Firefighting Equipment and Mobile Tactical Shelters will continue at about the same level as in FY 81.

5. Program To Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

Program Element (PE): #64708F
DOD Mission Area: Air Warfare Support #225

Title: Other Operational Equipment
Budget Activity: Tactical Programs #4

8. Comparison With FY 1980 Budget Data:

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	9,953	12,500	9,900	13,300	Continuing	N/A
1266	Microform Records System	700	200			0	7,500
2054	Aerospace Facilities Eng	2,000	2,300	4,300	6,500	Continuing	N/A
2093	Weather Systems Development	560	2,500	1,100	3,000	Transfers to PE 64707 in FY 81	
2173	Avionics Support Equipment	1,747	900			0	2,600
2479	Common Support Equipment	400	700	1,100	1,500	Continuing	N/A
2482	HAVE QUICK	1,091	4,600	Transfers to PE 27423F in FY 80			
2505	Aircraft Firefighting Equip	205	300	400	300	Continuing	N/A
2536	Mobile Acft Arresting Equip	250	0	1,500	500	0	2,000
5973	Visually Coupled Systems	3,000	1,000	1,500	1,500	Continuing	N/A

The planned funding estimate for the PE for FY 1980 remained the same in the FY 1981 budget submission as it was in the FY 1980 budget submission. The planned funding estimate for the PE for FY 1981 has been reduced from $13 million identified in the FY 1980 budget submission to $10.7 million identified in the FY 1981 budget submission. This change was due to the following:

(a) $3 million for Project 2093 identified in the FY 1980 budget submission will not be spent under this PE in FY 1981; because this project transfers to PE 64707 in FY 81.

(b) For FY 1981 the estimated funding for Project 2536 has been increased from $500 thousand to $1 million due to realignment of workload schedule. It is noted that the total cost remains at $2 million for the life of the project.

(c) For FY 1981, the estimated funding for projects 2479, 2505 and 5973 changed from $1.5 million, $300 thousand and $1.5 million in the FY 1980 budget submission to $1.4 million, $400 thousand and $1.3 million, respectively in the FY 1981 budget submission due to realignment of workload schedule.

(d) In the FY 1980 budget submission, work under Project 2054 included the work planned under Projects 2054, 2621 and 2674 in the FY 1981 submission. For FY 1981, the funding estimate for this work was $6.5 million (Project 2054 only) in the FY 1980 budget submission, as compared to $6.7 million total for Projects 2054, 2621 and 2674 in the FY 1981 budget submission.

Project: #2621 — Title: Rapid Runway Repair
Program Element: #64708F — Title: Other Operational Equipment
DOD Mission Area: Air Warfare Support, #225 — Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The advent of hardened aircraft shelters at United States Air Force bases in Europe makes attacks on airfield operating surfaces a lucrative target choice for hostile forces. Rapid Runway Repair is an engineering development program with four major technical thrusts: (1) Damage Assessment and Recovery Plan; (2) Bomb-Damage Repair; (3) Surface-Roughness Criteria Determination; and (4) Alternate Surfaces.

RELATED ACTIVITIES: Program Element 63723F/2104 (Rapid Runway Repair) performs advanced development of techniques and equipment improving rapid runway repair capabilities; it feeds the PE 64708F/2621 program.

WORK PERFORMED BY: The Air Force Engineering and Service Center (AFESC), Tyndall AFB, FL manages the overall Rapid Runway Repair (RRR) program. The Aeronautical Systems Division (ASD) manages the HAVE BOUNCE sub-task. A task-ordered contractor will be selected in FY 1980 to perform a large part of the RRR development effort.

PROGRAM ACCOMPLISHMENTS AND FUTURE PLANS:

1. FY 1979 and Prior Accomplishments (Conducted under PE 64708F/2054-6): New bomb crater fill and crown materials were investigated. An interim repair manual was prepared. HAVE BOUNCE computer simulation development and validation testing of the F-4E was performed. Interim surface roughness guidance for the F-4E was disseminated. A damage-resistant runway concept study was begun. A damage assessment system was defined and began model development.

2. FY 1980 Program (Conducted under PE 64708F/2054-6): Flush bomb-damage repair (BDR) field tests will be conducted to identify and develop "flush" repair designs for spall, small and large crater damage. Designs to be tested include flexible and rigid pavements, unsurfaced aggregates, "FOD Covers," and prefabricated caps. Various BDR equipment items will be tested and analyzed. HAVE BOUNCE testing of the F-16, C-130, and C-141 is proposed. To expedite civil engineering repairs and other recovery actions following an attack, a comprehensive general plan will be initiated.

3. FY 1981 Planned Program: FLush repair field-testing continues; technical efforts aided by computer programming focus on the structural integrity of the repair, roughness induced into the aircraft, the time, manpower, and equipment best suited to make the repairs. HAVE BOUNCE testing of the F-15 takes place.

Project: #2621 Title: Rapid Runway Repair
Program Element: #64708F Title: Other Operational Equipment
DOD Mission Area: Air Warfare Support, #225 Budget Activity: Tactical Programs, #4

(3. CONT'D)

Construction will begin on a damage-resistant runway target, built of the most promising materials, for air-delivered weapons-effects testing. Results of BDR and other associated R&D efforts to date will be incorporated into the general plan for base post-attack recovery.

4. FY 1982 Planned Program: A complete BDR manual will be produced incorporating all BDR and surface roughness lessons learned in the program to date. HAVE BOUNCE testing of the A-10, F-111, and C-5 will take place. Small test sections of alternate launch and recovery surfaces will be constructed for aircraft taxi tests. Construction of the damage-resistant runway target will be completed and operational tests begun. A prototype damage assessment system is initiated. The preliminary general plan for Rapid Runway Repair will be sent to the field for use and comments.

5. Program to Completion: The program is completed in FY 86 when each thrust area produces planned materials, equipment and/or technical procedures to counter validated threats.

6. Milestones: Not applicable.

7. Resources ($ in Thousands):

FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
1,495	3,000	5,000	9,000	22,480	41,900

8. Comparison with FY 1980 Budget Data: Funds remain unchanged; in FY 1980 Rapid Runway Repair was a task in project 2054, Aerospace Facilities.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64710F
DoD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255

Title: Reconnaissance Equipment
Budget Activity: Tactical Programs,#4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7,950	4,900[1/]	14,900	13,700	Continuing	Not Applicable
1155	Electro-Optical Collection/ Reconnaissance	3,000	2,400	3,500	4,600	Continuing	Not Applicable
1156	Radiation Intelligence	500	100	1,000	700	Continuing	Not Applicable
2096	Interim Tactical ELINT Processor	2,100	1,100	1,300	1,500	1,000	7,400
2337	Advanced Reconnaissance Sensor			1,800	1,900	10,500	14,200
2501	Joint Service Electronic Warfare Support Measures (ESM)		100	1,100	2,300	15,300	18,800
2533	Electronic Warfare/Close Air Support Joint Test	1,600	820	4,200	500	500	10,320
2704	Tactical Electronic Reconnaissance Sensor (TEREC)	200	200	2,000	1,400	4,600	21,100
2660	AAQ-X Infrared Sensor				800	27,200	28,000
2659	EW Area Reprogramming Capability (ARC)	550	180				730

1/ Includes $2,330 transferred from FY 1978 by Congressional direction.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Projects in this program element support Air Force operating commands' reconnaissance requirements by providing engineering development of airborne and ground equipment used to collect, record and process imagery and electronic warfare support measures data for operational forces.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for the development of airborne equipment for such aircraft as the RF-4C, F-4E, and RC-135 and includes electronic, optical, laser and infrared sensors, along with their associated data links, and ground equipment, such as the Electronic Intelligence data processor.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #64710F
DoD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255

Title: Reconnaissance Equipment
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Projects in this Program Element (PE) provide improvements to existing capabilities and provide new operational capabilities to collect, record and process imagery and electronic warfare support measures data for operational forces. These projects are primarily responsive to the reconnaissance and electronic warfare support requirements of the Tactical Air Forces, Strategic Air Command, and the Electronic Security Command. Airborne equipment includes electronic, optical, laser and infrared sensors and their associated data links. Ground equipment includes data processing and dissemination. While most systems developed under this PE become engineering prototypes for follow-on production, several projects develop unique intelligence gathering sensor systems to provide data required for design and development of new weapon systems.

RELATED ACTIVITIES: All projects in this PE are coordinated as appropriate with the other Services and/or the National Security Agency groups involved in reconnaissance and electronic warfare activities. PE 63743F, Electro-Optical Warfare, and PE 63208F, Reconnaissance Sensors/Processing Technology, provide advanced development technology inputs for this PE. The Interim Tactical Electronic Intelligence Processor is being developed in coordination with the Army TENCAP Office. An infrared intelligence receiver for intelligence collection is being developed in conjunction with the Defense Intelligence Agency and the Defense Advanced Research Projects Agency. Procurement funds for aircraft modifications resulting from this program, such as the Tactical Electronic Reconnaissance System (TEREC) are provided by PE 27213F, RF-4C Squadrons. Procurement funds for ground exploitation facilities such as TEREC processing, are generally provided by PE 27431F, Tactical Air Intelligence Systems Activities.

WORK PERFORMED BY: Responsible Air Force agencies of the Air Force Systems Command include the Aeronautical Systems Division, Wright-Patterson AFB, OH, and the Electronic Systems Division, Hanscom AFB, MA. The major contractors are: Texas Instruments, Dallas, TX - ground processing; AMECOM Division of Litton Industries, College Park, MD - electronic reconnaissance sensor; Vought Systems Division, Grand Prairie, TX - electro-optical systems; RCA, Burlington, MA - electro-optical processor; and Magnavox Corporation, Mahwah, NJ - electro-optical pod.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Examples of accomplishments include: a scientific and technical electro-optical intelligence receiver including extended frequency coverage for the RC-135; an advanced aerial color film processor; a medium altitude camera; and improved infrared sensor for the RF-4C; an airborne digital data set for film annotation; a special purpose airborne laser sensor; a prototype electronic reconnaissance system for the RF-4C; and the interface for a slewable sensor and laser designator on the RF-4C. These capabilities are operational.

Program Element: #64710F
DoD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255

Title: Reconnaissance Equipment
Budget Activity: Tactical Programs, #4

2. FY 1980 Program

Project 1155 - Electro-Optical Collection/Reconnaissance: The capability to collect data on electro-optical (E-O) associated threat systems will be developed. Efforts will include deployment of an infrared sensor in a pod on the F-4E; development of an advanced]capability and the design of a system for employment on intelligenc collection aircraft. A five year E-O investment strategy will be completed.

Project 2096 - Interim Tactical ELINT Program (ITEP): The ITEP is being developed by the Army and Air Force as a transportable system that will receive, process, correlate and disseminate Electronic Intelligence (ELINT) data from a variety of collection resources. The Air Force will field the system as a tes bed for development of ELINT correlation. The first system was delivered to the Army in September 1979. The Air Force unit is scheduled for delivery in May 1980. User training is being provided for operations and maintenance of the facility; however, contractor support is required to maintai the best commercial practice hardware.

Project 2337 - Advanced Reconnaissance Sensor: Not applicable.

Project 2501 - Joint Service Electronic Warfare Support Measures (ESM): An Air Force/Army/Marine cooperative development program will be initiated to qualify advanced ESM equipment that combines an electro-optical and radio frequency capability suitable for the next generation reconnaissance aircraft. Th system will address threats in the Gigahertz band and accommodate the exotic signals expected in the late 1980s. System requirements and definition will be initiated in FY 1980.

Project 2533 - Electronic Warfare/Close Air Support Joint Test: Phase I of this Joint Test, the Tactical Communi cations Jamming (TCJ) phase, began October 1978 at Eglin AFB, FL. The first four tests of the TCJ phase will provide data on the effects of jamming on specific communication links. The last two tests of this phase will be conducted at Ft Irwin, CA beginning in the second quarter of 1980 and consist of Electronic Warfare (EW) versus Close Air Support related Command, Control and Communications (C^3), EW versus Combined Arms C^3, and a large scale EW versus tactical C^3 test in conjunction with a Joint Exercise, Gallant Eagle 80.

Project 2704 - Tactical Electronic Reconnaissance (TEREC) Sensor: The software necessary for integration of TERE data link receivers with processing equipment will be completed. This data link processing will b accomplished witn the Imagery Interpretation segments of the Tactical Information Processing and Interpretation system. The sensor will be upgraded to accommodate current and planned threats out to Gigahertz.

Project 2659 - EW Area Reprogramming Capability (ARC): This will complete the study defining the practicality of identifying and providing EW system software changes in the field to counter changed threat parameters.

3. FY 1981 Planned Program:

Project 1155 - Electro-Optical Collection/Reconnaissance: A new development will be initiated for an electro-optical system on Data collection on systems will be continued.

Project 2096 - Interim Tactical ELINT Processor: Software improvements will continue in response to a changing threat and collection capability. Follow-on software integration concepts for applications of the Tactical Air Forces will be developed and the system deployed to Pacific and European theaters for Operational Demonstration and Evaluation in field exercises.

Project 2337 - Advanced Reconnaissance Sensor: Initiate engineering development of an advanced imaging system based on technology which has completed advanced development under Program Element (PE) 63208F, Reconnaissance Sensors/Processing Technology. This advanced reconnaissance sensor is in support of the Tactical Air Forces' requirement for an electro-optical system which provides a wide field-of-view coverage with high resolution in near-real time.

Project 2501 - Joint Service Electronic Warfare Support Measure: The Preliminary Design Review on the airborne components and ground processing elements of the system will be conducted.

Project 2533 - Electronic Warfare/Close Air Support Joint Test (EW/CAS): Phase II, the air support operations phase will begin in the first quarter of FY 1981. This phase adds a new dimension to the scenario in the form of air defense (AD) simulators. Close air and attack helicopter support operations will be flown in a high-density EW/AD environment for evaluation of Command, Control and Communications and strike techniques; ground and air defense suppression coordination and procedures will also be addressed. Army ground units will be represented from company through corps level by headquarters elements to work with the Air Force and Marine CAS system.

Project 2704 - Tactical Electronic Reconnaissance (TEREC) Sensor: Integration of TEREC and its associated ground processor will continue. Software for the TEREC Remote Terminal will be completed.

Program Element: #64710F
DoD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255

Title: Reconnaissance Equipment
Budget Activity: Tactical Programs #4

4. FY 1982 Planned Program:

Project 1155 - Electro-Optical Collection/Reconnaissance: Development of an electro-optical sensor system for a and data collection on systems will be continued.

Project 2096 - Interim Tactical Elint Processor: Software improvements will continue in response to a changing threat and collection capability. Operational Demonstration and Evaluation of the software integration concepts will continue on the fielded system.

Project 2337 - Advanced Reconnaissance Sensor: Engineering development of the Advanced Reconnaissance Sensor will be continued and test planning will be initiated.

Project 2501 - Joint Service Electronic Warfare Support Measures: The Critical Design Review will be conducted for the airborne and ground processing elements of the system. Test planning and fabrication of test hardware will be initiated.

Project 2533 - Electronic Warfare/Close Air Support Joint Test: Test results will be documented while final reports and final briefings will be prepared and presented.

Project 2704 - Tactical Electronic Reconnaissance (TEREC) Sensor: Integration of the TEREC airborne and ground elements will be completed. Update of software to counter current threat emitters will be continued.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

Program Element: #64710F
DOD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255

Title: Reconnaissance Equipment
Budget Activity: Tactical Programs, #4

8. Comparison with FY 1980 Budget:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	12,450	6,700	20,400	20,400	Continuing	Not Applicable
1155	Electro-Optical Collection/ Reconnaissance	3,800	1,800	2,000	3,200	Continuing	Not Applicable
1156	Radiation Intelligence				700	Continuing	Not Applicable
1157	Forward Looking Infrared Sensor	300					8,176
2057	Quick Strike Reconnaissance	4,250		10,100	7,500	6,000	36,900
2096	Interim Tactical ELINT Processor	600	1,600	1,300	2,200	1,000	7,800
2337	Advanced Reconnaissance Sensor				800	13,600	14,500
2368	Tactical Reconnaissance Data Link	1,600		5,400	2,500	3,000	12,500
2501	Joint Service Electronic Warfare Support Measures (ESM)		100	300	1,600	13,200	15,900
2533	Electronic Warfare/Close Air Support Joint Test	1,600	3,000	1,000	1,500	500	8,600
2704	Tactical Electronic Reconnaissance Sensor (TEREC)	300	200	200	400	400	14,200
6403	AAQ-X Infrared Sensor					15,400	15,400

The Actual funds for FY 1979 were $1,250 thousand more than that submitted in the FY 1980 Descriptive Summary. Of these additional funds, $500 thousand was reprogrammed for Project 1156, Radiation Intelligence, and $750 thousand for Project 2659, Electronic Warfare Area Reprogramming Capability (ARC). ARC was initiated to provide a quick capability to change software/firmware in mission data to counter changes in electronic warfare threat parameters. The estimated funds for FY 1980 were reduced $17,830 thousand by Congressional action to cancel Quick Strike Reconnaissance (QSR) and Tactical Reconnaissance Data Link (TRDL). Language directed the Air Force to transfer $2,330 thousand remaining in FY 1978 forward into FY 1980. The FY 1981 estimate is $5,500 thousand less than that previously submitted due to deletion of QSR and TRDL, while other projects have been restructured to align with current estimates.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 64715F
DoD Mission Area: Land Combat Service Support # 216

Title: DoD Physical Security Equipment-Exterior (Eng Dev)
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	Total For Program Element	9,600	18,200	29, 800	23,100	53,000	156,200

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the development of the Department of Defense (Do Base and Installation Security System (BISS), a DoD standardized exterior physical security system, by accomplishing full-scale development tasks in four functional areas: detection, command and control, imaging, and entry control. A DoD need exists for a family of standardized modular equipment, integrable into system configurations to provide a level of security in consonance with the deployment mode, threat level and sensitivity of the asset being protected.

BASIS FOR FY 1981 RDT&E REQUEST: Funds are required to finalize the production specifications for those system components intended for Total BISS, to initiate engineering development of Total BISS components which completed advanced development during FY 1980, and to continue engineering development of Total BISS items which were initiated in prior years. Primary emphasis is being placed on detection (sensor) subsystems, imaging subsystems, and the entry control segment.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 64715F
DoD Mission Area: Land Combat Service Support #216

Title: DoD Physical Security Equipment-Exterior (Eng Dev)
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: This program responds to Secretary of Defense direction contained in Department of Defense (DoD) Directive 3224.3, 1 Dec 76, which designates the Air Force as executive agency for the development of DoD Standardized exterior physical security equipment and systems for the protection of bases and installations. This program will provide pre-production equipment and subsystems, and through test and evaluation, production specifications for the Base and Installation Security System (BISS) equipment for the four Services. The engineering development tasks consists of optimization of the overall system configuration through simulation modeling, conduct of component, subsystem, and system testing, and preparation of production specifications. Under the Initial BISS efforts, production specifications are being finalized for equipment which provides medium level security for small permanent locations and a partial system capability for selected resources deployed in a semi-permanent mode. The Total BISS objectives are to provide a capability for high level security, against all threat levels, for resources in the three deployment modes: permanent, semi-permanent, and mobile. The system will consist of four functional areas, each comprised of various modular components, capable of being integrated in various combinations and configurations to meet all DoD user requirements on a world-wide basis. Facilities and developments of other Services, government agencies, and commercial industries will be used to the maximum to insure that duplication of effort is avoided.

RELATED ACTIVITIES: Advanced development tasks including equipment prototypes, development of technology base, and development testing for the BISS program is accomplished under Program Element (P.E.) 63714F, DoD Physical Security Equipment-Exterior (Adv Dev). Development of the BISS equipment is designed for interoperability with the Army interior security system (Facility Intrusion Detection System -FIDS) and the Army tactical sensor system (Remotely Monitored Battlefield Senor System - REMBASS). Management oversight of DoD physical security programs is provided by the DoD Physical Security Equipment Action Group with the Chairperson residing in the Office of the Under Secretary of Defense for Research and Engineering.

WORK PERFORMED BY: This program is managed by the Physical Security System Directorate, HQ Electronic Systems Division, Hanscom AFB, MA. Department of Defense agencies performing development for the BISS program are: Rome Air Development Center, Griffiss AFB, NY; Army Mobility Equipment R&D Command and Army Night Vision Laboratory, Fort Belvoir, VA; Army Waterways Experimental Station, Vicksburg MS; Army Harry Diamond Laboratories, Adelphi, MD; Naval Avionics Center, Indianapolis, IN; Naval Ocean Systems Center, San Diego, CA; and the Naval Coastal Systems Center, Panama City, FL. In addition to the DoD agencies, the Department of Energy/SANDIA Laboratories, Albuquerque, NM performs engineering development tasks. In January 1979, a contract was awarded to Analytical Systems Engineering Corporation for the system engineering support and integration task.

Program Element # 64715F
DoD Mission Area: Land Combat Service Support #216

Title: DoD Physical Security Equipment-Exterior (Eng Dev)
Budget Activity: Tactical Programs #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: All of the items undergoing development for the Initial BISS capability have completed engineering development. This includes a buried line sensor, perimeter fence sensor, closed aircraft shelter sensor, above ground barrier sensor, wide area sensor, boundary alarm assessment segment, and sensor data transmission and display segment.

2. FY 1980 Program: The program provides for continued full-scale development of the following items: electromagnetic point sensor, individual resource protection sensor (mobile), sensor data radio frequency (R/F) link, video frame storage element, and magnetic/seismic line sensor (MILES) signal processor. Full-scale development has started for the following items which completed advanced development in FY 1979; ported coaxial cable line sensor, waterborne intrusion detection segment (WIDS), and open shelter aircraft sensor.

3. FY 1981 Planned Program: The planned FY 1981 program provides for continuation of full-scale development of Total Base and Installation Security System (BISS) components and subsystems. These include the individual resource protection sensor (mobile), ported coaxial cable line sensor, electromagnetic point sensor, open shelter aircraft sensor, the installation security radar, waterborne intrusion detection segment, wideband R/F video communication segment, and the coaxial cable multiplex video communication segment. Initiation of engineering development is planned for the entry control segment, pyroelectric vidicon camera, infrared charge coupled device (IRCCD) fence sensor, and the multi-channel Security Police radio.

4. FY 1982 Planned Program: The planned FY 1982 program provides for continuation of full-scale development of Total BISS to include sensor data radio frequency (R/F) link, WIDS, entry control segment, ported coaxial cable line sensor, installation security radar, IRCCD fence sensor, and pyroelectric vidicon. Initiation of engineering development is planned for the advanced fence sensor.

5. Program to Completion: This is a continuing program which will provide type C (production) specifications for a family of modular electronic equipment, capable of being integrated in various system configurations to meet Department of Defense (DoD) and service requirements for physical security. As requirements for exterior physical security are validated by DoD, development tasks will be assigned to the Air Force by the Under Secretary of Defense for Research and Engineering to satisfy the requirement.

6. MILESTONES: Not Applicable

7. RESOURCES: Not Applicable

Program Element: # 64715F
DoD Mission Area: Land Combat Service Support, # 216

Title: DoD Physical Security Equipment-Exterior (Eng Dev)
Budget Activity: Tactical Programs, # 4

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	8,875	12,600	18,200	29,000	Continuing	Not applicable

Reduction in FY 1979 due to delay in the award of the system engineering support and integration contract and cancelation of the development of the microwave fence sensor. Increase in FY 1981 due to addition of the multi-channel Security Police radio and inflation factors. This is the first year that estimates were made for total costs.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64724F
DOD Mission Area: #257, Electronic Warfare/Counter C^3

Title: Tactical C^3 Countermeasures
Budget Activity: #4, Tactical Programs

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,785	11,000	15,700	8,200	Continuing	Not Applicable
2462	Compass Call Development	2,785	11,000	15,700	8,200	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: To accomplish close air support, interdiction, and counter air missions the Tactical Air Forces (TAF) require an airborne Command, Control and Communication (C^3) countermeasure capability. TAF currently possess aircraft do have some equipment that operates in the communication frequencies and are available for wartime augmentation; however, the capabilities of these aircraft are very limited for the overall C^3 countermeasures task. We must improve the TAF capability to support and protect friendly forces while operating within the enemy air defense system. A key instrument to improve the TAF capability is the ability to

This program provides for the engineering development of new C^3 countermeasures equipment for tactical electromagnetic combat applications.

BASIS FOR FY 1981 RDT&E REQUEST: The Air Force completed a definition in FY 1979 for as partial fulfillment of the mission need. The definition proposes a time-phased solution. This program includes all the efforts that require engineering development. These efforts are to be added to a basic capability installed on the The FY 1981 request includes funds to continue the development of a high-band jammer system that

Engineering improvements are also necessary to keep the a viable system throughout the 1980s. The improvements addressed in the FY 1981 request include a more efficient processing of (to improve effectiveness in a high-density environment), an interface data link between the and our tactical commanders (to be more responsive to the progress of the battle), and a continuing effort to keep the software in the processors current (to keep up with new technology and changing threat files). The FY 81 request also includes the related development of training device to qualify the crews and keep them proficient.

OTHER APPROPRIATIONS FUNDS: Not Applicable

Project: 2462 Title: Compass Call Development
Program Element: #64724F Title: Tactical C^3 Countermeasures
DOD Mission Area: #257, Electronic Warfare/Counter C^3 Budget Activity: 4, Tactical Programs

DETAILED BACKGROUND AND DESCRIPTION: In FY 1978, the Air Force defined to be integrated into a Defense-wide command, control and communications (C^3) jamming capability. The airborne capability will complement both present and future ground and sea based systems to provide the theater commander with a coordinate jamming capability. The will initially use readily available equipment and will allow us to have a near-term C^3 countermeasures capability. Meanwhile, the portions of the C^3 countermeasures package that need development will proceed in this program element. This program provides engineering development of a tactical high-band jammer to counter or disrupt This program makes major improvements to the initial installed equipment to make it more powerful, faster, smarter, and able to handle more threats at one time. These updates are necessary to keep current throughout the 1980s. In subsequent years, this program will address C^3 countermeasures modules for tactical electronic countermeasures pods and C^3 countermeasures packages and antennas for expendable mini-drones. The outyear programs will further complicate enemy command and control combat operations and provide a more comprehensive capability to satisfy the mission need.

RELATED ACTIVITIES: The efforts in this program will round out the capability of the initial equipment installed in The initial proposal for a tactical C^3 countermeasures system occurred in Program Element 64739F, Tactical Protective Systems. The Air Force production manager (Air Force Logistics Command) and development manager (Air Force Systems Command) will operate with a joint agreement for interface and configuration control to ensure that new equipment developed as part of this program can be incorporated into operational use. This program also will support independent C^3 countermeasures systems for manned aircraft as well as efforts to develop a C^3 countermeasures capability for drone operations. This program will build upon technology demonstrated in PE 63718F, Electronic Warfare Technology. Technology that statisfies similar requirements for other systems may be drawn upon, such as those in PE 62204F, Aerospace Avionics; PE 62715A, Expendable Jammers; and PE 63214N, Tactical C^3 Countermeasures. This program provides engineering development for PE 27253F, Tactical C^3 Countermeasures and in the near future to PE 27246F, Expendable Drones.

WORK PERFORMED BY: Aeronautical Systems Division, Wright-Patterson AFB, OH - management of the program to develop new systems for the Air Force Avionics Laboratory, Wright-Patterson AFB, OH - technique development for C^3 countermeasures; and Air Force Logistics Command, Wright-Patterson AFB, OH - management of the modification program.

Project: 2462 — Title: Compass Call Development
Program Element: #64724F — Title: Tactical C^3 Countermeasures
DOD Mission Area: #257, Electronic Warfare/Counter C^3 — Budget Activity: #4, Tactical Programs

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In FY 1978 the Air Force proposed the time-phased modification of the to perform command, control, and communications countermeasures tasks. FY 1979 saw the completion of the definition phase with most of the effort concentrated on the antenna system. The Air Force perfomed a test and evaluation program to check how well an improved receiver-analyzer can handle the electromagnetic environment and started development of a high-band jammer to disrupt The Air Force deferred planned efforts to improve signal acquisition and analysis as well as updates to exciters and transmitters until the baseline modification program was funded.

2. FY 1980 Program: The Air Force will continue developing the high-band jammer that disrupts systems. New engineering contributions to the include improved time sharing techniques, improved signal acquisition and analysis, higher power transmitters, and power management algorithms. Efforts involved in these contributions include: improved antenna and radio frequency (RF) distribution networks that will allow low-band time sharing techniques, and development of an improved signal acquisition analysis identification system to provide an automatic recognition capability for selected priority signals. The Air Force will start development of trainer.

3. FY 1981 Planned Program: The Air Force plans to continue the high-band jammer development as well as the time sharing techniques, improved signal acquisition analysis, higher power transmitters, power management algorithms, and trainer. We plan to start a communication data link for the to be more responsive to the progress of the battle.

4. FY 1982 Planned Program: The Air Force plans to complete development of the trainer. We will continue developing the high-band jammer, the time-sharing techniques, the improved signal acquisition analysis, the higher power transmitters, and the power management algorithm. The Air Force plans to start the development of multiple intersystem tasker/interface to provide improved capability to command the jamming mission and coordinate jamming assignments among different jammers.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

Project: 2462
Program Element: #64724F
DOD Mission Area: #257, Electronic Warfare/Counter C^3

Title: Compass Call Development
Title: Tactical C^3 Countermeasures
Budget Activity: 4, Tactical Programs

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	0	4,000	11,000	20,100	Continuing	Not Applicable

FY 1979: FY 1979 was reduced by $ 1,215 thousand. This action delayed the development program so as to be compatible with the delayed start of the modification program.

FY 1980: No Change

FY 1981: The FY 1981 fundirg was reduced $4,400 thousand to fund higher priority programs. Project 2677, C^3 Countermeasures Development, has been deleted. It was to have initiated C^3 jammer investigations for the ALQ-131 electronic countermeasures pod. $2,400 thousand from Project 2462, Compass Call Development, was deleted to eliminate the on-board evaluation subsystem and reduce the hardware and software upgrade programs.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64725F
Title: Aircraft Identification Systems
DOD Mission Area: Tactical Command and Control, #254
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,300	8,300	11,000	9,900	Continuing	Not Applicable
2463*	Mark XII Identification Friend or Foe (IFF) Program	2,300	2,900	2,500	700	0	8,900
2597	Non-cooperative Identification Subsystems	0	5,400	7,500	7,200	Continuing	Not Applicable
2598	North Atlantic Treaty Organization (NATO) Identification System	0	0	1,000	2,000	Continuing	Not Applicable

* In FY 1979, Project 2463 was contained in Program Element 35114F, TRACALS.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this program element is to accomplish engineering development of systems that will provide reliable long-range identification of aircraft in both all-weather and hostile electromagnetic countermeasures environments. This program is necessary because the numerical superiority of the projected threat demands that we be capable of engaging the enemy at long ranges with our advanced missile systems. The long range identification which is a prerequisite for such engagements

BASIS FOR FY 1981 RDT&E REQUEST: In 1981 this program element will provide funds for engineering development of two categories of identification systems: cooperative and non-cooperative. FY 1981 will mark the beginning of engineering development of a NATO-interoperable cooperative identification subsystem that will have major operational payoff in the post-1990 era. The work on cooperative identification subsystems for near term application will be a continuation of the ongoing effort to develop and test product improvements for the Mark XII IFF System. The effort on non-cooperative subsystems will support the continued development of an identification technique that is based on an analysis of

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #64725F
DOD Mission Area: Tactical Command and Control, #254

Title: Aircraft Identification System
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND DESCRIPTION: Today's advanced air-to-air missiles are lethal at extremely long ranges under varying weather conditions. Operations involving the use of these high-performance missiles must be supported with positive target identification to enable economy of force and also to prevent fratricide. In view of the intensity of the air battle that is postulated for any future conflict in Central Europe, today's identification systems will In March 1978, North Atlantic Treaty Organization (NATO) Long Term Defense Program Task Force Five on Air Defense

the required identification capability can only be provided through the effective use of a combination of identification subsystems. The engineering development of these subsystems as well as a system to integrate their outputs will be accomplished in this program element. All work will be done in cooperation with related efforts of the Army, Navy and NATO. This program element's workload falls into three areas. The Mark XII Identification Friend or Foe (IFF) Improvement Program is developing design modifications for Mark XII IFF equipment to Tasks under the Non-cooperative Identification Subsystems Project will provide an autonomous identification capability for the F-15 and F-16. Although initial emphasis is placed on the engineering development of non-cooperative identification techniques, this project is also developing a means for integrating identification data from multiple sources to provide a high confidence composite identification assessment. The NATO Identification System (NIS) Project will support the long-range multinational development of a NATO common identification system. The NIS Project will begin in Fiscal Year 1981 with engineering development support for the secure and jam-resistant question and answer identification subsystem.

RELATED ACTIVITIES: The work in this program element is accomplished in coordination with the activities of: Program Element (PE) 63742F, Tactical Identification Systems; PE 64201F, Aircraft Avionics Equipment Development; PE 35114F, Traffic Control and Landing Systems (TRACALS); PE 64709A, Identification, Friend or Foe; and PE 64211N, AIMS, ATCRBS, MARK XII. This coordination is achieved under the U.S. IFF Development Program for which the Air Force is lead Service.

WORK PERFORMED BY: The Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, OH is responsible for the management of projects under this program element. The Aeronautical Systems Division receives support from the Air Force Avionics Laboratory, Wright-Patterson AFB, OH and the Electromagnetic Compatibility Analysis Center, Annapolis, MD. The following contractors are engaged in work under the Mark XII IFF Improvement Program: Bendix Communications Division, Towson, MD; Teledyne Electronics, Newbury Park, CA; Quest Research Corp, McLean, VA; and Hazeltine Corporation, Greenlawn NY.

Program Element: #64725F
DOD Mission Area: Tactical Command and Control #254

Title: Aircraft Identification System
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAM:

1. FY 1979 and Prior Accomplishments: Under the Mark XII Identification Friend or Foe (IFF) Improvement Program a detailed vulnerability assessment of existing Mark XII equipment was completed. Contracts were awarded for the development of a solid-state transmitter for the IFF transponder. The system analysis task associated with the Mark XII IFF Improvement Program was also initiated.

2. FY 1980 Planned Program: A contract will be awarded for the development of improvements to the Mark XII IFF transponder, interrogator and reply evaluator. The critical design review of these improvements will also be completed. Work will begin on computer algorithms which will be required to perform non-cooperative target recognition with the Methods for integrating identification data will be studied.

3. FY 1981 Planned Program: Work on the non-cooperative identification subsystem which uses will progress through the preliminary design review phase for the F-15 and F-16. The engineering development of an identification-data integration subsystem for application on F-15 and F-16 will be initited. All hardware to be built under the Mark XII IFF Improvement Program will be delivered and testing will begin. Contracts will be awarded for system integration studies on the NATO-common question and answer system.

4. FY 1982 Planned Program: In FY 1982 the Mark XII IFF Improvement Program will be completed and the recommendation for improvements to be incorporated will be issued. Development of the non-cooperative identification subsystem for the F-15 will progress through critical design review. The engineering development of the question and answer (Q&A) component of the NATO Identification System (NIS) will continue.

5. Program to Completion: In FY 1983 the non-cooperative identification subsystem and the identification-data integration subsystem will enter evaluation on the F-15. The specification for the Q&A component of NIS will also be completed in FY 1983. Subsequently, equipment that satisfies this specification will be developed under this program element. A subsystem that identifies aircraft will be developed when the technology transfers from Program Element 63/42F.

6. Milestones: Not applicable.

7. Resources: Not applicable .

8. Comparison with FY 1980 Budget Data: Not applicable. No change.

Project: #2597 Title: Non-Cooperative Identification Subsystems
Program Element: #64725F Title: Aircraft Identification Systems
DOD Mission Area: Tactical Command and Control, #254 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: As was demonstrated in the joint Air Force/Navy Air Intercept Missile Evaluation exercises, the status of our tactical air-to-air identification capability

With the emergence of the all-aspect missile environment,

the Air Force (lead service) in cooperation with the Army and Navy is developing several complementary cooperative and non-cooperative identification techniques. This project will accomplish engineering development of the most promising methods for non-cooperative air-to-air target identification. Certain Non-cooperative techniques have the potential for near term operational payoff because equipment and/or computer reprogramming need only be accomplished on the fighter aircraft. The initial goal of this project is to provide a capability that can be applied to the F-15 and F-16 prior to It is estimated that a modest autonomous identification capability can be provided in that time frame by drawing on non-cooperative technology that is currently in advanced development. A successful deployment of this autonomous identification capability coupled with continued use of the Mark XII IFF System could mitigate the and facilitate the transition to the NATO Identification System, which is supported by Project 2598 of this Program Element.

RELATED ACTIVITIES: The Non-cooperative Identification Subsystems Project will provide engineering development for the advanced development products from Program Element (PE) 63742F/1177, Non-cooperative Identification Techniques. All engineering development under the Non-cooperative Identification Subsystems Project is carefully reviewed to ensure that it does not duplicate related efforts under Army PE 64709A, Identification Friend or Foe, and Navy PE 64211N, AIMS, ATCRBS, MARK XII. These programs and other secondary identification equipment development efforts of the Army, Navy and Air Force are coordinated under the U.S. IFF Development Program to ensure that the composite Department of Defense effort is efficient and effective.

WORK PERFORMED BY: This is an FY 1980 new start. The Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, OH will manage this project. This projet receives support from the Air Force Avionics Laboratory, Wright-Patterson AFB, OH. Contractors will be selected in FY 1980.

Project: #2597
Program Element: #64725F
DOD Mission Area: Tactical Command and Control #254

Title: Non-Cooperative Identification Subsystems
Title: Aircraft Identification Systems
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAM:

1. FY 1979 and Prior Accomplishments: Because the project is an FY 1980 start, the FY 1979 effort was limited to the forming of a program office cadre, preparation of agreements with related program offices, drafting of program plans and the preparation of procurement packages.

2. FY 1980 Planned Program: This project begins in FY 1980 with emphasis on the engineering development of the Dual Mode Recognition (DMR) technique. The DMR technique will provide the F-15 and F-16 with an inexpensive means of accomplishing air-to-air identification. The development of the DMR technique will center on the development and test of computer algorithms that facilitate an analysis of In FY 1980 this work is planned to progress to the point where flight testing of the DMR technique with the F-15 can begin. Methods for the automatic integration of two or more sources of identification data will be studied.

3. FY 1981 Planned Program: The development of the DMR technique will progress through the preliminary design review phase for the F-15 and it will receive initial flight testing on the F-15. A method for automatically integrating the output of several sources of identification data, such as MARK XII Identification Friend or Foe (IFF), DMR, and Electronic Support Measures, will be developed and tested by simulation. The planned product of this effort will permit the pilot of a fighter to be provided with a high confidence target classification (friend, enemy and/or aircraft type) with minimal increase in workload. In FY 1981, the data integration process as applied to the F-15, should progress through preliminary design review.

4. FY 1982 Planned Effort: The Application of the DMR technique and the identification-data integration process will complete critical design review on the F-15 and preliminary design review on the F-16. The refinement of the data integration process through simulation should be completed and optimum cockpit instrumentation for the F-15 and F-16 should be defined. Flight testing of the DMR technique on the F-15 will continue.

5. Program to Completion: The DMR identification technique and data integration process will transition into operational use. Non-cooperative target recognition airframe identification techniquess such as the Navy/Air Force techniques will enter engineering development. Identification methods based on analysis of the will be developed. This will be a continuing project.

Project: #2597
Program Element: #64725F
DOD Mission Area: Tactical Command and Control

Title: Non-Cooperative Identification Subsystems
Title: Aircraft Identification Systems
Budget Activity: Tactical Programs, #4

6. Milestones: Not Applicable

7. Resources: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
2597	Non-cooperative Identification Subsystems	0	5,400	7,500	7,200	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: No change. Not applicable.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 64733F
DOD Mission Area: Defense Suppression, #224

Title Surface Defense Suppression
Budget Activity Tactical Programs, #4

RESOURCES (PROJECT LISTINC): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	49,100		37,200	38,600	24,200	273,800
2147	Imaging Infrared Seeker Integration	21,800		20,300	12,600	2,100	56,800
2195	Modular Guided Weapon System	24,700		3,300	3,900	7,200	143,900
2225	Weapon System Integration	2,600		1,000	1,500	1,500	26,500
2226	JSOR Data Link			12,600	20,600	13,400	46,600

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops the GBU-15 Modular Guided Weapon System. This weapon is a 2000 lb class guided glide bomb designed to destroy high value fixed targets (interdiction), enemy surface-to-air defenses (defense suppression), and ship targets (sea lane defense). The program improves our capability to attack from extremely low altitude or standoff ranges to avoid enemy defenses. A growth capability to provide night and adverse weather operations is being pursued in a modular fashion and integrated into a system to provide aerodynamic, warhead, and guidance options for the GBU-15.

BASIS FOR FY 1981 RDT&E REQUEST: This request will continue development of the GBU-15, including imaging infrared integration, flight testing, aircraft integration tasks, and support equipment update.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Other Procurement (3080)			20,276	49,242	TBD	TBD
(Quantity)			(60)	(250)	(TBD)	(TBD)
Aircraft Procurement (3010)	3,000		11,151	15,872	14,198	47.921

Program Element: # 64733F
DOD Mission Area: Defense Suppression, #224

Title Surface Defense Suppression
Budget Activity Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: This program was initiated to establish a continuing effort to match improving enemy air defense systems with air-to-surface weapon developments. This full scale development program develops the GBU-15 Modular Guided Weapon System and provides improvements in modular form. One aerodynamic configuration, the Cruciform Wing Weapon, provides launch aircraft survivability when launched from very low altitudes. A second configuration, the Planar Wing Weapon, provides for a long range standoff capability when launched from high altitude. In addition to a television seeker, a data link is employed which allows for commanding the weapon after launch as the weapon is enroute to the target. Distance Measuring Equipment (DME) is integrated into this system as an option which can be used in adverse weather conditions to provide both enroute and terminal guidance. An imaging infrared seeker option will be employed to provide a 24 hour attack capability. Cruciform and Planar wing configurations can use either a 2000 pound unitary warhead for targets such as railway bridges or a 2000 pound cluster warhead for such targets as surface-to-air missile sites. This development is step-wise, progressing from a television guided weapon to a weapon which can use imaging infrared or Distance Measurement Equipment. The imaging infrared seeker will be tested in the GBU-15 after television with data link (TV/DL) options have completed development.

RELATED ACTIVITIES: Related and supporting efforts are pursued in program element (PE) 64742F, Precison Location Strike System (PLSS); PE 64608F, Close Air Support Weapon System; and PE 63727F, Advanced Communication Technology. PE 64742F develops Distance Measuring Equipment for adverse weather guidance; PE 64608F develops an imaging infrared seeker to be used on MAVERICK, WALLEYE, and GBU-15 weapons. PE 64742F (Proj 2589) Joint Service Weapon Data Link (JSWDL) develops an Anti-Jam data link to be used on the GBU-15; PE 63727F conducts advance development efforts for follow-on improvements to JSWDL modules.

WORK PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command (AFSC), Andrews AFB, MD, and Armament Division (AD), Eglin AFB, FL. Major contractors are Rockwell International, Columbus, OH; Fairchild Camera Inst, Long Island, NY; Motorola, Inc, Scottsdale, AZ; and Hughes Aircraft Co, Culver City/Canoga Park, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Both the Planar and Cruciform Wing Weapons incorporate prior year development efforts which began in FY 1974. These included design and wind tunnel work, design of a data link, and development of a cluster warhead known as the Cluster Bomb Unit (CBU-75). Development and flight testing of the basic Cruciform Wing Weapon was to be completed in FY 1976; however, due to the operational command's preference for a weapon with data link, the flight test program was expanded to include data link testing which was completed in early FY 1978. Also, Distance Measuring Equipment (DME) equipped Cruciform and Planar Wing Weapons were flight tested. In project 2195, Modular Guided Weapon System, testing of the Cruciform Wing Weapon has been extended to satisfy Congressional concerns which arose during the FY 1979 Appropriations hearings. Flight testing of the Planar Wing Weapon with television and data link was conducted with the B-52 D. FY 1979 was the initial year for Project 2147, Imaging Infrared Integration, which integrates the imaging infrared guidance seeker developed in the MAVERICK program into the GBU-15.

Initial work identified system specifications and the development of the interface hardware. In Project 2225, Weapon System Integration, the total system integration responsibility contractual arrangements are pursued with the contractors, Hughes and Rockwell. This assures that new modules being integrated into the GBU-15 (Data Link, Imaging Infrared (IIR) Seeker) meet the interface requirements of the baseline GBU-15.

2. FY 1980 Planned Program: This program is zero funded in FY 1980; however, the continuation of the GBU-15 program through FY 1980 will be accomplished using FY 1979 funds. Project 2147, Imaging Infrared Integration, will be continued. IIR seekers for flight testing will be procured and captive flight testing will be continued. Project 2195, Modular Glide Weapon System, flight testing of the Planar Wing Weapon with television and data link on the B-52 will be deferred due to fiscal constraints. Project 2225, Weapon Systems Integration, Total Systems Integration Responsibility (TSIR) contractual efforts will be pursued with Rockwell and Hughes.

3. FY 1981 Planned Program: Project 2147, Imaging Infrared (IIR) Integration, Development of GBU-15 IIR guidance module will be completed. The free flight test program will be initiated to demonstrate the utility of the GBU-15 /IIR weapon. Project 2195, Modular Guided Weapon System, Support Equipment will be updated to provide for IIR guidance module integration. Project 2225, Weapon System Integration, Total Systems Integration Responsiblity (TSIR) contracts will be pursued with both Rockwell and Hughes. Project 2226, Joint Service Operational Requirement (JSOR) Data Link, development efforts for a jam resistant data link under program element (PE) 64608F and PE 63727F will be integrated into the GBU-15.

4. FY 1982 Planned Program: Project 2147, IIR Integration, flight testing will be continued. Project 2195, Modular Guided Weapon System, - support equipment update will be continued. Project 2225, Weapon System Integration - TSIR efforts will continue. Project 2226, JSOR Data Link - Development and integration of the jam resistant data link will continue.

5. Program to Completion: FY 1984 will be the final year for this program element. Project 2147, Imaging Infrared Integration - Free flight testing will be completed in FY 1983 and a production decision will be made in FY 1983 to procure IIR guided GBU-15 weapons. This will give our tactical forces a 24 hour strike capability. Project 2195, Modular Glide Weapon System - Support equipment update will be completed. Project 2225, Weapon Systems Integration This project will complete in FY 1984 with completion of all planned aircraft integration and TSIR efforts. Related programs which require integration with the GBU-15 will be pursued in the designated program elements. Project 2226, JSOR Data Link Testing will be completed. Production decision in FY 1983 will lead to first production hardware in FY 1984.

6. Milestones: Not Applicable

7. Resources: Not Applicable

Program Element: # 64733F
DOD Mission Area: Defense Suppression, #224

Title Surface Defense Suppression
Budget Activity Tactical Programs, #4

8. Comparison with FY 1980 Budget Data:

This program was zero funded in FY 1980 due to fiscal constraints. The current program reflects the impact of no FY 1980 funds as well as eliminating the F-111A/E integration, reduced TSIR funding, and eliminating advanced guidance options such as Radiometric Area Correlation (RAC).

Project: #2147 Title: Imaging Infrared Seeker Integration
Program Element: #64733 Title: Surface Defense Suppression
DOD Mission Area: Defense Suppression, #224 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The imaging infrared (IIR) seeker is a significant development which enhances the capability to conduct effective attack against surface targets during day,night, and hazy conditions. The feasibility of this seeker has been established in demonstrations conducted in program element (PE) PE 63601F, Conventional Weapons. Development efforts are underway to integrate this seeker into the MAVERICK missile in PE 64608F to provide a capability against mobile targets. This project integrates the IIR seeker developed in the MAVERICK program into the modular glide weapon system developed in project 2195. This provides a 24 hour capability against interdiction, defense suppression and ship targets.

RELATED ACTIVITIES: Related and supporting efforts are pursued in PE 64608F, Close Air Support Weapon System (MAVERICK); and in Project 2195, Modular Glide Weapon System, which is in this PE. The engineering development of the basic IIR sensor is performed in PE 64608F. The Modular Glide Weapon System project develops the base line weapon for this seeker integration.

WORK PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command, Andrews AFB, MD and its subordinate organization, Armament Division, Eglin AFB, FL. Rockwell International Corporation, Columbus, OH is the contractor for the Cruciform Wing Weapon (CWW) . The contractor for the development of the imaging infrared seeker is Hughes Aircraft Co., Culver City, Ca.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: This project, initiated in FY 1979, integrates the imaging infrared (IIR) guidance seeker developed in the MAVERICK program into the GBU-15. Work was initiated with the captive flight testing of an advanced development IIR seeker for evaluation. System specifications and insight into operational requirements were provided. A full scale development contract was signed with Hughes Aircraft Corp. This pursues design and development of the GBU-15 IIR module and associated interface electronics. A contract will be let to procure flight test hardware for free flight testing to begin in FY 1981.

2. FY 1980 PLANNED PROGRAM: This program is zero funded in FY 1980; however, the continuation of this effort through FY 1980 will be accomplished using FY 1979 funds. Pursuit of the efforts initiated in FY 1979 will be continued during this period including the development of the IIR guidance module and interface electronics as well as seekers for flight testing. Captive flight testing with the early advanced development seeker will also be completed.

3. FY 1981 PLANNED PROGRAM: During this period, flight testing of the prototype IIR modules with the CWW will be initiated. Approximately 20 launches are anticipated during the flight test program. Development of guidance modules and interface electronics will be completed. Procurement of flight test hardware for the PWW flight testing will also be initiated.

Project # 2147 Title: Imaging Infrared Seeker Integration
Program Element: #64733 Title: Surface Defense Suppression
DOD Mission Area: Air Defense Suppression, #423 Budget Activity: Tactical Program, #4

4. FY 1982 PLANNED PROGRAM: During this period the captive and free flight testing of the Cruciform Wing Weapon with Imaging Infrared guidance will be completed and a production decision made. Imaging infrared guidance integration efforts on the Planar Wing Weapon (PWW) will be continued.

5. PROGRAM TO COMPLETION: Flight testing of the PWW will be completed in FY 1983 to be followed by a production decision. This will conclude this project.

6. MILESTONES: Not Applicable

7. RESOURCES: ($ IN THOUSANDS)

	FY 79	FY 80	FY 81	FY 82	Additional to Completion	Total Estimated Cost
RDT&E	21,800		20,300	12,600	2,100	56,800

8. COMPARISON WITH FY 1980 BUDGET DATA:

This program was zero funded in FY80 due to fiscal constrants. The current program reflects the impact of no FY 1980 funds.

Project: #2226
Program Element: #64733F
DoD Mission Area: Defense Suppression, #224

Title: JSOR Data Link
Title: Surface Defense Suppression
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Because the Soviet/Warsaw Pact forces continue to emphasize jamming in tactical ground operations, any data link deployed as part of a tactical weapon system must be capable of successful operation in a tactical jamming environment. In 1985, this environment will be particularly severe for strike systems which must operate in close proximity to jammers deployed on targets beyond the Forward Edge of the Battle Area (FEBA). In recognition of this fact, the Tactical Air Forces stated the requirement for anti-jam guidance of the GBU-15 using Distance Measuring Equipment (DME), television (TV), and imaging infrared (IIR) techniques. Present GBU-15 guidance capability consist of a video/command data link currently used in conjunction with a TV seeker. This data link has insufficient jam resistance to survive in the 1985 tactical jamming environment. In 3Q FY 77, DoD directed Joint Service participation in the development and integration of a tri-Service anti-jam data link for Remotely Piloted Vehicle (RPV), WALLEYE and the GBU-15. The developments to be utilized are the Air Force Precision Location Strike System (PLSS) and the Army Modular Integrated Communication Navigation System (MICNS). In PLSS full scale development (FSD), the Air Force combines the GBU-15 DME and imagery link requirements to define a modular data link architecture which accomodates all the desired weapon guidance options. Within this architecture, PLSS also provides command link, DME response link, and radio frequency (RF) modules. Video link modules will be provided by the MICNS FSD, which combines the Standoff Target Acquisition System (SOTAS) and mini-RPV data link requirements into a single command/video link. The resultant Joint Service Weapon Data Link (JSWDL) program is conducted in program element (PE) 64742F, Project 2589. This project integrates the JSWDL and the GBU-15.

RELATED ACTIVITIES: Related and supporting efforts are pursued in PE 64742F, Project 2589, Joint Service Weapon Data Link (JSWDL) which has responsibility to integrate the video and command data links into a single JSWDL module for use on GBU-15 and on RPVs; PE 63727F, Advanced Communications Technology, conducts advanced development efforts for follow-on improvements to JSWDL modules; Project 2195 of this program element develops basic planar and cruciform wing versions of the GBU-15 which will use the JSWDL.

WORK PERFORMED BY: JSWDL is managed by the Air Force Systems Command (AFSC), Aeronautical Systems Division (ASD), Wright-Patterson AFB, OH. The JSWDL integrating contractor is the PLSS prime contractor, Lockheed Missiles and Space Company, Sunnyvale, CA. The contractor for the command link, DME link, and radio frequency modules in the PLSS DME subcontractor, Harris Corporation, Melbourne, FL. The video modules will be developed under the MICNS FSD program, managed by the Army Electronics Research and Development Command, Combat Surveillance and Target Acquisition laboratory, FT Monmouth, NJ. Air Force advanced development efforts for follow-on JSWDL modular improvements are managed by AFSC, Air Force Avionics Laboratory (AFAL), Wright-Patterson AFB, OH. AFAL contractors are General Electric Company, Utica, NY; RCA, Camden, NJ; and Motorola Corporation, Scottsdale, AZ. Support for JSWDL/GBU-15 integration and test will be provided by the GBU-15 prime contractors, Rockwell International Corporation, Columbus, OH for the Cruciform Wing Weapon (CWW) and Hughes Aircraft Company, Canoga Park, CA, for the Planar Wing Weapon (PWW). MIT Lincoln Laboratory, Lexington, MA, performs studies and analyses and provides consultative services in suppport of JSWDL. GBU-15 development is managed by AFSC, Armament Division, Eglin AFB, FL.

Project: #2226
Program Element: #64733F
DoD Mission Area: Defense Suppression, #224

Title: JSOR Data Link
Title: Surface Defense Suppression
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In July 1977, the Precision Location Strike System (PLSS) Defense Systems Acquisition Review Council (DSARC) Milestone II directed the Air Force to incorporate Joint Service Weapon Data Link (JSWDL) into the PLSS full scale development (FSD) FSD Program. A JSWDL systems analysis was initiated under the PLSS contract in September 1977 and completed in December 1977. A JSWDL development plan was submitted to the Air Staff in February 1978 and approved by the Air Staff and the Secretary of Defense in April 1978. In April 1978, a JSWDL specification and Statement of Work were written and put on contract by means of a change order for initial JSWDL design definition efforts leading to the submission of an Engineering Change Proposal (ECP) for the total JSWDL program. In September 1978, the ECP was received by the Air Force. During 2-4Q FY 78, the Air Force incorporated JSWDL requirements into the Modular Integrated Communication and Navigation System (MICNS) Request For Proposal, which was released to industry in August 1978.

2. FY 1980 Program: A supplemental agreement to the PLSS contract will be negotiated, incorporating the JSWDL ECP and continuing the design effort initiated by change order during this period. The PLSS contractor will begin work on an aircraft data link pod for the reception of jam-resistant imagery transmissions from the GBU-15.

3. FY 1981 Planned Program: A Preliminary Design Review for the pod and GBU-15 JSWDL terminals will be held in July 1981. GBU-15 weapon system operator evaluation of jam-resistant TV image quality will be conducted under an Army simulation contract with Hughes Aircraft Company. JSWDL antenna testing on a mockup of the GBU-15 will be conducted by Lockheed Missile and Space Corp. at Rome Air Development Center. Government furnished equipment will be purchased. Fabrication of JSWDL components will be initiated.

4. FY 1982 Planned Program: A Critical Design Review of the pod and GBU-15 JSWDL terminals will be held in February 1982. Fabrication of JSWDL components will be completed, and the video modules from the Army MICNS will be integrated with the command link, Distance Measuring Equipment (DME), and radio frequency modules. Qualification testing of the entire data link will begin.

5. Planned Program to Completion: JSWDL qualification testing will be completed. JSWDL/GBU-15 integration and flight utilizing the Cruciform Wing Weapon (CWW) will be conducted. Production planning will be completed and a production decision for the use of JSWDL on the GBU-15 CWW will be obtained. Operational testing and correction of deficiencies will be completed. Production initiated in FY 83 will lead to availability of first production hardware in CY 1985.

6. Milestones: Not Applicable

Project: #2226 Title: JSOR Data Link
Program Element: #64733F Title: Surface Defense Suppression
DoD Mission Area: Defense Suppression, #224 Budget Activity: Tactical Programs, #4

7. Resources: ($ in thousands)

	FY 79 Actual	FY 80	FY 81	FY 82	Additional to Completion	Total Estimated Cost
RDT&E			12,600	20,600	13,400	46,600

8. Comparison with FY 1980 Budget Data: This program was zero funded in FY 1980 due to fiscal constraints. FY 1980 would have been the initial year for this project; therefore, the current program reflects the impact of no FY 1980 funds.

Budget Activity: Tactical Program, #4

Program Element: 64733F, Surface Defense Suppression

Test and evaluation Data

1. Development Test and Evaluation: The GBU-15(V)/B Modular Guided Weapon System is a family of guidance control, and airframe modules which, when combined with either the MK-84 General Purpose Bomb or the CBU-75A/B Cluster Warhead, can be configured as different weapons tailored for various attack and target conditions. The two airframes are the Cruciform Wing Weapon (CWW) and the Planar Wing Weapon (PWW). The former is designed for low level standoff delivery; the latter permits a high altitude, long range standoff capability. Aircraft peculiar equipment for data link capability includes the data link pod, control panel, and support equipment.

a. Cruciform Wing Weapon. Development contractor is Rockwell International Corp., Columbus, OH. Program management is provided by Headquarters, Air Force Systems Command, Andrews AFB, Md, and its subordinate organization, Armament Division, Eglin AFB, Fl. The CWW testing consisted of a development test and evaluation (DT&E) effort, conducted by AFSC, and a combined development test and evaluation/ initial operational test and evaluation (DT&E/ IOT&E), conducted by Tactical Air Warfare Center (TAWC), Eglin AFB, Fl. A total of 44 GBU-15 CWWs have comprised the DT&E portion of the test program. Mass simulation vehicles were used to verify aircraft handling and safe jettison characteristics (six MK-84 and three CBU-75A/B on F-4 and eight MK-84 on F-111). Six weapons were preprogrammed MK-84 vehicles launched from an F-4 to verify weapon response to initial autopilot design. Seven were equipped with distance measuring equipment (DME) (two MK-84 and five CBU-75A/B). Six MK-84 weapons were launched from an F-4 using television (TV) guidance in the lock-on-before-launch profile. Eight weapons were equipped with TV/data link (DL) guidance and MK-84 warhead; three launched from an F-4, two from a B-52, and three from an F-111. All flight tests were conducted at Eglin AFB, Fl. with the exception of the DME tests which were conducted at White Sands Missile Range, NM. and the F-111 integration tests conducted at China Lake, CA. Fuzing systems used were the FMU-124A/B for the MK-84 and the FMU-123/B for the CBU-75 warhead. Results of the FMU-124 reliability testing was .968 at the 90% confidence level (requirement is .95/90%). An extensive series of captive flight tests was also conducted at Eglin AFB,FL. to evaluate airborne data link pod coverage and evaluate ECM/EMI capability of both the CWW and the AN/AXQ-14 data link pod. Ground tests included radar cross section testing and Rome Air Development Center testing to determine the antenna pattern coverage of the AN/AXQ-14 data link pod on the F-4, F-111, and B-52. Major changes for IOT&E weapons included improvements in the autopilot for low level launch capability. Required modifications as a result of the DT&E program were incorporated into the IOT&E test hardware. With the exception of producibility changes, the IOT&E hardware represents the form, fit, and function of the hardware to be procured. The CWW with TV guidance has successfully met out-of-the-box reliability requirements (95%) with the exception of the guidance module (92%), demonstrated a 22.7 hr mean time before failure (MTBF) for the reliability assurance tests (17.4 hr requirement), and demonstrated an MTBF of 18.8 hrs during IOT&E testing. The CWW with TV guidance satisfactorily passed the environmental qualification tests as required by Military Standard 810B.

b. Planar Wing Weapon. Development contractor is Hughes Aircraft Company, Missile Systems Group, Canoga Park, CA. Program management is provided by Headquarters, Air Force Systems Command (AFSC), Andrews AFB, MD., and its subordinate organization, Armament Division, Eglin AFB, FL. The PWW testing consisted of a development test and evaluation (DT&E) effort, conducted by AFSC, and a combined development test and evaluation / initial operational test and evaluation (DT&E / IOT&E) effort conducted by the Air Force Test and Evaluation Center, Kirtland AFB, NM. A total of 14 PWW weapons comprise the DT&E program. During FY 1975 through 1977, three mass simulation MK-84 vehicles and seven preprogrammed MK-84 weapons were dropped at the Eglin AFB range. All but one MSV was from F-4 aircraft; the other was from a B-52. In July 1977 a PWW program with functional guidance systems was initiated. Ten MK-84/ television (TV) with data link (DL) versions were allocated to the B-52 compatibility program for a combined DT&E/IOT&E test program. During FY 1978-79 two PWW/CBU-75 with distance measuring equipment (DME) guidance were successfully launched from F-4 aircraft using the Advanced Location Strike System to demonstrate feasibility of the PWW/DME hardware compatibility and DME guidance algorithms. Also during this period two PWW/TV/DL/MK-84 with LORAN midcourse guidance were successfully launched from F-4 aircraft to demonstrate the feasibility of LORAN midcourse guidance for GBU-15. The PWW remains in development. Environmental qualification and reliability tests are incomplete at this time.

2. Operational Test and Evaluation:

a. Cruciform Wing Weapon (CWW). The GBU-15/CWW testing was a combined development test and evaluation/ initial operational test and evaluation (DT&E/IOT&E) conducted by Tactical Air Warfare Center (TAWC). As the IOT&E test monitor, AFTEC approved the IOT&E test plan and, based on observation of key tests and analysis of test data, supported the recommendation for production of the CWW/TV/DL.

(1) As members of the combined test, TAWC aircrews participated in 19 of 21 fully operational TV and TV/DL weapon launches. Design baseline and IOT&E hardware reliability accounting occurred on the last ten launches which were TV/DL weapons. Weapon maintenance and testing was conducted by a combined group consisting of TAWC maintenanc evaluation team (MET) and contractor personnel. Operational effectiveness was evaluated by determination of launch envelope capabilities, terminal accuracy, data link control and tactics, electronic countermeasures (ECM) weather limitations, and aircraft/weapon survivability. In addition, aircrew personnel training requirements were determined and aircraft cockpit modifications were evaluated. Operational suitability was evaluated through investi gatio and determination of hardware reliability, technical documentation, support equipment, and maintenance personnel training requirements. The test was completed in December 1977.

(2) The test demonstrated the capability of the CWW to launch at very low altitudes (200 ft) without the target in sight. The launch crew, using data link, acquired the target during egress and controlled the CWW to

impact. This low-altitude blind launch capability is unique and will enhance launch aircraft survivability in operations conducted against heavily defended high value targets. The mean time between failures (MTBF) and mean time between maintenance actions (MTBMA) for The IOT&E was 18.8 hours. Mean time to repair (MTTR) was 31 minutes with a high of 102 minutes and a low of two minutes. Sample size was 17. The GBU-15 average sortie duration on an F-4 aircraft was 1.4 hours. The reliability, using the average sortie duration, was calculated to be 92.8 percent. Mission completion success probability was 90.5 percent. The "out of box reliability" was 50 percent (5 out of 10). This low reliability was attributed to high time on the weapons, poor quality control on hand built prototype weapons, and use of some commercial parts. The testing identified major deficiencies in the autopilot, data link antenna indicator, support equipment, and a deficiency in the level of detail of technical orders.

(3) Autopilot design changes were made prior to the design baseline and were fully tested on IOT&E launches. A retest, with satisfactory results, of the support equipment was accomplished by the TAWC MET at the contractor facility. An engineering change to indicate antenna position has been incorporated into the control pods and is being evaluated in the Navy data link test and Planar Wing Weapon (PWW) testing with favorable results to date. All other improvements will be tested during a 25 weapon FOT&E to be conducted on production weapons. TAWC and AFTEC expressed concern about the number of failures encountered during weapon system checkout (50 percent). The program office has incorporated a production package of MIL STD parts, increased quality control, production with automatic card insertion, and a stringent "burn-in" program to improve reliability. FOT&E will validate these improvements.

(5) In September 78, the CWW/TV/DL with the MK-84 warhead was aproved for production (DSARC III). However, production was delayed by the Congress until additional testing was accomplished on the CWW. This additional testing was to emphasize an evaluation of the Naval Aionics Center (NAC) weapon data link (WDL), low altitude blind launch, lock-on after launch, and ECM vulnerability. The overall CWW IOT&E program became a four phase effort. Phases I and II were DT&E/IOT&E efforts conducted before DSARC III in September 1978. Phase III was to consist of three weapon launches, primarily directed toward evaluation of the NAC WDL and low altitude blind launch. Phase IV was to consist of five weapon launches to evaluate lock-on after launch and ECM. The Phase IV weapons will be production like hardware, incorporating ASC seekers and NAC data links with production antenna. Phase III IOT&E was completed in June 1979. Phase IV began on 9 Octoter 1979 and is expected to continue through April 1980. Two launches have been completed in Phase IV testing.

(6) During Phase III, operational realism was stressed and practiced to the maximum extent possible during flight tests. For example, during the two low altitude launches, the weapons were launched on the first pass; the delivery tactics used were designed for minimum exposure to enemy defenses; the two-ship launch was conducted "radio out," the aircrew had not made previous weapon delivery against the targets attacked, and the launches were made in the blind. Further, the F-111 launch was also the first pass without previous "dry run." The Phase III test indicated that the NAC WDL has demonstrated performance at least equal to previously used Hughes WDL, that data link system improvements have eliminated previously detected co-channel interference, that confidence in the low level blind launch tactic has been increased, and that successful supersonic launch from the F-111 can be achieved. A summary of Phase III results is as follows:

Aircraft	Tactic	Speed	Release Altitude	Distance From Target	Target	Score
F-4E	single ship	0.86 mach	185 feet AGL	5 nm	radar van	direct hit (3 feet from aim point)
F-4E	two ship	0.84 mach	175 feet AGL	5 nm	aircraft shelter	direct hit (0 feet from aim point)
F-4E	single ship	1.4 mach	22,500 feet AGL	20 nm	ship	direct hit (4 feet from aim point)

(8) Future IOT&E of the Imaging Infrared (IR) guided GBU-15/CWW will be managed by AFTEC. After a 5-weapon DT&E, AFTEC will conduct a 15-weapon IOT&E during the period October 1981 - September 1982. Preliminary

planning is underway. Emphasis is being given to operational realism in terms of test sites selected, targets (off range for captive-carry program and on range for launch missions), ECM/EOCM, and availability of support equipment. The night/adverse weather capability of the GBU-15/CWW/IR will be evaluated. The F-4 Pave Tack and F-111/Pave Tack will be the delivery aircraft.

b. Planar Wing Weapon (PWW). The GBU-15 test of the PWW was a combined DI&E/IOT&E program. A ten-weapon B-52D test program commenced at Carswell AFB TX (SAC's planned operatinal base) during May 77 with weapon launches conducted at the White Sands Missile Range and Eglin AFB Range complex. The purpose of the IOT&E was to provide an early estimate of the operational effectiveness and operational suitability of the GBU-15 PWW in support of a production decision. The program consisted of an AFTEC test team composed of AFTEC, Strategic Air Command (SAC), Air Force Logistics Command, and Air Training Command personnel to conduct the IOT&E portion of the test. AFTEC participated in test planning and will submit an independent IOT&E report. SAC aircrews and maintenance personnel were actively involved in flying and maintaining the weapon during test.

(1) Operational scenarios were established for evaluating the GBU-15-equipped B-52D against both land and naval targets. The test program consisted of captive flight and live launch missions to examine the operational effectiveenss and suitability of the systems.

(2) The operational effectiveness objectives were:

(a) Evaluate the operational effectiveness of the GBU-15 PWW system with respect to its demonstrated performance parameters and planned employment concept.

(b) Comment on previously conducted survivability studies and gather data elements which may be used to address survivability.

(3) The operatinal suitability objectives were:

(a) Evaluate the hardware reliability of the PWW system.

(b) Evaluate the maintainability of the GBU-15 PWW, the AN/AXQ-14 ADL pod, and the carrier aircraft equipment.

(c) Evaluate the availability of the AN/AXQ-14 ADL pod and the carrier aircraft equipment and identify the components that cause nonoperational status.

(d) Evaluate the logistics supportability of the GBU-15 system to include the support equipment.

(e) Update the operating and support cost assessment of the GBU-15 PWW system.

(f) Evaluate the suitability of the GBU-15 software.

(4) During FY77-79, ten MK84/TV/DL weapons were launched from the B-52 at land and sea targets. Of the ten launched conducted during FY77-79, three were successful and 7 launches failed for the following reasons: (1) failure of an amplifier in the aircraft data link pod precluded effective weapon control after launch. The failure was considered random; (2) the weapon entered a cloud as it neared the target. Upon loss of the target from the field of view, the operator initiated data link command inputs which resulted in loss of weapon aerodynamic stability. The weapon fell short of the targets. A software change will be implemented which will allow the operator to place the weapon in cruise mode should similar situations arise; (3) the wing restraint pin failed to retract upon release from the aircraft. The wings failed to open and the weapon impacted the ground shortly after release. An engineering design change, eliminating the restraint pin, is proposed solution. Tests without the restraint pin are planned to verify the fix; (4) a weapon launch, at a sea target, failed due to poor video reception and insufficient gas supply to the flight control system actuators. Problems encountered are still being inestigated. (5) the weapon went out control during terminal dive. Excessive gas concumption was also noted. Cause for loss of the weapon was unknown and was considered a random failure. (6) the aircrew inadvertently turned the incorrect switch, commanding the weapon to trans-enable mode two minutes after launch. A Service Report was submitted for modification of the switch. (7) intermittent data link control and no-beacon-received problems were experienced. The crew broke lock to go to trans-enable mode, and data link control was lost. The weapon was destroyed. Cause was weapon data link module failure.

(5) Due to substandard results of the ongoing PWW testing, IOT&E was terminated. It was decided to restructure the program and conduct future testing following further research and development. Major deficiencies to be resolved include excessive actuator gas consumption, aircraft data link pod reliability, weapon umbilical, and midcourse guidance beacon problems.

Budget Activity: Tactical Program, #4

Program Element: 64733F, Surface Defense Suppression

3. System Characteristics:

CWW/MK-84/TV/DL TECHNICAL CHARACTERISTICS

	Threshold	Goal	Demonstrations [1]
Launch Envelope			
Max Mach			
Max Alt (ft)			
Min Alt (ft)			
Range (NM)			
Accuracy (ft) (CEP)			
Reliability (weapon hardware inflight)	.90 [3]	.92	.928

1 Demonstration of parameter maximum was not necessarily a test objective.
2 Data not specified in technical specifications
3 TAC threshold
4 Demonstrated during Development Test & Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) program conducted by Tactical Warfare Center.
5 Demonstrated during DT&E program conducted by Air Force Systems Command.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64737F
DoD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Airborne Self-Protective Jammer (ASPJ)
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING) ($ in thousands):

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	(4,900)*	(4,200)*	12,400	32,100	Continuing	Not Applicable
2685	Airborne Self-Protection Jammer	(4,900)*	(4,200)*	12,400	32,100	Continuing	Not Applicable

* Preliminary ASPJ effort has been funded in Program Element 64739F, Tactical Protective Systems.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a joint Air Force/Navy program for the engineering development of an internally mounted self-protection electronic countermeasures (ECM) jammer for various tactical aircraft applications, including an advanced receiver/processor (R/P) subsystem which can be integrated into the Air Force ALQ-131 ECM pod.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for continued development of an internal self-protection ECM system for use with the F-16 and possibly F-111 tactical aircraft to allow them to accomplish their assigned missions without incurring an unacceptable attrition rate. Also included in this request are funds to continue the development of an advanced R/P, known as the comprehensive power management sytsem (CPMS), for use with the ALQ-131 ECM pod. CPMS is an integral part of the basic ASPJ internal ECM system. CPMS will increase the capability of the ALQ-131 ECM pod for aircraft not programmed to be equipped with ASPJ.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #64737F
DoD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Airborne Self-Protective Jammer (ASPJ)
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The purpose of this program element (PE) is to develop, test and evaluate an internally mounted electronic countermeasures (ECM) system known as the Airborne Self-Protection Jammer (ASPJ). The ASPJ system is required to provide various advanced tactical aircraft with a capability of employing effective ECM techniques against the constantly expanding and sophisticated Soviet air defense threats that our tactical aircraft could encounter during the mid-1980s and 1990s. This system must be capable of operating in a dense, multiple threat emitter environment and must be capable of countering the latest threats expected during this time period. The ASPJ internal ECM system is intended for installation in the F-16 aircraft and possibly in tactical F-111 aircraft. The receiver/processor (R/P) portion of ASPJ is also being developed to provide a long term upgrade to the power management capability of the ALQ-131 ECM pod for use on aircraft not scheduled to be equipped with the ASPJ internal ECM system, such as the A-7D, A-10, and F/RF-4. This R/P development effort is known as the comprehensive power management system (CPMS).

RELATED ACTIVITIES: This program is structured as a joint Navy/Air Force effort with Navy funds provided under PE 64226N, Advanced Self-Protection Systems. It is the intent of this program to attain 100% commonality of the ASPJ system design for internal application and to equally share the total group B cost of engineering development between the two Services. The Air Force and Navy joint development efforts initiated during FY 1979 will continue into FY 1980 with Air Force funds provided under PE 64738F, Protective Systems and PE 64739F, Tactical Protective Systems. In FY 1981 Air Force direction and funds for this effort will be consolidated under PE 64737F, Airborne Self-Protection Jammer. The F-16 internal ECM (IECM) efforts are directly related to PE 27133F, F-16 Squadrons, and the possible F-111 IECM efforts are directly related to PE 27129F, F-111 Squadrons.

WORK PERFORMED BY: ASPJ is managed by a joint Navy/Air Force Program Office at the Naval Air Systems Command, Washington, D.C. The Navy is the lead Service. The Air Force unique portion of this program, CPMS, is managed by the Aeronautical Systems Division, Wright-Patterson AFB, OH. The ASPJ/CPMS effort is being developed by two competitive contractor teams. One team is Northrop Corporation, Rolling Meadows, IL and Sanders Associates, Nashua, NH. The second team is ITT, Nutley, NJ and Westinghouse Corporation, Baltimore, MD.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In FY 1979, the airborne self-protection jammer (ASPJ) program successfully passed the Defense Systems Acquisition Review Council (DSARC) II milestone. As a result of the DSARC II decision, the Air Force was directed to fully participate with the Navy in the joint development of the ASPJ system. During FY 1979, phase one of the ASPJ engineering development effort was initiated with the award of contracts to two competitive contractor teams. During phase one, the program will proceed from the engineering design to critical design review.

Program Element: #64737F
DoD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Airborne Self-Protective Jammer (ASPJ)
Budget Activity: Tactical Programs, #4

2. FY 1980 Program: The phase one engineering design will continue through FY 1980. The effort will include the ASPJ system design as well as the fabrication, test and demonstration of critical system components. During this same period, the ASPJ receiver/processor (R/P) design criteria will be developed for integration with the ALQ-131 electronic countermeasures (ECM) pod. Design studies for an internal F-16 installation will be initiated.

3. FY 1981 Planned Program: The ASPJ Phase One engineering design will be completed and one of the two competitive contractor teams will be selected to proceed into Phase Two, Engineering Development Model Fabrication and Test. Prototype airborne hardware will be fabricated for installation in the F-16 as well as for qualification test use. Prototype hardware of the comprehensive power management system (CPMS) will also be fabricated for integration with the ALQ-131 ECM pod.

4. FY 1982 Planned Program: The ASPJ phase two engineering development will continue with fabrication of a prototype Group A kit for the F-16. The CPMS will be integrated into the ALQ-131 pod. Ground tests of the CPMS and ASPJ will be initiated at the Air Force Electronic Warfare Environment Simulator.

5. Program to Completion: In FY 1983, aircraft installation of the ASPJ will be accomplished and development, test and evaluation (DT&E) flight tests will commence. DT&E of the CPMS with the ALQ-131 will commence. Qualification tests of ASPJ hardware will be completed. In FY 1984, initial operational test and evaluation (IOT&E) will start and be completed. DSARC III will occur during FY 1984. The completion of IOT&E, a successful DSARC III decision and subsequent reports will conclude this engineering development program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: Not Applicable (New submission in FY 1980)

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64738F
DoD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Protective Systems
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	48,499	58,300	71,100	90,200	Continuing	Not Applicable
1627	Simulation, Analyses and Evaluation	5,400	4,700	5,700	5,700		
2114	Antenna Test Range	2,200	1,400	1,500	1,500		
2683	Radar Countermeasures		*17,800	27,600	42,200		
3829	Infrared and Optical Countermeasures	3,600	800	2,000	2,000		
5615	B-52 Protective Systems	24,200	23,000	26,200	29,400		
5616	F/FB-111 Protective Systems	5,400	7,200	3,200	4,500		
6510	Flight Test Simulators	7,699	3,400	4,900	4,900		

* Approval for $17,800 thousand reprogramming authority will be requested from Congress.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides funds for: (1) engineering development of new or improved electronic countermeasures (ECM) equipment for B-52 and F/FB-111 aircraft; (2) infrared countermeasures equipment for multi-aircraft application; (3) an expedited effort to develop electronic countermeasures techniques against the new generation of highly ECM resistant and very capable radar threats; (4) development of Soviet radar replicas against which electronic warfare equipments are flight tested; (5) the evaluation and analysis of electronic warfare equipment; and (6) development of an antenna test range to support both ground and airborne evaluation of new electronic warfare antennas.

BASIS FOR FY 1981 RDT&E REQUEST: The Soviets continue to develop, deploy, and provide their allies with sophisticated electronic and electro-optical surface-to-air and air-to-air weapon systems. Of particular concern is the appearance in significant numbers of both airborne and ground based radar systems against which current generation ECM systems have effectiveness. These circumstances make it imperative that

Program Element: #64738F
DoD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Protective Systems
Budget Activity: Tactical Programs, #4

Air Force aircraft carry effective electronic countermeasures (ECM) equipment which can provide protection against enemy air defenses and help ensure the successful accomplishment of assigned wartime missions without incurring unacceptable attrition. Further, the President's decision to cancel production of the B-1 has levied responsibility for an effective manned bomber element of the strategic triad squarely on the B-52. In order to ensure continued B-52 effectiveness against Soviet defensive weaponry in the 1980s, a significant investment in ECM equipment development has been made so that qualitative upgrade of existing B-52 defensive avionics may be accelerated. The enhancement in ECM capability deriving from these developments will ensure continued mission effectiveness of the B-52 bomber force through the 1980s, particularly in its evolving mission as the cruise missile carrier.

OTHER APPROPRIATIONS FUNDS: Not Applicable.

Program Element: #64738F
DoD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Protective Systems
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The purpose of this Program Element (PE) is to: (1) develop, test and evaluate electronic countermeasures (ECM) equipment for B-52 and F/FB-111 aircraft; (2) develop infrared (IR) and optical countermeasures equipment for all combat aircraft; (3) develop new ECM systems, or techniques which can be integrated into existing aircraft ECM systems, that will be effective against the new generation of highly ECM resistive radar threat weapon systems; (4) upgrade existing, or develop new, simulations/replicas of Soviet radar controlled weapon systems against which electronic warfare (EW) equipments undergo both ground and flight testing; and (5) develop/upgrade the antenna test range which supports both ground and airborne evaluation of new electronic warfare antennas. The quality, quantity, and diversity of Soviet and Soviet provided Middle East and Warsaw Pact air defense command/control and weapon systems dictate a need for improved, as well as new, types of EW equipment for tactical and strategic aircraft. Laboratory and flight test simulations of Soviet radars and defense systems are needed in order to evaluate new EW techniques, equipment, and tactics. Developments are in direct response to identified operational deficiencies where existing EW equipment will not provide sufficient protection for aircraft performing assigned wartime missions. These seven projects fall in two functional areas: (1) aircraft protective systems (2683 - Radar Countermeasures, 3829 - IR and Optical Countermeasures, 5615 - B-52 Protective Systems, and 5616 - F/FB-111 Protective Systems); and (2) systems analyses or testing (1627 - Simulation Analyses and Evaluation, 2114 - Antenna Test Range, and 6510 - Flight Test Simulators).

RELATED ACTIVITIES: The efforts in this program build upon concepts and technology demonstrated in advanced development programs PE 63718F, Electronic Warfare Technology, and PE 63743F, Electro-Optical Warfare. They are closely coordinated with ECM engineering development projects in PE 64739F, Tactical Protective systems. Previous low level development efforts in the radar countermeasures area in PE 64739F are being consolidated under PE 64738F and elevated to major development initiative status begining in FY 1981 in Project 2683 - Radar Countermeasures.

WORK PERFORMED BY: The aircraft subsystems and laboratory simulation programs are managed by the Aeronautical Systems Division, Wright-Patterson Air Force Base (AFB), OH. The flight test simulation project is managed by the Armament Development and Test Center, Eglin AFB, FL. The antenna test range is managed by Rome Air Development Center, Griffis AFB, NY. The major contractors are: General Dynamics, Inc., Fort Worth, TX threat simulation; Westinghouse Corp., Baltimore, MD - tail warning system for B-52 and F/FB-111; Sedco Systems, Inc., Long Island, NY - electronically steerable phased array jamming antenna system for B-52; and ITT Avionics, Inc., Nutley, NJ upgrade of ALQ-117 jammer for B-52.

Program Element: #64738F
DoD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Protective Systems
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Significant milestones have been production of: the B-52 jammer power management system; the B-52 tail warning radar system; and the ALQ-137 jammer for the FB-111. Initiations were: prototype development of an electronically steerable phased array jamming antenna system for the B-52; update of the B-52 ALQ-117 jammer; and development programs for replicas of systems; and continued update improvements to laboratory and flight test simulations/replicas of a wide range of Soviet radars.

2. FY 1980 Program: Hardware development programs for the B-52, F/FB-111 and combat support aircraft initiated in FY 1978 and FY 1979 will continue. These include adaptation of the B-52 tail warning radar system for F/FB-111 application; B-52 electronically steerable phased array jamming antenna system; B-52 ALQ-117 jammer improvement to include electronic countermeasures (ECM); and an infrared missile warning receiver for use on combat support aircraft. The level of effort in the development and fabrication of Soviet threat radar simulators/replicas, and upgrade of the antenna test range, to support ground and flight test of electronic warfare equipment will continue.

3. FY 1981 Planned Program: The dramatic appearance of a new generation of highly ECM resistant and very dangerous ground and airborne radar threats has resulted in the initiation of an intensive engineering development effort aimed at providing new and effective ECM techniques/capabilities for all Air Force combat aircraft. Major development emphasis continues to be focused on improving B-52 ECM capability and particularly in optimizing it for the B-52s evolving cruise missile carrier mission. The B-52 electronically steerable phased array jamming antenna will undergo a comprehensive testing and evaluation program in FY 1981. B-52 ALQ-117 jammer improvement will complete fabrication and begin the testing phase. The F/FB-111 doppler tail warning radar will complete the system testing required to allow a production decision. A new infrared (IR) flare (IR missile decoy device) will begin full scale engineering development. This flare (a material) which will be a fuel rather than an explosive device, shows promise of being twice as effective at half the cost of existing pyrotechnic flares. The level of effort for electronic warfare (EW) simulation facility upgrading will continue with emphasis on developing simulations of new systems.

4. FY 1982 Planned Program: The major development initiative begun in FY 1981 to provide radar countermeasures techniques/capabilities will be reaching maturity. Techniques integration and testing with existing airborne ECM systems will begin. The B-52 ALQ-117 jammer improvement effort will complete testing and require production decision. IR flare development and flight testing will complete and require production decision. Upgrade of EW simulation and testing capabilities will continue. Development of new threat replicas and simulators will begin as both need and availability of necessary intelligence data dictates. A new engineering development initiative involving countermeasures against electro-optically directed threats will begin.

Program Element: #64738F
DoD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Protective Systems
Budget Activity: Tactical Programs, #4

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	33,400	46,500	40,500	43,500	Continuing	Not Applicable
1627	Simulation, Analyses and Evaluation	5,860	5,400	4,700	5,200		
2114	Antenna Test Range	2,677	2,200	1,400	1,500		
3829	Infrared and Optical Countermeasures	4,260	3,900	800	1,200		
5615	B-52 Protective Systems	15,543	24,200	23,000	20,100		
5616	F/FB-111 Protective Systems	1,070	5,400	7,200	11,200		
6510	Flight Test Simulators	3,990	5,400	3,400	4,300		

FY 1979: An additional $1,999 thousand of FY 1979 money was reprogrammed into this program element and used on Project 6510 - Flight Test Simulators, to pay the Air Force share of a joint Air Force/Navy program to develop a modular generic threat radar replica. This flight test device will be capable of being programmed to look and respond like Soviet surface-to-air missile radars, and be available for test utilization as soon as intelligence identifies the electronic characteristics of the new threat.

FY 1980: An additional $17,800 thousand of FY 1980 funds has been identified for the initiation of a major engineering development effort to provide effective electronic countermeasures (ECM) techniques against the new generation of radar systems. A separate development project, #2683, titled Radar Countermeasures" has been established under which all ECM related work will be accomplished. Reprogramming authority for these funds will be requested from Congress.

FY 1981: The funding request for FY 1981 represents an increase of $27,600 thousand. These funds are necessary to continue the urgent development effort to provide effective ECM against radars begun in FY 1980.

Project: #1627
Program Element: #64738F
DoD Mission Area: Electronic Countermeasures/C^3, #257

Title: Simulation, Analyses and Evaluation
Title: Protective Systems
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the development and fabrication of laboratory simulations of Soviet radar systems and the analyses of potential candidate countermeasures systems. Definition, design and evaluation of new/improved electronic countermeasures (ECM) equipment against Soviet surveillance radars, command and control networks, and radar or optically controlled weapons, requires a realistic simulation of these threats.

RELATED ACTIVITIES: This project relies on many technical intelligence sources to define and assist in the design of functional electronic duplicates (simulations) of Soviet radar systems. These laboratory simulations are used by virtually all Air Force, and many Army and Navy, electronic warfare development programs during definition, design and/or evaluation. The analyses capability sponsored by this project supports Program Element (PE) 63718F, Electronic Warfare Technology; PE 63743F, Electro-Optical Warfare; PE 27252F, EF-111A; PE 64724F, Tactical C^3 Countermeasures; and PE 64739F, Tactical Protective Systems. These simulators are also used by Strategic and Tactical Air Commands to measure the change in effectiveness of operational ECM systems resulting from the use of new tactics or equipment settings against any specific threat radar.

WORK PERFORMED BY: The laboratory simulation programs are managed by the Aeronautical Systems Division, Wright-Patterson Air Force Base (AFB), OH. The major contractors are: General Dynamics, Inc., Fort Worth, TX, - Air Force Electronic Warfare Evaluation Simulator (AFEWES); Calspan Corp., Buffalo, NY - Real Time Electromagnetic Digitally Controlled Analyzer and Processor (REDCAP) Simulator; and the Aeromedical Research Laboratory, Wright-Patterson AFB, OH. Strategic Avionics Crew Station Design Facility.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Previously established simulation facilities are: the AFEWES, at General Dynamics, Fort Worth, TX; REDCAP Simulator at Calspan Corp., Buffalo, NY; and the B-52 Electronic Warfare Officer crew station for human factors engineering design evaluations at Wright-Patterson AFB OH. AFEWES consists primarily of five general classes of simulations of threat radar systems: (1) surface-to-air missile, (2) antiaircraft-artillery, (3) airborne interceptor, (4) acquisition, and (5) ground control intercept/height finder radars. This facility provides the Air Force and other Department of Defense agencies the capability to perform thorough assessments of electronic warfare techniques, equipment, and subsystems, as well as systematic in-depth evaluations of ECM system capabilities and weapon system survivability analyses. It is a valuable decision tool to supplement advanced development, engineering development, flight test, and related analyses efforts. The unique feature of this facility is that actual ECM equipment is evaluated at its normal operating frequencies. REDCAP was established for evaluation of jamming equipment used against Soviet early warning radars and command and

control network communications. The following simulator developments/upgrades were initiated in FY 1979: Soviet simulation; Soviet command, control and communications (C^3) and data link systems simulation; upgrade of existing early warning (EW) and ground controlled intercept (GCI) radar simulations to bring them into compliance with current intelligence estimates; and the development of an Adaptable Radar Simulator which can be quickly assembled from available components and preliminary intelligence estimates to provide a rapid "first-look" at a potential new Soviet radar system.

2. FY 1980 Program: No new development initiatives will be undertaken because of budgetary constraints. Fabrication of the Adaptable Radar Simulator, radar, and Soviet C^3 system simulations will continue in parallel with update of existing EW/GCI simulations bringing them into compliance with current intelligence estimates.

3. FY 1981 Planned Program: Initiation of full scale development of radar simulations will begin. Installation and test of Soviet C^3 simulations and EW/GCI upgrades will make them once again available for countermeasures equipment testing. Upgrade of existing simulations will be accomplished to bring them into compliance with existing intelligence estimates.

4. FY 1982 Planned Program: Fabrication of radar simulations will continue. Upgraded simulations will be completed and made available for countermeasures testing work. The continuing effort to upgrade the various threat radar simulations to insure their compliance with latest threat estimates will continue.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

Project: #1627 — Title: Simulation, Analyses and Evaluation
Program Element: #64738F — Title: Protective Systems
DoD Mission Area: Electronic Countermeasures/C^3, #257 — Budget Activity: Tactical Programs, #4

7. Resources: ($ in thousands):

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Cost
1627	Simulation Analyses and Evaluation	5,400	4,700	5,700	5,700	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Cost
1627	Simulation Analyses and Evaluation	5,860	5,400	4,700	5,200	Continuing	Not Applicable

FY 1979: Not Applicable, no change.

FY 1980: Not Applicable, no change.

FY 1981: The funding request for FY 1981 represents an increase of $500 thousand. These funds are necessary to accelerate development of simulations of radar systems to insure their availability for use in developmental testing of radar countermeasures techniques. These funds are not a part of the overall requested increase for PE 63738F of $27,000 thousand. They come from realigning funds from project 3829, Infrared and Optical countermeasures, slowing development of countermeasures one year, and reflecting the greater urgency associated with developing effective radar countermeasures.

Project: #2683 Title: Radar Countermeasures
Program Element: #64738F Title: Protective Systems
DoD Area Mission: Electronic Warfare/Counter C3, #257 Budget Activitiy: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Most recent intelligence estimates confirm that approximately

target tracking techniques.

Thus the Air Force now faces the serious prospect that a portion of its aircraft self-protection ECM capability by this dramatic advance in Soviet weaponry. This project is being constituted as a major development initiative to focus both resources and management attention on the urgent objective to find and integrate effective radar countermeasures into existing aircraft self-protection ECM systems.

RELATED ACTIVITIES: This is a new project which did not appear in the FY 1980 Descriptive Summary. It will draw heavily on concepts and technology demonstrated in advanced development program element PE 63718, Electronic Warfare Technology. As techniques or new systems successfully emerge from engineering development, they may be input directly into hardware systems or channeled into selected Program Elements in which further integration into specific systems may be accomplished. The Air Force single manager for radar countermeasures has already established direct liason with Army and Navy electronic warfare development managers and is working to establish this project on a tri-service basis. Some low level efforts aimed at specific radar countermeasures investigations have been pursued in FY 1979 and FY 1980 in other projects within this PE and in PE 64739F, Tactical Protective Systems. Beginning in FY 1981, these efforts are totally consolidated within this project.

WORK PERFORMED BY: The Air Force manager is the Aeronautical Systems Division (ASD), Wright Patterson Air Force Base (AFB), OH. Air Force has established a special management program office, nicknamed the "HAVE EXIT" Program Office, directly under the cognizance of the ASD Commander. The HAVE EXIT Program Office has management responsibility for all Air Force radar countermeasures development efforts. Major contractors have not yet been identified. Bids are anticipated from numerous avionics contractors or teams of contractors. It is anticipated that this work will be spread across a large segment of the avionics industry and American institutions of higher learning.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable, new project.

2. FY 1980 Program: The Air Force has already begun to evaluate preliminary systems concepts submitted by industry in response to a Request for Information. Aircraft installation/integration analyses and trade studies to determine candidate systems approaches are already in progress. Efforts involving the development of specifications for specific techniques/ systems in preparation for request for proposals from industry are under way. Approval for $17,800 thousand reprogramming authority will be requested from Congress.

Project: #2683 Title: Radar Countermeasures
Program Element: #64738F Title: Protective Systems
DoD Mission Area: Electronic Warfare/Counter C^3, #257 Budget Activity: Tactical Programs, #4

3. FY 1981 Planned Program: The Air Force will undertake as its first priority the attainment of effective Specific systems targeted for countermeasures enhancement are the ALQ-117 radar jammer for the electronic countermeasures (ECM) Drawing on Defense Science Board recommendations and the product of internally conducted Air Force studies, a number of promising countermeasures techniques will be accelerated into engineering development. Full scale design, engineering development, and fabrication of prototype systems or modifications to existing systems will occur. At this point in time there appears to be no single technique which will be effective in all cases against all types of threat systems. Rather, a combination of new techniques will likely be required to provide the necessary survivability and mission effectiveness. The selected techniques will be fabricated as quickly as possible and integrated into the aforementioned ECM systems for testing against radars. In parallel with efforts to find immediate or near term solutions for these specific hardware items, efforts will begin which will investigate other potential alternatives such as and techniques for other specialized aircraft applications. The expedited development of an for the is planned. This effort could provide a highly effective complementary capability for the since it capitalizes on existing on-the-shelf systems which could be reinstalled in a short period of time at modest cost. The long term goal of finding a single or generic type solution will not be abandoned and studies, analyses, and some testing will be accomplished to further this objective.

4. FY 1982 Planned Program: Completion of fabrication of upgrades will occur. Comprehensive ground and flight testing of these upgrades will lead to the selection of those which are effective and warrant production for retrofit into these systems. Parallel efforts to design fabricate and test corresponding improvements for and all other Air Force aircraft ECM systems will continue. A continuing effort to solicit and evaluate new ideas will be maintained.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: ($ in thousands):

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Cost
2683	Radar Countermeasures		17,800	27,600	42,200	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: Not Applicable, new project.

Project: #5615 — Title: B-52 Protective Systems
Program Element: #64738F — Title: Protective Systems
DoD Mission Area: Electronic Warfare/Counter C^3, #257 — Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the development of new and improved electronic countermeasures (ECM) system for the B-52 aircraft. The B-52 is, and will continue to be, the mainstay of strategic bomber aircraft offensive capability. The continued improvement in the quantity, quality and diversity of Soviet air defense command/control and weapon systems establishes a corresponding need to improve self-protection countermeasures systems on the B-52. The B-52 in its cruise missile carrying role will face a multitude of airborne interceptor aircraft. Efforts in this project focus specifically on optimizing existing B-52 ECM systems to provide the protection this new role requires.

RELATED ACTIVITIES: The efforts in this project draw heavily on concepts and technology demonstrated in advanced development Program Element (PE) 63718F, Electronic Warfare Technology, and PE 63743F, Electro-Optical Warfare. Technology from other projects within this PE and PE 64739F, Tactical Protective Systems, are utilized to the maximum extent possible.

WORK PERFORMED BY: The Air Force manager is the Aeronautical Systems Division, Wright-Patterson Air Force Base (AFB), OH. The major contractors are: Sedco Systems Incorporated, Long Island, NY - electronically steerable phased array jamming antenna system, with Defense Systems Division of Northrop Corporation, Rolling Meadows, IL as a major subcontractor; and ITT Avionics, Nutley, NJ - for update of ALQ-117 jammer, with Sedco Systems Incorporated, Long Island, NY as major subcontractor for ALQ-117 ECM antennas.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Completed efforts in prior years which are currently being installed in the B-52 as Class V modifications include: the ALQ-122 ECM system which jams the Soviet the ALQ-155 ECM power management system, which integrates ALT-28 jammers, covering the spectrum of radars, with the ALR-46 radar warning receiver to provide rapid, accurate and prioritized jamming response to these threats; and the ALQ-153 tail warning radar (which detects approaching air-to-air missiles and the B-52). Initiated developments included: electronically steerable phased array jamming antenna; and update of the ALQ-117 jammer to provide

and lay the foundation for the inclusion of ECM techniques.

Project: #5615
Program Element: #64738F
DoD Mission Area: Electronic Warfare/Counter C^3, #257

Title: B-52 Protective Systems
Title: Protective Systems
Budget Activity: Tactical Programs, #4

2. FY 1980 Program: Only two significant efforts, both focused on providing enhanced protection for the B-52 in its cruise missile carrier role, continue in development in this project. The electronically steerable phased array jamming antenna system can magnify existing B-52 ALT-28 jamming power up to times more than is currently available. This system, which is designed to counter radars will complete critical design review, system fabrication and be ready for comprehensive testing. The ALQ-117 provides electronic countermeasures against radars. The development of enhancements to this system continues with heavy emphasis placed on achieving a countermeasures breakthrough against the proliferating and very capable systems. ALQ-117 upgrade design will be completed and system fabrication well under way by the end of FY 1980.

3. FY 1981 Planned Program: No new development initiatives are planned. The electronically steerable phased array jamming antenna will undergo a comprehensive testing regimen. The upgraded ALQ-117 jammer will complete system fabrication and begin an extensive program of both ground and flight testing.

4. FY 1982 Planned Program: Again, no new development initiatives are planned. The two ongoing developments for cruise missile carrying B-52s will complete engineering development leading to a production decision. The upgraded ALQ-117 will complete a rigorous program of flight and qualification (reliability/maintainability/durability) testing leading to a production decision in late FY 1982.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

Project: #5615
Program Element: #64738F
DoD Mission Area: Electronic Warfare/Counter C^3, #257

Title: B-52 Protective Systems
Title: Protective Systems
Budget Activity: Tactical Programs, #4

7. Resources: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Cost
5615	B-52 Protective Systems	24,200	20,900	26,200	29,400	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Cost
5615	B-52 Protective Systems	15,543	24,200	20,900	20,100	Continuing	Not Applicable

FY 1979: Not Applicable, no change.

FY 1980: Not Applicable, no change.

FY 1981: The funding request for FY 1981 represents an increase of $6,100 thousand. These funds are not a part of the overall requested increase for Program Element (PE) 64738F of $27,000 thousand, but rather are the product of a very careful realignment and rephasing of work in other projects within the PE, so that program slippages resulting from previous budget cuts could be redressed. These B-52 upgrades are viewed as critical for continued B-52 effectivenes in its cruise missile carrying mission in the mid-to-late 1980s.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64739F
DOD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Tactical Protective Systems
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	33,513	14,200	24,600	23,300	Continuing	Not Applicable
2272	Active Countermeasures Systems	13,378	7,500	15,900	10,400	Continuing	Not Applicable
2273	Warning Systems	115		1,400	6,400	Continuing	Not Applicable
2274	Dispensers	1,085	1,300	1,300	500	Continuing	Not Applicable
5618	F-15 Protective Systems	18,935	5,400	6,000	6,000	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the engineering development of new and improved self-protection electronic warfare equipment (EW) for tactical strike, air superiority, and reconnaissance aircraft.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for development of various self-protection EW systems for tactical strike, air superiority, and reconnaissance aircraft to allow them to accomplish their assigned missions without incurring an unacceptable attrition rate. Self-protection EW equipment includes internally mounted countermeasure systems, electronic countermeasures pods, radar warning receivers, chaff /flare dispensers and expendables and the F-15 Tactical Electronic Warfare System.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #64739F
DOD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Tactical Protective Systems
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The purpose of this program element (PE) is to develop, test, and evaluate electronic warfare (EW) systems for tactical strike, air superiority, and reconnaissance aircraft. Through FY 1976/19TQ, this program was limited to the design, development, qualification and evaluation of the ALQ-131 advanced modular electronic countermeasures (ECM) pod. The ALQ-131 can be configured with up to five transmitter modules and a receiver/processor (R/P) module. Increased frequency coverage, power management, and software threat programming provide a greatly enhanced capability. Production was started on the

In FY 1978, this PE was expanded to include the engineering development of improvements to the F-15 Tactical Electronic Warfare System (TEWS). The efforts associated with the F-15 TEWS are intended to expand the capabilities of the existing warning receivers and jammers to counter new or redefined Soviet threats. The F-15 EW upgrade also includes the development of a chaff/flare dispenser to provide a capability to counter air-to-air missiles. In FY 1979, the PE included four new starts which were intended to improve the capability of inventory ECM pods, internal ECM systems and inventory chaff and flare dispensers. An improved R/P started development as a near term power management capability for the ALQ-131 ECM pod. A comprehensive power management system (CPMS) is under development jointly with the Navy as part of the Airborne Self-Protection Jammer (ASPJ) system. In FY 1980 the ALQ-131 module development program will be initiated.

RELATED ACTIVITIES: The efforts in this program draw upon technology developed in various other program elements, such as PE 64738F, Protective Systems; PE 63718F, Electronic Warfare Technology; and PE 63743F, Electro-Optical Warfare. The F-15 TEWS efforts are directly related to PE 27130F, F-15 Squadrons. Program Element 64737F, Airborne Self-Protection Jammer (ASPJ), has been established to provide direction and funding for the United States Air Force (USAF) share of the jointly funded ASPJ program in FY 1980. Low level development efforts begun in this PE for countermeasures for FY 1979 and FY 1980 will be consolidated under PE 64738F, Protective systems, and will become a major development initiative in that PE beginning in FY 1981 to satisfy

WORK PERFORMED BY: This PE is managed at the Aeronautical Sytems Division, Wright-Patterson AFB, OH. The prime contractor for the ALQ-131 Advanced Tactical Countermeasures Pod is Westinghouse Electric Corporation, Baltimore, MD. The subcontractor for the R/P portion of the pod is Loral Electronics Systems, Yonkers, NY. The major contractors for the F-15 TEWS are: Northrop Corporation, Rolling Meadows, IL - Internal Countermeasures Set (ICS) ; Loral Electronic Systems, Yonkers, NY Radar Warning Receiver (RWR) ; Magnavox Company, Ft Wayne, IN - Electronic Warfare Warning Set (EWWS); and McDonnell-Douglas Aircraft Corporation, St. Louis, MO - aircraft integration and countermeasures dispenser (CMD).

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The of the ALQ-131 ECM pod completed all development efforts during FY 1976. A production decision was made for this configuration in July 1976. Development testing

of the receiver/processor (R/P) for the ALQ-131 continued. In FY 1978, flight testing for the ALQ-131 R/P was completed and a decision was made to add a capability to the module. In FY 1979, the improved R/P development effort was initiated. Development of the F-15 radar warning receiver (RWR), electronic warfare warning set (EWWS) and internal countermeasures set (ICS) were completed during the period from FY 1971 to FY 1976. An effort to improve the F-15 RWR and the ICS systems was initiated. The development of the CMD for the F-15 was initiated.

2. FY 1980 Program: An improvement to the (R/P) module for the ALQ-131 to counter radar threats will be continued. Development will be continued of ALQ-131 modules designed to jam radars in order to degrade the Development will be completed of a designed to match the of the F-15 aircraft. Development continue of a dual chaff cartridge with dual chaff elements each having a countermeasures capability equivalent to one existing chaff unit. This is intended to be done as a cooperative development with the Royal Netherlands Air Force. The effort to upgrade the F-15 Tactical Electronic Warfare System (TEWS) will be continued. A study that will identify deficiency corrections to the EWWS will be completed.

3. FY 1981 Planned Program: The development efforts, initiated in FY 1980 and prior years, for electronic countermeasures (ECM) systems, radar warning receivers and chaff/flare dispenser systems will be continued. A feasibility study to determine the redesign needed to adapt available for use with the A-10 aircraft will be started. The development of the ALE-40 dual chaff cartridge, done as a joint United States/Netherlands effort will be completed. The development of a designed to match a variety of aircraft will be continued. The F-15 TEWS upgrade effort will be continued. The development of the improved R/P for the ALQ-131 ECM Pod will be completed. The development of capability for RWR incorporation will be initiated. The EWWS update program will be initiated.

4. FY 1982 Planned Program: The development efforts, initiated in FY 1981 and prior years, for ECM systems, RWR systems and chaff/flare dispensers will be continued. The development of the improved R/P module for the ALQ-131 will have been completed in FY 1981 and the production decision will be made in FY 1982. The development of upgrade efforts for the F-15 Tactical EWWS will be completed. The development of a capability to counter will be started. The development of an

will be initiated.

5. Program to Completion: This is a continuing program.

Program Element: #64739F
DOD Mission Area: Electronic Warfare/Counter C^3, #257

Title: Tactical Protective Systems
Budget Activity: Tactical Programs, #4

6. Milestones: Not Applicable.

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	20,515	32,400	18,400	32,300	Continuing	Not Applicable
2272	Active Countermeasures Systems	5,566	12,100	10,700	24,800	Continuing	Not Applicable
2273	Warning Systems	145	100	1,000		Continuing	Not Applicable
2274	Dispensers and Expendables	729	1,300	1,300	1,500	Continuing	Not Applicable
5618	F-15 Protective Systems	14,075	18,900	5,400	6,000	Continuing	Not Applicable

FY 1979: Funding in FY 1979 represented an increase of $1,113 thousand. This was a result of an urgent unfunded requirement to provide additional funds to investigate the development of countermeasures techniques for inventory and future tactical electronic countermeasure (ECM) systems.

FY 1980: Funding in FY 1980 represents a decrease of $4,200 thousand. These funds were planned for the ASPJ program in PE 64739F and are now realigned into PE 64737F, Airborne Self-Protection Jammer (ASPJ).

FY 1981: Funding in FY 1981 represents a decrease of $7,700 thousand. These funds were planned for the ASPJ program in PE 64739F and are now realigned into PE 64737F, ASPJ, as was done in FY 1980.

Project: #2272 — Title: Active Countermeasures Systems
Program Element: #64739F — Title: Tactical Protective Systems
DOD Mission Area: Electronic Warfare/Counter C^3, #257 — Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the development of improved electronic countermeasures (ECM) capability for inventory ECM pods and internal jamming systems and for the development of new ECM capability for tactical strike and reconnaissance aircraft. Updates are required for these systems to

The continued improvement in the quantity, quality, and diversity of creates a continuing need to improve the self-protection countermeasures capability for tactical strike and reconnaissance aircraft.

RELATED ACTIVITIES: The efforts in this project build upon feasibility concepts and techniques demonstrated in Program Element (PE) 63718F, Electronic Warfare Technology. Techniques and technology from PE 64738F, Protective Systems, that satisfy similar requirements for other aircraft will be utilized.

WORK PERFORMED BY: The Air Force manager is the Aeronautical Systems Division, Wright-Patterson Air Force Base, OH. The major contractor is Westinghouse Electric Corporation, Baltimore, MD.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Development of the of the ALQ-131 ECM pod was completed and production of the initial 50 pods started in FY 1976, 50 pods were placed on contract in FY 1977 and 68 additional pods were contracted in early FY 1979. Development of improved traveling wave tubes for use with inventory ECM pods to improve ECM effectiveness was initiated. Joint Air Force/Navy feasibility studies of the Airborne Self-Protection Jammer System (ASPJ) as a candidate for use as an internal countermeasures system for the F-16 were conducted and completed. These feasibility studies were directly used by the Navy in preparing the design specifications for full scale engineering development of ASPJ. Development test of a receiver/processor (R/P) to provide a stand-alone power management capability for the of the ALQ-131 ECM pod continued.

2. FY 1980 Program: Traveling wave tube improvements for the ALQ-131 ECM pod and improvements to the ALQ-131 R/P module to counter radar threats will be continued. The development of modules for the ALQ-131 ECM pod designed to jam in order to degrade will be initiated.

3. FY 1981 Planned Program: The ECM improvement programs initiated in FY 1980 and prior years will be continued. countermeasures technology developed and adapted from PE 64738F will be integrated into existing tactical ECM systems and tested.

4. FY 1982 Planned Program: The ECM development efforts, initiated in FY 1981 and prior years will be continued. The development of the improved R/P module for the ALQ-131 ECM pod and a production decision will be completed.

Project: #2272 Title: Active Countermeasures Systems
Program Element: #64739F Title: Tactical Protective Systems
DOD Mission Area: Electronic Warfare/Counter C^3, #257 Budget Activity: Tactical Programs, #4

The development of an

mode will be initiated.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: ($ in thousands)

Project	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
2272	Active Countermeasures System	13,378	7,500	15,900	10,400	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

Project	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2272	Active Countermeasures Systems	5,566	12,100	10,700	24,800	Continuing	Not Applicable

FY 1979: The increase of $1,278 thousand in FY 1979 was a result of an unfunded requirement and subsequent reprogramming of additional funds to investigate the development of capabilities for application to inventory and future electronic countermeasures systems.

FY 1980: The decrease of $3,200 thousand in FY 1980 represents a realignment of funds from the project to PE 64739F, Airborne Self-Protection Jammer (ASPJ) in FY 1980.

FY 1981: The decrease of $3,900 thousand in FY 1981 represents a continuation of a realignment of funds from the Project to the joint ASPJ program (PE 64737F) as in FY 1980.

Project: #5618 Title: F-15 Protective Systems
Program Element: #64739F Title: Tactical Protective Systems
DOD Mission Area: Electronic Warfare/Counter C^3, #257 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: This project provides for development of electronic warfare (EW) equipment for the F-15 aircraft. The F-15, in its counter-air role, will be required to operate in the presence of hostile ground controlled fighter interceptors, surface-to-air missiles and antiaircraft artillery. With respect to enemy fighter aircraft, the F-15 pilot must be alerted to the presence of the enemy aircraft so that he can achieve a favorable attack position. With respect to enemy antiaircraft ground defenses, the F-15 must be sufficiently protected to be able to escort friendly ground attack forces into enemy held territory and to be able to pursue enemy fighters into and over their own defended territory. A combination of warning devices, jammers, and decoys have been selected to degrade the capabilities of the enemy electronic defense systems.

Work efforts within this project accomplish the necessary research, development, test and evaluation to expand the capabilities of the existing warning receivers and jammers to counter new or redefined threats. Also included is the development of a chaff/flare dispenser to provide improved capability to counter threats. The current configuration consists of a radar warning receiver (RWR) , electronic warfare warning set (EWWS) and internal countermeasures set (ICS). A countermeasures dispenser set (CMD) is a planned addition to this configuration. Collectively, these four subsystems are known as the F-15 Tactical Electronic Warfare System (TEWS). A previous Project (2073) for development of the new subsystem was folded into this project, (5618), to provide for more effective Air Force management.

RELATED ACTIVITIES: The work under this project is directly related to program element (PE) 27130F, F-15 Squadrons, which provides for procurement of the F-15 TEWS as part of the F-15 Weapons System. Technology developed in PE 63718F, Electronic Warfare Technology, and PE 63743F, Electro-Optical Warfare, provides the basis for improvements to counter new threats. Close coordination occurs between this project and other aircraft EW programs within this program element and programs in PE 64738F, Protective Systems. For example, the CMD will use identical chaff and a variation of the flares and the dispenser developed in this PE for other tactical aircraft.

WORK PERFORMED BY: The Air Force manager is the Aeronautical Systems Division, Wright-Patterson, AFB, OH. Major contractors are: Defense Systems Division of the Northrop Corporation, Rolling Meadows, IL - ICS; Loral Electronics Systems, Yonkers, NY - RWR; Magnavox Company, Fort Wayne, IN - EWWS ; and McDonnell-Douglas Aircraft Corporation, St. Louis, MO - Aircraft Integration and the CMD.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Development of RWR, EWWS, and ICS was completed during the period of FY 1971 to FY 1976. Production was initiated on the two recievers in FY 1975 and on the ICS in FY 1976. One threat related improvement for the RWR was initiated in FY 1976 and completed in FY 1977 to provide improved performance against continuous wave threats. Also during FY 1977, a method to improve location of surface-to-air missile guidance signals was initiated. In 1977, a major update was started on the TEWS. This update

Project: #5618 — Title: F-15 Protective Systems
Program Element: #64739F — Title: Tactical Protective Systems
DOD Mission Area: Electronic Warfare/Counter C^3, #257 — Budget Activity: Tactical Programs, #4

This update will provide an improved jamming capability against the and other threats. It will also provide a foundation to counter and future threats. An improvement to the electronic warf warning set to provide improved electronic countercounter-measures performance against possible inadvertant interference was initiated. Development of the countermeasure dispenser (CMD) was initiated.

2. FY 1980 Program: The new threat radar warning receiver (RWR) hardware will be in production/retrofit. The CMD, modular software, and Operational Flight Program changes will be flight tested. The 1980 program is budget constrained to the ongoing programs. If funds become available, studies will be conducted to address the emerging threats.

3. FY 1981 Planned Program: During FY 1980, the improvements to the RWR will be flight tested and a decision on retrofit kit procurement is planned. Development of the improvements for the internal countermeasures set (ICS) and development of the CMD will continue. Development and testing of the tactical electronic warfare set (TEWS) update and the CMD will be completed to include a production decision. Detail design studies to counter, and future threats will be started assuming TEWS update as a baseline.

4. FY 1982 Planned Program: Production/retrofit on CMD, and TEWS Update could begin. Systems integration/optimization for these changes will be accomplished. Hardware development f and future threats will start. Development of will be initiated.

5. Program to Completion: New or improved Soviet weapon system developments will be monitored and improved capability efforts initiated to the F-15 TEWS as required, to avoid obsolescence. New Soviet defensive systems using may be deployed, requiring corresponding improvements to the F-15 TEWS.

6. Milestones: Not Applicable.

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
F-15 Protective Systems	18,935	5,400	6,000	6,000	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data: NOT APPLICABLE

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64740F
Title: Computer Resources Management Technology
DoD Mission Area: Tactical Command and Control, #254
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,000	2,800	5,800	6,800	Continuing	Not Applicable
2239	Computer Security Technology	200	600	1,400	2,000	Continuing	Not Applicable
2222	Requirement Analysis	500	600	1,100	1,000	Continuing	Not Applicable
2523	Management Control Technology	300	200	600	1,200	Continuing	Not Applicable
2524	Policy and Procedure Guidance	800	800	500	700	Continuing	Not Applicable
2526	Software Engineering Tools and Methods	1,200	600	1,700	1,200	Continuing	Not Applicable
2652	Computer Architecture Standards			500	700	Continuing	Not Applicable

BRIEF DESCRIPTION OF THE ELEMENT AND MISSION NEED: Air Force and Department of Defense (DOD) studies have shown that the rapidly increasing cost of computer software diverts resources from other vital mission requirements. The increasing complexity of the threat has forced an increase in mission complexity and increased proliferation of digital computers and computer software. The current DOD computer software cost in excess of $3 billion per year is rapidly growing and this growth must be brought under control. The goal of this program is to apply technology in the system acquisition and maintenance process in order to reduce the life cycle costs of software by a factor of three and improve the quality of operational defense weapon system software by the Mid-1980's. This program is part of a joint service effort coordinated under the Office of the Secretary Defense (OSD) Management Steering Committee for Embedded Computer Resources and as such is responsive to DoD-wide deficiencies.

BASIS FOR FY 1981 RDT&E REQUEST: This program is part of the joint Defense System Software Research and Development (R&D) Technology program to overcome deficiencies in the development, acquisition, operation, and support of embedded computer resources. The primary thrusts of the Air Force program are to develop requirements analysis and life cycle management techniques; evaluate software quality and cost improvements using data collected from actual development programs; continue multilevel computer security initiative; develop policy and procedure guidance standardization; investigate and apply modern software engineering methods and tools; and achieve high order programming language standardization. The FY 1981 objective will be to advance the use of new proven software technologies by program managers and defense contractors and to institutionalize this use through acquisition policy guidance.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: 64740F
DoD Mission Area: Tactical Command and Control, #254

Title: Computer Resources Management Technology
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Recent studies by the Air Force and the Department of Defense (DOD) as well as observations by Congress, have established that the development and timely delivery of software of adequate quality is a major problem in weapon system development. New policies have been issued by the Air Force and DOD to improve the management of computer software acquisition. This program provides the technology transfer necessary to support these management initiatives. This program will develop and apply tools that provide the system developer rapid insight into the technical implications of stated system requirements on computer resources. These tools are used to identify costs and risk areas, and to explore implementation alternatives before making hardware, schedule, and financial commitments. Disciplined control of computer resources will be developed by improving tools and techniques. Management areas being addressed include computer software configuration item definiton and methodologies for control, management tools for control and the visibility of software development, engineering change proposal tracking and accounting methods, cost and requirements traceability and accountability tools and methods. This program is developing and recommending comprehensive, specific standards and procedures to guide the acquisition and support of computer resources. The initial task was to develop and maintain three sets of software acquisition management guidebooks that will use the products of related software tasks providing guidance for program and system managers on the implementation of requirements and concepts set forth in DOD Directives and Air Force Regulations and Standards. An additional task will provide technical and executive seminars to support transfer and application of computer resource acquisition technology to offset the current and projected shortage of trained computer resource specialists. A comprehensive, integrated set of engineering tools to improve Air Force software acquisitions is being developed. Tools and methods will be developed to facilitate the use of High Order Computer Languages (HOL) including compilier, translator and other support tool developments to accelerate Air Force standardization of JOVIAL J73 and Ada. A goal of the Ada program is to develop a single language to facilitate commonality and effectiveness between US Services and our North Alantic Treaty Organization allies. Instruction set standards for computers applied to command, control and communication (C^3) and intelligence applications will be developed. These standards define the software/hardware interface and will not stifle industry's creative initiative in electronics technology. These standards will allow the Government to capitalize on previous software investment, expand the competitiveness of the Government computer market and allow resources to be placed toward improving the quality, reliability and maintenance of embedded computers. This program provides the technology transfer of advanced multilevel computer security technologies, techniques, and validation procedures to meet USAF weapon system, resource management, C^3 and intelligence computer security requirements through commercially available automated data processing systems. This program supports the DOD Computer Security Technology Consortium, develops methodologies and criteria for validating the security of secure commercial computer systems, and underwrites the initial introduction of secure commercial computer systems into USAF

acquisition programs. Support to the DoD consortium was started in FY 79 and this project is the Air Force focal point to the DoD Computer Security Technology Consortium. Products of this program will provide the essential tools by which the new policies incorporated into DOD Directive 5000.29, "Management of Computer Resources in Major Defense Systems" will implemented.

RELATED ACTIVITIES: This program is closely related to PE 63728F, Advanced Computer Technology and will apply these advanced technologies to Air Force embedded computer resources. Other Air Force PEs which constitute the Air Force software science and technology program are: 62204F, Aerospace Avionics and 62702F Command, Control and Communications.

WORK PERFORMED BY: The Electronics Systems Division (ESD) Hanscom AFB, MA has management responsibilities for the program. Contractors include the System Development Corporation, Santa Monica, CA; TRW, Redondo Beach, CA; Boeing Computer Services, Seattle, WA; Logion Inc., Bedford, MA; University of Michigan, Ann Arbor, MI; MITRE Corporation, Bedford, MA; Doty Associates, Inc., Rockville, MD; Denver Research Institute, Denver, CO; and System Architecture Inc., Randolph, MA.

PROGRAM ACOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 79 and Prior Accomplishments: The utility of the previously developed Computer Aided Design and Specification Analysis Tool was successfully demonstrated through its use by several program offices. An estimated savings of $750,000 was realized through this tool's application to an analysis of an engineering change proposal for the E-3A. The JOVIAL Language Control Facility was established through the Rome Air Developemnt Center. Multilevel computer security efforts included co-sponsorship of the Air Force Computer Security Summer Study, participation in the DOD Computer Security Technical Consortium, and development work on a kernelized virtual machine secure system were started. Computer resource estimating methodologies were acquired and experimentally applied to program offices to estimate required contractor personnel resources and software development schedules. A project for developing computer sizing and timing methodologies was initiated. Additionally, a video tape series on the software acquisition process was begun in conjunction with the the Software Acquisition Guidebook series.

2. FY 80 Program: Previously initiated Software Acquisition Guidebook development will be completed for the Aeronautical Systems and Space Divisions. Exploration of automated requirements analysis tools will continue. Computer system acquisition merits, or measurement standards (software size, CPU usage, timing, throughput, etc.,) will be evaluated for inclusion in a software acquisition metrics handbook for direct use in the acquisition process. Development of a simulation capability for performing detailed analyses of alternative design approaches in the Conceptual Phase or early phase of acquisition will be accomplished and used in a Program Office to perform operational and design trade-off studies. Software resource and cost prediction methodologies will be expanded to aid in Program Office visibility into the contractor's software development. Multilevel computer security efforts will continue and emphasize involvement on the part of the commercial sector. Additionally, the National Software Works technology demonstration within Air Force Logistics Command will be initiated.

Program Element: #64740F
DoD Mission Area: Tactical Command and Control, #254

Title: Computer Resources Management Technology
Budget Activity: Tactical Programs, #4

3. FY 81 Planned Program: The High Order Language Control Facility for JOVIAL J73 language control will be transitioned to a fully operatioal status and begin validating compilers in support of the MX missile, Advanced Medium Range Air-to-Air Missile (AMRAAM) and the Army Pershing missile Program. Follow on enhancements to JOVIAL J73 compilers, development tools and validation aids will be undertaken to insure use of and conformance to this single JOVIAL standard as directed by Department of Defense (DoD) Instruction 5000.31. The development of a 32 bit, Ada efficient instruction set architecture standard will be started. A phased, multi contractor and public review approach is planned to insure maximum support from industry and potential DoD and North Alantic Treaty Organization wide applications. This instruction set architecture will also be responsive to Command, Control and Communication and Intelligence (C^3I) applications requiring multi level computer security, networking and fault tolerance. Planning efforts will be started to identify the most promissing program candidates for the low risk, high payoff introduction of Ada into Air Force system acquisition. The use of the National Software Works (NSW) technology to save software maintenance cost will be evaluated in two different Air Logistics Center operational environments. Software support facilities such as those serving the F-15, E-3A and F-111 will be linked for synergetic access and sharing of software maintenance tools. The most promising results will be pursued as the basis for high level demonstrations of the NSW in FY 1982. Tools developed for software cost prediction/estimation will be validated and applied on a major weapon system acquisition to be identified during FY 1980. Preparation will begin for the FY 1982 operational demonstration of multi level computer security technologies in the Advanced Tactical Air Control System environment and the US interface with the Korean Air Intelligence System. Technical support will continue to DoD computer security initiatives evaluating commercially developed trusted computer systems and Air Force program offices specifying computer security requirements.

4. FY 82 Planned Program: Proven automated requirements analysis tools will be transitioned to a support facility. A requirements definition and analysis guidebook will be developed. Efforts in support of the common Department of Defense high order language Ada will be continued. The Air Force Logistic Command operational demonstration of the National Software Work in a networked environment will be completed. Operational demonstrations of multilevel computer security technology will be conducted.

5. Program to Completion: While specific tasks will conclude, the level of effort will continue as new technology initiatives will be started.

Program Element: #64740F
DoD Mission Area: Tactical Command and Control, #254

Title: Computer Resources Management Technology
Budget Activity: Tactical Programs, #4

6. Milestones:

		Date
A.	Complete Cost estimation procedures	Jan 80
B.	Complete video tapes on software acquisition and initiate software training center	Jul 80
C.	Transition JOVIAL Control Facility	Jan 81
D.	Complete NSW Tool Bearing Host	Mar 81
E.	Apply Computer Security Verification Technology	Jul 81
F.	Evaluate Ada for use in JTIDS Class II terminals	Oct 81
G.	Demonstrate operational multi level secure computer	Mar 82
H.	Demonstrate Ada compiler and support environment	Jul 82
I.	Evaluate C^3I Instruction Set Architecture	Mar 83
J.	First Air Force government furnished total Ada environment	Jul 84

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT		3,000	2,800	5,200	Continuing	N/A
2522	Requirements Analysis		643	480	1,130	Continuing	N/A
2523	Management Control Technology		389	260	583	Continuing	N/A
2524	Policy and Procedure Guidance		887	350	433	Continuing	N/A
2526	Software Engineering Tools and Methods		981	1,110	1,654	Continuing	N/A
2239	Computer Security Technology		100	600	1,400	Continuing	N/A

The program reflects yearly realignment to the needs and priorities as outlined in the Office of the Secretary of Defense Computer Resource Management Research and Develoment Technology Plan and increased emphasis on the part of the Air Force on long term investment strategies to control the rapid introduction of computer technologies into weapon systems.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64742F
Title: Precision Location Strike Systems
DoD Mission Area: Electronic Warfare and Counter C^3, #257
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECTED LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	86,800	15,000	62,600	60,800	55,900	379,700
1190	Precision Location Strike System (PLSS)	79,500	11,800	61,900	60,200	55,300	327,900
1947	Emitter Location System (ELS)	2,200	1,200	0*	0	0	7,100
1949	Airborne Location Strike System (ALSS)	2,700	700	700	600	600	39,800
2106	Photogrammetric Target System (PTS)	0	0	0	0	0	1,200
2589	Joint Service Weapon Data Link (JSWDL)	2,400	1,300	0*	0	0	3,700

* Continue required development as part of PLSS, Project 1190.

BRIEF DESCRIPTION OF ELEMENT AND MISION NEED: The Soviet/Warsaw Pact forces are projected to continue to increase their air defense capability in support of 24 hour-a-day forces operations. Through the 1990s, significant increases in quantities, quality, mobility and countermeasures capabilities of enemy air defense systems are projected. The objective of this Program Element is to develop and test a tactical strike system that will locate, identify and provide an all weather attack capability against emitting enemy air defense systems and will provide an all weather attack capabiliy against non-radiating targets (bridges, armor, airfields, marshaling areas, etc.,). This capability, is rated by the 1977 Air Force/Army Tactical Reconnaissance Force Mix Study as number one in value to the tactical commander and the highest priority system in terms of cost versus payoff. Since then PLSS has received continuous support from the USAF tactical leadership and combat commanders. As late as November 1979, in a Theater Capability Review Study, PLSS was cited as the electronic warfare system to the technical growth of the emitter threat and an excellent foundation for This study reiterated the importance and significantly increased the priority of PLSS as the centerpiece for tactical operations theater-wide. This tactical system, in concert with other Air Force and Army systems, will significantly increase Air Force, Army and North American Treaty Organization (NATO) capabilities in defense suppression, close air support, interdiction and reconnaissance operations through the 1990s.

Program Element: #64742F
DoD Mission Area: Electronic Warfare and Counter C^3, #257

Title: Precision Location Strike Systems
Budget Activity: Tactical Programs, #4

BASIS FOR FY 1981 RDT&E REQUEST: Design of the Precision Location Strike System will be finalized with the Critical Design review scheduled early in the year. In addition, initial subsystem element hardware fabrication will begin. Demonstration of near-real time capabilities of Emitter Location System (ELS) will be done as part of the Coherent Emitter Location Testbed (CELT) and Battlefield Exploitation and Target Acquisition (BETA) programs. Advanced Location Strike System (ALSS) will support the Research, Development, Test and Evaluation (RDT&E) efforts for Precision Location Strike System (PLSS) risk reduction and tactical demonstrations/exercises. Elements of ALSS will be used to support Assult Breaker/Pave Mover test and demonstration. Development of the Photogrammetric Target System (PTS) is deferred until a statement of need is submitted and validated. The Joint Service Weapon Data Link (JSWDL) is being developed to provide anti-jam guidance of weapons using distance measuring equipment (DME), television (TV) and imaging infrared (IIR) techniques as well as hybrid combinations of these. Critcial Design Review (CDR) of JSWDL will be conducted. Development will be continued as an element of PLSS, Proj 1190.

OTHER APPROPRIATION: * ($ in thousands)

	FY 79 Actual	FY 80 Estimate	FY 81 Estimate	FY 82 Estimate	Additional to Completion	Total Estimated Costs
Aircraft Procurement (3010)				8.2	259.4	267.6*
Other Procurement (3080)				0	67.6	67.6*
(Quantities)					(1+)	(1+)*

* Funds shown here for reference will be in Program Element 27244F, Location Strike System and will be for augmentation and upgrade of the development system to an operational status. One complete PLSS system plus an additional ground station for training and deployment will be procured. Funds shown here include TR-1 airborne relay vehicles (ARVs) which would be in addition to the TR-1 procurement for the COMPASS CAPE mission. For the FY 1982 budget request the funds for these aircraft will be included into the TR-1 procurement program element, 27215F, which already contains an approved TR-1 procurement effort.

Program Element: #64742F
DoD Mission Area: Electronic Warfare and Counter C^3, #257

Title: Precision Location Strike Systems
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Soviet/Warsaw Pact tactical doctrine emphasizes a 24-hour a day capability with a strong emphasis on protection of ground forces using air defense systems to reduce the effectiveness of air-power. Since the mid-1960s, Soviet air defense systems have evolved from a small network of anti-aircraft artillery (AAA) and surface-to-air missils (SAM) sites to a large complex family of highly mobile SAMs and AAA weapons. Concurrent with this development has been a significant increase in Soviet jamming capability. In the Warsaw Pact countries alone, there are currently over SAM launchers, jammers, and anti-aircraft guns. Most of these weapons are radar controlled. Defense Intelligence Agency document, "Precision Location Strike System (PLSS) Electronics Warfare Threat Through 1990, " June 1977, projects trends

Current and projected Air Force and Army systems will threat. All weather operations are constrained by accurate weapons with capability, while all weather weapons systems are constrained by Delivery of weapons is primarily from within the lethal range of the enemy air defense systems. Current reconnaissance systems lack the ability to The development of the Precision Location Strike System (PLSS), Emitter Location System (ELS), and Photogrammetric Target System (PTS) is based on a building block approach to obtain an integrated tactical system which will substantially alleviate any of the critical deficiencies in our all-weather tactical defense suppression close air support interdiction attack and reconnaissance capabilities. The Advanced Location Strike System (ALSS) is the predecessor system which supports continued development of operational concepts for a PLSS system by the Tactical Air Command and serves as a Research, Development, Test and Evaluation (RDT&E) testbed for PLSS risk reduction efforts.

The PLSS project is the major development effort and the basic system to which other projects will be added to obtain the total required capability. The PLSS project is to design, fabricate and test a tactical system which will provide an all-weather standoff strike capability against both emitters and non-radiating targets. This capability, is rated by the 1977 Air Force/Army Tactical Reconnaissance Force Mix Study as number one in value to the tactical commander and the highest priority system in terms of cost versus payoff. Since the PLSS has received continuous support from the USAF tactical leadership and combat commanders. As late as November 1979, in a Theater Capability Review Study, PLSS was cited as the electronic warfare system to the technical growth of the emitter threat and an excellent foundation for This study reiterated the importance and significantly increased the priority of PLSS as the centerpiece for tactical operations theater-wide. The PLSS will provide a circular error probable (CEP) location accuracy against air defense systems and a CEP location accuracy against

#64742F Title: Precision Location Strike Systems

DoD Mission Area: Electronic Warfare and Counter C^3, #257 Budget Activity: Tactical Programs, #4

Once processed, located and identified, the system relays emitter information to the appropriate Air Force or Army battlefield commander within Emitter location is accomplished by using time-difference-of-arrival and direction-of-arrival techniques. Identification of emitter type is accomplished from comparison with known parameters. New signals are used to update the electronic order of battle data. Further identification is being developed as a part of the Precision Location Strike System (PLSS). The PLSS will be capable of operating in the dense emitter signal environment projected for Europe through 1990.

Attacks on radiating and non-radiating targets will be with standoff guided weapons such as the GBU-15 and with conventional ordnance using the PLSS Distance Measuring (DME) precision guidance. Use of DME guided standoff weapons significantly reduces the attrition of attacking forces from surface-to-air missile/anti-aircraft artillery (SAM/AAA) defenses. The PLSS will allow circular error probable (CEP) guidance accuracy giving a total system accuracy (location/strike) of less than emitters. Using DME units on attacking aircraft, the PLSS can direct unguided ordnance delivery within an CEP of the target location. The DME guidance data link being developed is the Joint Services Weapon Data Link (JSWDL) for use in the GBU-15, Navy Walleye, and other guided weapons. The data link will provide PLSS with high anti-jam protection to counter the Defense Intelligence Agency (DIA) projected threat environment.

Full Scale Engineering Development of the PLSS was initiated in September 1977 after review by the Defense System Acquisition Review Council and approval by the Deputy Secretary of Defense. The completion of the PLSS project has been slipped in order to fund higher priority programs in FY 1980.

The Emitter Location System (ELS), Project 1947, is being developed to accurately locate for attack accuracy

The addition of ELS as an integrated subsystem of PLSS will give the Air Force the total capability for accurate location and all-weather attack of the full range of emitting enemy air defense systems. The ELS approach uses
and has been pursued as a separate effort. The technology has rapidly advanced and the ELS capability can be integrated into PLSS through a phased approach to achieve location

The development of Photogrammetric Target System (PTS), Project 2106, could provide the accurate location of fixed non-radiating targets for attack by the PLSS or other attack systems. The PTS will use strategic or tactical reconnaissance photography, side looking radar, or other high resolution imagery together with photogrammetric (photography derived) data base materials to precisely determine target locations consistent with PLSS near-real

time capability and accuracy. The current capability, the Analytical Point Positioning System (APPS), can derive target information; however, each target location requires to process after identification by the photointerpreter.

The Advanced Location Strike System (ALSS), Project 1949, is the predecessor system to PLSS. The ALSS was designed to quickly deploy to Southeast Asia (SEA) in 1972 to locate and destroy sites. ALSS was never deployed to SEA; however, it was deployed to Europe for operational test and evaluation. The known limitations (limited frequency coverage, weapons control, vulnerabilities to countermeasures, etc.,) precluded introduction of ALSS into the operational inventory. Studies concluded that it was not cost-effective to modify ALSS to meet the PLSS requirement. ALSS is being used jointly by Air Force Systems Command as an Research, Development, Test and Evaluation testbed and by the Tactical Air Command in operational exercises to develop and refine operational concepts for a PLSS system.

The development of the Joint Service Weapon Data Link (JSWDL), Project 2589, will provide a data link for tactical guided weapons by merging elements of the Air Force PLSS and Army Modular Integrated Communication Navigation System (MICNS).

RELATED ACTIVITIES: The GBU-15 modular glide weapons used with PLSS are developed under Program Element (PE) 64733F, Surface Defense Suppression. The portion of the JSWDL is being developed in conjunction with the Army's MICNS currently under full scale development. Advanced development work within PE 63727F, Advanced Communication Technology, has been structured to complement JSWDL and MICNS full scale development and provide improvements to the capability. The PLSS program is being coordinated with the Army's AGTELIS program, PE 31011G, which is An emitter identification effort has Army and Navy participation through sharing of technology, equipment and test information. Demonstration of the Emitter Location System (ELS) capability is a joint Air Force/Army/Defense Advanced Research Project Agency (DARPA) effort associated with Battlefield Exploitation and Target Acquisition (BETA) under PE 27431F, Tactical Air Intelligence Systems. The airborne relay vehicles (TR-1) will be procured under PE 27215F, TR-1 Squadron.

WORK PERFORMED BY: Overall management of all projects in this program element is by Air Force Systems Command, Aeronautical Systems Division, Wright-Patterson AFB, OH. See individual project descriptions on Precision Location Strike System (PLSS) and Advanced Location Strike System for details on specific contractors and participating organizations. The PLSS prime contractor is Lockheed Missiles and Space Company (LMSC), Sunnyvale, CA. The contractor for the command link, Distance Measuring Equipment (DME) link, and radio frequency (RF) modules is the PLSS DME subcontractor, Harris Corporation, Melbourne, FL. The JSWDL video modules will be developed under MICNS full scale development program, managed by the Army Electronics Research and Development Command (ERADCOM), Combat Surveillance and Target Acquisition Laboratory, Ft Monmouth, NJ. Air force advanced development efforts for follow-on JSWDL modular improvements are managed by Air Force Systems Command (AFSC), Air Force Avionics Laboratory (AFAL), Wright-Patterson AFB, OH. AFAL contractors are General Electric Company, Utica, NY; RCA, Camden, NJ; and Motorola Corporation, Scottsdale, AZ.

Program Element: #64742F
DoD Mission Area: Electronic Warfare and Counter C^3, #257

Title: Precision Location Strike Systems
Budget Activity: Tactical Programs, #4

MIT Lincoln Laboratory, Lexington, MA, performs studies and provides consultive services. Tactical cognizance of the Emitter Location System is performed by the Rome Air Development Center (RADC), Rome, NY with International Business Machines (IBM) Owego, NY, as the development contractors. Technical cognizance of the Photogrammetic Target System is performed by Rome Air Development Center, Rome, NY.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Precision Location Strike (PLSS) contractor, Lockheed Missiles and Space Company, was selected in June 1977. The Defense System Acquisition Review Council II (Development Readiness) review was held in July 1977 and the Deputy Secretary of Defense approved PLSS full scale development on 1 September 1977. System Requirements Review was held in January 1978. System Design Review was held in May 197. Subcontractor Preliminary Design Reviews (PDRs) began in July 1978 to support subsystem PDRs beginning in November 1978. The system PDR was conducted satisfactorily in October 1979. Brassboard fabrication and testing aimed at risk reduction were also initiated. An independent contractor for software validation and verification, SoftTech Corporation, was selected and began efforts to support the program. Discussions were conducted with North American Treaty Organization (NATO) allies on the combat potential of PLSS in NATO. Discussion on operational integration of PLSS into the NATO structure were also initiated.

An emitter identification effort was initiated in 1973 with initial emphasis on feasibility demonstration of the technique. A large enough data base of emitters to give confidence in the technique under limited conditions was established in 1973-74. Three Advanced Identification signal processors were built in 1974 and became the brassboards for the Air Force testing of the technique. From 1975 to 1977, a large data base was collected to demonstrate feasibility under a wider range of conditions. This effort culinated in a flight test conducted during September 1978.

Since 1975, the Advanced Location Strike System (ALSS) has been utilized as a testbed to help define the PLSS baseline configuration, and in developing, evaluating, and refining operational concepts for a PLSS. Distance measuring equipment (DME) guidance for both guided and unguided ordnance delivery was demonstrated using a Pod Relay Subsystem on tactical aircraft. The Air Force and Army jointly succeeded in integrating the capabilities of moving target indicator radars with DME guidance techniques, and also demonstrated DME guidance by ALSS of surface-to-surface missiles. ALSS was utilized in the Red Flag and Blue Flag operational exercises and in successful demonstrations of DME guided GBU-15 Cruciform Wing and Planar Wing Weapons, the latter demonstration was completed in July 1979.

Project 1947, Emitter Location System (ELS) study efforts and follow-on demonstration programs show the ELS technique to be viable for precise location. The technique proven by a Defense Advanced Research Projects Agency (DARPA) sponsored program was integrated into the PLSS baseline design for Phase I of ELS/PLSS integration. Following completion of the ELS demonstrations in March 1978, ELS funds and equipment were applied to support the Joint/AF/Army/DARPA Coherent Emitter Location Testbed (CELT) development.

Program Element: #64742F
DoD Mission Area: Electronic Warfare and Counter C^3, #257

Title: Precision Location Strike Systems
Budget Activity: Tactical Programs, #4

Project 2106, Photogrammetric Target System (PTS), was initiated in 1974 with initial emphasis on a manual system for use with the Advanced Location Strike System, to be followed b a more automated system of greater capacity to be used throughout the Tactical Air Forces. Development of the manual system was cancelled in April 1975 with the Air Force procurement of the Army Analytical Point Positioning system. A service test model (STM) was procured for development of optical exploitation techniques and software for a PTS. A study of Tactical Air Force requirements began in September 1977 to resolve issues involving point positioning requirements.

In July 1977, the Precision Location Strike System (PLSS) Defense Systems Acquisition Review Council (DSARC) II directed the Air Force to incorporate the Joint Service Weapon Data Link (JSWDL) into the PLSS development program. A JSWDL system analysis was initiated under the PLSS contract in September 1977 and completed in December 1977. A JSWDL development plan was approved in April 1978 whereupon the PLSS contractor was directed to initiated JSWDL design definition efforts. The Air Force also incorporated JSWDL requirements into the Army's Modular Integrated Communication Navigation System (MICNS) program.

2. FY 1980 Program: Design efforts and engineering tests will intensify, culminating in completed drawings and specifications for the system Critical Design Review. Precision Location Strike System (PLSS) subsystems will be fabricated. Qualification and acceptance testing of completed subunits will be initiated. Integration tasks relating to test and checkout of subsystems will also be initited. Software development is to be continued. Advanced Location Strike System (ALSS) will continue to support development testing associated with PLSS risk reduction as well as increasing knowledge of distance measuring equipment (DME) and time of arrival (TOA) techniques. ALSS will participate in joint Air Force/Army demonstrations. ELS funds will continue to contribute to joint funding for the Coherent Emitter Location Testbed (CELT) and to support continuation of ELS/PLSS integration. Following flight tests, the CELT system will be transported to Europe for demonstration. Design/integration efforts leading to the Critical Design Review (CDR) for JSWDL will continue. Fabrication of JSWDL components will be initiated and the video modules from the Army data link will be integrated with the JSWDL modules.

3. FY 1981 Planned Program: During this period the CDR will be conducted. PLSS subsystem fabrication will continue. Qualification and acceptance testing of compeleted units will occur. Software development and independent software validation and verification will continue. Advanced Location Strike System (ALSS) will continue to support development testing primarily in development of baseline data for PLSS test with potential use as range instrumentation during initial phases of PLSS Development Test and Engineering (DT&E). Emitter Location System (ELS)/PLSS integration will continue as a part of Precision Location Strike System (PLSS), Project 1190 to extend the PLSS threat and frequency coverage. Joint Service Weapon Data Link (JSWDL) qualification testing will be conducted as part of PLSS, Project 1190.

4. FY 1982 Planned Program: Precision Location Strike System (PLSS) Subcontractor units will be fabricated and delivered for system integration, testing and checkout. Software development will be completed. Test aircraft

delivered for system integration, testing and checkout. Software development will be completed. Test aircraft modification will occur. Procurement of Development Test and Engineering/Initial Operational Test and Evaluation (DT&E/IOT&E)items will begin. Advanced Location Strike System (ALSS) will continue support through DT&E and phase out in late FY 1983.

5. Program to Completion: The combined DT&E/IOT&E for the PLSS will be completed followed by a Defense System Acquisition Review Council review for production. The ALSS will continue to support PLSS development testing into FY 1983. A positive production decision will be followed by initial deliveries beginning in late FY 1984. Emitter Location System (ELS)/PLSS integration will be completed. Joint Service Weapon Data Link (JSWDL) operational testing and correction of deficiencies will be completed.

6. Milestones:

			Date
A.	Area Coordinating Paper Number 4		Mar 1972
B.	TAF ROC 314-74 Validated		Nov 1974
C.	ALSS - Deployment to Europe		May 1975
D.	PLSS Defense System Acquisition Review Council (DSARC) II/Milestone II		Jul 1977
E.	ELS Feasibility Demonstration Complete		Mar 1978
F.	Photogrammetric Targeting System (PTS) Studies Complete		Oct 1978
G.	PLSS DSARC Review	*(May 1979)	TBD
H.	PTS - Start Development	*(Oct 1980)	TBD
I.	Complete JSWDL DT&E	* (TBD)	
J.	Initiate PLSS DT&E/IOT&E	* (TBD)	Sep 1982
K.	Complete JSWDL IOT&E	* (TBD)	Dec 1983
L.	Complete DT&E/IOT&E - PLSS	* (TBD)	Dec 1983
M.	PLSS DSARC III/Milestone III	* (TBD)	Mar 1984
N.	PTS - Production Decision	* (TBD)	TBD
O.	PLSS Initial Operational Capability (1st production unit, 1st UE squadron)	* (TBD)	

* Data presented in FY 1980 Descriptive Summary.

EXPLANATION OF MILESTONES CHANGES: See Section 8.

7. Resources: Not Applicable

Program Element: #64742F — Title: Precision Location Strike Systems
DoD Mission Area: Electronic Warfare and Counter C^3, #257 — Budget Activity: Tactical Programs, #4

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	31,704	86,800	24,900	77,600	88,200	376,104
1190	Precision Location Strike System (PLSS)	30,504	74,900	21,800	59,900	52,600	268,404
1947	Emitter Location System (ELS)	0	3,000	2,800	10,300	19,100	38,900
1949	Advanced Location Strike System (ALSS)	1,200	6,400	100*	1,500	1,000	43,500
2106	Photogrammetric Target System (PTS)	0	100	100	2,800	4,900	9,100
2589	Joint Service Weapon Data Link (JSWDL)	0	2,400*	100*	3,100	10,600	16,200

* for FY 1980 and beyond, Project 1949 contains funds previously programmed in PE 35157F, Advanced Location Strike System. Project 2589, JSWDL is a new project in FY 1980 but was a part of Project 1190, PLSS in FY 1979.

The FY 1980 estimate of FY 1981 requirements for the Program Element (PE) was $77,600 thousand. The FY 1981 request of $62,000 thousand reduced the PE by $15,600 thousand in order to fund programs of higher priority. The reduction was associated with the FY 1980 reduction and requires major schedule adjustments in all of the projects in the PE. Funding requirements for FY 1982 through completion are preliminary estimates pending schedule adjustments based on the reduction. Total estimated cost of the PE increased by $1,300 thousand to $377,400 thousand primarily as a result of the shift of efforts into FY 1982 and beyond. Development of the Photogrammetric Target System, Project 2106, has been deferred until a statement of need is submitted and validated. Development of the Emitter Location System, Project 1947, and the Joint Service Weapon Data Link, Project 2589, as they apply to Precision Location Strike System (PLSS) requirements, are being carried as part of the PLSS, Project 1190, funds.

Project: 1190 Title: Precision Location Strike System (PLSS)
Program Element: # 64742F Title: Precision Location Strike System
DoD Mission Area: Electronic Warfare and Counter C^3, #257 Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Soviet/Warsaw Pact tactical doctrine emphasizes a 24 hour-a-day capability with a strong emphasis on protection of ground forces using air defense systems to reduce the effectiveness of airpower. Since the mid-1960s, Soviet air defense systems have evolved from a small network of anti-aircraft artillery (AAA) and surface-to-air missile (SAM) sites to a large complex family of highly mobile SAMs and AAA weapons. Concurrent with this development has been a significant increase in Soviet jamming capability. In the Warsaw Pact countries alone, there are currently over SAM launchers, jammers, and anti-aircraft guns. Most of these weapons are radar controlled. Defense Intelligance Agency document, "Precision Location Strike System (PLSS) Electronic Warfare Threat Through 1990," June 1977, projects trends

Current and projected Air Force and Army systems will threat. All weather operations are constrained by accurate weapons' capability while all weather weapons systems are constrained Delivery of weapons is primarily from within the lethal range of the enemy air defense system. Current reconnaissance systems lack the ability to The development of the PLSS, Emitter Location System (ELS), and Photogrammetric Target System (PTS) is based on a building block approach to obtain an integrated tactical system which will substantially alleviate many of the critical deficiencies in our all-weather tactical defense suppression close air support interdiction attack and reconnaissance capabilities. The Advanced Location Strike System (ALSS) is the predecessor system which supports continued development of operational concepts for a PLSS system by the Tactical Air Command and serves as a Research, Development, Test and Evaluation testbed for PLSS risk reduction efforts.

The PLSS project is the major development effort and the basic system to which other projects will be added to obtain the total required capability. The PLSS project is to design, fabricate and test a tactical system which will provide an all-weather standoff strike capability against both emitters and non-radiating targets. This capability, is rated by the 1977 Air Force/Army Tactical Reconnaissance Force Mix Study as number one in value to the tactical commander and the highest priority system in terms of cost versus payoff. Since then PLSS has received continuous support from the USAF tactical leadership and combat commanders. As late as November 1979, in a Theater Capability Review Study, PLSS was cited as the electronic warfare system to the technical growth of the emitter threat and an excellent foundation for This study reiterated the importance and significantly increased the priority of PLSS as the centerpiece for tactical operations theater-wide. The PLSS will provide a circular error probable (CEP) location accuracy against air defense systems and a CEP location accuracy against

Project: 1190 Title: Precision Location Strike System (PLSS)
Program Element: # 64742F Title: Precision Location Strike System
DoD Mission Area: Electronic Warfare and Counter C^3, #257 Budget Activity: Tactical Programs, #4

Once processed, located and identified, the system relays emitter information to the appropriate Air Force or Army battlefield commander within Emitter location is accomplished by using time-difference-of-arrival and direction-of-arrival techniques. Identification of emitter type is accomplished from comparison with known parameters. New signals are used to update the electronic order of battle data. Further identification is being developed as a part of the Precision Location Strike System (PLSS). The PLSS will be capable of operating in the dense emitter signal environment projected for Europe through 1990.

Attacks on radiating and non-radiating targets will be with standoff guided weapons such as the GBU-15 and with conventional ordnance using the PLSS Distance Measuring Equipment (DME) precision guidance. Use of DME guided stand-off weapons significantly reduces the attrition of attacking forces from surface-to-air missile/anti-aircraft artillery (SAM/AAA) defenses. The PLSS will allow circular error probable (CEP) guidance accuracy giving a total system accuracy (location/strike) of less than emitters. Using DME units on attacking aircraft, the PLSS can direct unguided ordnance delivery within an CEP of the target location. The DME guidance data link being developed is the Joint Services Weapon Data Link (JSWDL) for use in the GBU-15, Navy Walleye, and other guided weapons. The data link will provide PLSS with high anti-jam protection to counter the Defense Intelligence Agency projected threat environment.

Full Scale Engineering Development of the PLSS was initiated in September 1977 after review by the Defense System Acquisition Review Council and approval by the Deputy Secretary of Defense. The completion of the PLSS project has been slipped in order to fund higher priority programs in FY 1980.

RELATED ACTIVITIES: The GBU-15 modular glide weapons used with PLSS are developed under Program Element (PE) 64733F, Surface Defense Suppression. The portion of the JSWDL is being developed in conjunction with the Army's Modular Integrated Communication Navigation System (MICNS) currently under full scale development. Advanced development work within PE 63727F, Advanced Communication Technology, has been structured to complement JSWDL and MICNS full scale development and provide improvements to the capability. The PLSS program is being coordinated with the Army's AGETLIS program, PE 31011G, which is a An emitter identification effort has Army and Navy participation through sharing of technology, equipment and test information. Demonstration of the Emitter Location System capability is a joint Air Force/Army/Defense Advanced Research Project Agency effort associated with Battlefield Exploitation and Target Acquisition (BETA) under PE 27431F, Tactical Air Intelligence Systems. The airborne relay vehicles (TR-1) will be procured under PE 27215F, TR-1 Squadron.

WORK PERFORMED BY:

Development of Precision Location Strike System (PLSS) is managed by the Air Force System Command, Aeronautical System Division, Wright-Patterson AFB, OH. The prime contractor is the Lockheed Missiles and Space Company, Sunnyvale CA.

Project: 1190 Title: Precision Location Strike System (PLSS)
Program Element: # 64742F Title: Precision Location Strike System
DoD Mission Area: Electronic Warfare and Counter C^3, #257 Budget Activity: Tactical Programs, #4

Major subcontractors are: E-System, Garland, TX (intercept equipment and aircraft modification); Sperry Univac, Salt Lake City, UT (data link equipment); IBM, Owego, NY (strike and jammer location software and equipment); Collins, Dallas, TX (ground communications subsystems); Control Data Corporation, Minneapolis, MN (UYK-25 computers); Brunswick, Marion, VA (shelters); Harris Corporation, Melborne, FL (navigation and strike data link), and Motorola Corporation, Phoenix, AZ (displays). MIT Lincoln Laboratory, and Aerospace Corporations perform studies, analyses and related efforts in support of PLSS. Softech Corporation performs independent software verification and validation.

PROGRAMS ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments:

The contractor, Lockheed Missile and Space Company, was selected in June 1977. The Defense System Acquisition Review Council Milestone II (Development Readiness) review was held in July 1977 and the Deputy Secretary of Defense approved PLSS Full Scale Development on 1 September 1977. System Requirements Review was held in January 1978. System Design Review was held in May 1978. Subcontractor Preliminary Design Reviews (PDR) began in July 1978 in preparation for subsystem PDRs beginning in October 1978. Subsystem PDRs supported the system PDR held in October 1979. Brassboard fabrication and testing for risk reduction was also initiated. An independent contractor for software validation and verification, SofTech Corporrion, was selected and began efforts to support the program. Discussions were conducted with North Atlanta Treaty Organization (NATO) allies on the combat potential of PLSS in NATO and on the operational integration of PLSS into the NATO structure. The Task Force 7, Electronic Warfare report as a part of the NATO Long Term Defense Program recommended the

2. FY 1980 Program:

PLSS contractors will continue design efforts, engineering tests, and documentation culminating in completed drawings and specifications for the subsystem Critical Design Reviews (CDR). Software development will continue. Integration tasks relating to test and checkout of subsystems will be initiated.

3. FY 1981 Planned Program:

During this period, the system CDR will be conducted. Subsystem elements will be fabricated by subcontractors. Qualification and acceptance testing of completed units will continue. Integration tasks relating to test and check-out at the subsystem level will also continue.

Project: 1190
Program Element: # 64742F
DoD Mission Area: Electronic Warfare and Counter C3, #257

Title: Precision Location Strike System (PLSS)
Title: Precision Location Strike System
Budget Activity: Tactical Programs, #4

4. FY 1982 Planned Program:

Precision Location Strike System subcontractor units will be fabricated and delivered for system integration, testing and checkout. Software development will be completed. Test aircraft modification will occur. Procurement of Development Testing and Engineering/Initial Operational Test and Evaluation (DT&E/IOT&E) items will begin.

5. Program to Completion:

Combined DT&E/IOT&E will continue and is scheduled to be completed in December 1983 followed by a Milestone III (production) review.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

6. Milestones

		Date
A.	TAF ROC 314-74 Validated	Nov 1974
B.	Defense System Acquisition Review Council (DSARC) II/Milestone II	Jul 1977
C.	Full Scale Development Contract	Sep 1977
D.	Airborne Relay Vehicle Decision	Oct 1978
E.	Preliminary Design Review *(May 1977)	Oct 1979
F.	DSARC Review *(May 1979)	TBD
G.	Critical Design Review *(TBD)	Dec 1980
H.	Initiate DT&E/IOT&E *(TBD)	Sep 1982
I.	Complete DT&E/IOT&E *(TBD)	Dec 1983
J.	DSARC III/Milestone III *(TBD)	Mar 1984
K.	PLSS Initial Operational Capability (first production unit, first UE Squadron) *(TBD)	

* Date presented in FY 1980 Descriptive Summary.

EXPLANANTION OF MILESTONE CHANGES: See Section 8.

Project: 1190 — Title: Precision Location Strike System (PLSS)
Program Element: # 64742F — Title: Precision Location Strike System
DoD Mission Area: Electronic Warfare and Counter C^3, #257 — Budget Activity: Tactical Programs, #4

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimate Costs
Project 1190, Precision Location Strike System (PLSS)	79,500	11,800	61,900	60,200	55,300	327,900

8. Comparision with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimate Costs
Project 1190, Precision Location Strike System (PLSS)	30,504	74,900	21,800	59,900	52,600	268,404

The FY 1980 estimate for the FY 1981 project requirement was $59,900 thousand. The FY 1981 request of $61,900 thousands is an increase of $2,000 thousand due to rephasing and restructuring the program as a result of FY 1980 fiscal constraints. Funding requirements for FY 1981 through completion are preliminary estimates pending schedule adjustments based on the reduction.

Project: 1949 — Title: Advanced Location Strike System (ALSS)
Program Element: # 64742F — Title: Precision Location Strike System
DoD Mission Area: Electronic Warfare and Counter C^3, #257 — Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Losses to Surface to Air Missiles (SAMS) early in 1972 during the Southeast Asian (SEA) conflict led to the establishment of a high priority, quick reaction program to supress these SAMS. The Advanced Location Strike System (ALSS) was developed using technology developed under previous programs (COMPASS STRIKE, Time of Arrival Location System, Defense Suppression Task 04, Electronic Emitter Location System, etc) to quickly deploy to SEA to locate and destroy sites. Due to the termination of hostilities, ALSS was never deployed to SEA. It was recognized that the ALSS would not satisfy Air Force requirements for the 1980s; however, ALSS was deployed to Europe in 1975 as a possible interim capability. Inherent design characteristics precluded introducing ALSS into the inventory and modifications to satisfy the operational requirment were not cost effective. The ALSS does not have the signal-sorting and data processing capability to handle the dense electromagnetic environment of Europe and is vulnerable to enemy countermeasures. The data links are especially vulnerable The ALSS was returned to the Continential United States and located at Holloman AFB, NM. The ALSS has been used jointly as a development testbed by Air Force Systems Command and by the Tactical Air Command for operational exercises and for development of operational concepts for a Precision Location Strike System (PLSS).

The ALSS includes the following major elements: a master ground control station; ground Distance Measuring Equipment (DME) beacons for accurate location and positioning of airborne elements; airborne intercept receivers and relay equipment. Contractor maintenance support is used for the system.

RELATED ACTIVITIES: Operational and Maintenance funds from Program Element (PE) 27244, Location Strike System, have been used to support the Air Force Systems Command Detachment operations.

WORK PERFORMED BY: The ALSS project is managed by the Air Force Systems Command, Aeronautical Systems Division, Wright-Patterson AFB, OH. Contractor maintenance support is provided by IBM, Owego, NY.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Advanced Location Strike System has been used extensively as a development testbed since 1975. Test results from ALSS were used to help define the baseline configuration for the Precision Location Strike System (PLSS). Data link vulnerability testing was accomplished and the concept for using a pod relay subsystem on tactical aircraft for Distance Measuring Equipment (DME) guidance of guided and unguided ordnance delivery was demonstrated. A joint effort with the Army was successfully completed which combined multilateration moving target indicator radars with DME guidance techniques. It demonstrated detection and tracking of ground moving targets for strike, and the use of Distance Measuring Equipment (DME) guided standoff glide weapons for accurate attack against the moving targets. An FY 1977 joint effort with the Army demonstrated DME guidance by Advanced Location Strike System (ALSS) of surface-to-surface missiles. Modified Hawk Missiles were used at missile ranges of miles, miss distances

Project: 1949 Title: Advanced Location Strike System (ALSS)
Program Element: # 64742F Title: Precision Location Strike System
DoD Mission Area: Electronic Warfare and Counter C^3, #257 Budget Activity: Tactical Programs, #4

ranged from ALSS has been used by the Tactical Air Command in developing, evaluating, and refining operational concepts for a Precision Location Strike System (PLSS). ALSS has been used in both RED FLAG and BLUE FLAG operational exercises. In FY 1977, sixty four (64) triad missions (each mission requires three U-2C aircraft carrying the ALSS equipments) were flown for both development and operational efforts. ALSS supported DME guidance testing with the GBU-15 Planar Wing Weapon (PWW). These tests assisted in defining the GBU-15 PWW DME guidance parameters for inclusion into the Precision Location Strike System software routines and were completed in July 1979. S

2. FY 1980 Program: ALSS will continue to support development testing associated with PLSS risk reduction as well as increasing knowledge of distance measuring equipment (DME) and time of arrival (TOA) techniques.

3. FY 1981 Planned Program: ALSS will continue to support development testing primarily in development of baseline data for PLSS test with potential use as range instrumentation during initial phases of PLSS Development Test and Engineering (DT&E).

4. FY 1982 Planned Program: ALSS will continue support through DT&E and phase out in late FY 1983.

5. Program to Completion: ALSS will continue to support development testing through FY 1983. As the PLSS enters into development testing in FY 1983, the ALSS will be phased out. Air Force Systems Command and Tactical Air Command personnel associated with the ALSS will become the test cadre for the PLSS.

6. Milestones:

	Date
Start Development	1971
Development Testing	1972
Initial Operational tests	1973
Deployment to Europe (CONSTANT TREAT)	May 1975
GBU-15 Cruciform Wing Weapon Tests	Sep 1976
RED FLAG Exercise	Sep 1977
GBU-15 Planar Wing Weapon Tests	Sep 1978 and Jul 1979
RED FLAG Exercise	Sep and Nov 1978
Begin Phase Out	Oct 1982
Phase Out	1983

Project: 1949 — Title: Advanced Location Strike System (ALSS)
Program Element: # 64742F — Title: Precision Location Strike System
DoD Mission Area: Electronic Warfare and Counter C^3, #257 — Budget Activity: Tactical Programs, #4

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Project 1949, Advanced Location Strike System (ALSS)	2,700	700	700	600	600	39,800

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Project 1949, Advanced Location Strike System (ALSS)	1,200	6,400	100	1,500	1,000	43,500

* For FY 1980 and beyond Project 1949 contains funds previously programmed in PE 35157F, Advanced Location Strike System.

The FY 1980 estimate of FY 1981 project requirement was $1,500 thousand. The FY 1981 request of $700 thousand is a reduction of $800 thousand brought on by restructuring the whole program element and reducing the ALSS project as a result of the FY 1980 budget cut.

Project: #2589 — Title: Joint Service Weapon Data Link (JSWDL)
Program Element: #64742F — Title: Precision Location Strike Systems
DoD Mission Area: Electronic Warfare and Counter C^3, #257 — Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: Because the Soviet/Warsaw Pact forces continue to emphasize jamming in tactical ground operations, any data link deployed as part of a tactical weapon system must be capable of successful operation in a tactical jamming environment. In 1985, this environment will be particularly severe for strike systems which must operate in close proximity to jammers deployed on targets beyond the Forward Edge of the Battle Area (FEBA). In recognition of this fact, the Tactical Air Forces stated the requirement for anti-jam guidance of the GBU-15 using Distance Measuring Equipment (DME), television (TV), and imaging infrared (IIR) techniques. Present GBU-15 guidance capability consists of a video/command data link currently used in conjunction with a TV seeker. This data link has insufficient jam resistance to survive in the 1985 tactical jamming environment. In 3Q FY 77, DoD directed Joint Service participation in the development and integration of a tri-Service anti-jam data link for Remotely Piloted Vehicle (RPV), WALLEYE and the GBU-15. The developments to be utilized are the Air Force Precision Location Strike System (PLSS) and the Army Modular Integrated Communication Navigation System (MICNS). In PLSS full scale development (FSD), the Air Force combines the GBU-15 DME and imagery link requirements to define a modular data link architecture which accomodates all the desired weapon guidance options. Within this architecture, PLSS also provides command link, DME response link, and radio frequency (RF) modules. Video link modules will be provided by the MICNS FSD, which combines the Standoff Target Acquisition System (SOTAS) and mini-RPV data link requirements into a single command/video link. The resultant Joint Service Weapon Data Link (JSWDL) program is conducted in program element (PE) 64742F, Project 2589. This project integrates the JSWDL and the GBU-15.

RELATED ACTIVITIES: Related and supporting efforts are pursued in PE 64733F, Project 2226, JSOR Data Link which has responsibility to integrate a video data link into the GBU-15. PE 63727F, Advanced Communications Technology, conducts advanced development efforts for follow-on improvements to JSWDL modules; PE 64733F, Project 2195 Surface Defense Suppression (GBU-15), develops basic planar and cruciform wing verions of the GBU-15 which will use the JSWDL.

WORK PERFORMED BY: JSWDL is managed by the Air Force Systems Command (AFSC), Aeronautical Systems Division (ASD), Wright-Patterson AFB, OH. The JSWDL integrating contractor is the PLSS prime contractor, Lockheed Missiles and Space Company, Sunnyvale, CA. The contractor for the command link, DME link, and radio frequency modules is the PLSS DME subcontractor, Harris Corporation, Melbourne, FL. The video modules will be developed under the MICNS FSD program, managed by the Army Electronics Research and Development Command, Combat Surveillance and Target Acquisition laboratory, FT Monmouth, NJ. Air Force advanced development efforts for follow-on JSWDL modular improvements are managed by AFSC, Air Force Avionics Laboratory (AFAL), Wright-Patterson AFB, OH. AFAL contractors are General Electric Company, Utica, NY; RCA, Camden, NJ; and Motorola Corporation, Scottsdale, AZ. Support for JSWDL/GBU-15 integration and test will be provided by the GBU-15 prime contractors, Rockwell International Corporation, Columbus, OH for the Cruciform Wing Weapon (CWW) and Hughes Aircraft Company, Canoga Park, CA, for the Planar Wing Weapon (PWW). MIT Lincoln Laboratory, Lexington, MA, performs studies and analyses and provides consultative services in suppport of JSWDL. GBU-15 development is managed by AFSC, Armament Division, Eglin AFB, FL.

Project: #2589 Title: Joint Service Weapon Data Link (JSWDL)
Program Element: #64742F Title: Precision Location Strike Systems
DoD Mission Area: Electronic Warfare and Counter C^3, #257 Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In July 1977, the Precision Location Strike System (PLSS) Defense Systems Acquisition Review Council (DSARC) Milestone II directed the Air Force to incorporate Joint Service Weapon Data Link (JSWDL) into the PLSS full scale development (FSD) Program. A JSWDL systems analysis was initiated under the PLSS contract in September 1977 and completed in December 1977. A JSWDL development plan was submitted to the Air Staff in February 1978 and approved by the Air Staff and the Secretary of Defense in April 1978. In April 1978, a JSWDL specification and Statement of Work were written and put on contract by means of a change order for initial JSWDL design definition efforts leading to the submission of an Engineering Change Proposal (ECP) for the total JSWDL program. In September 1978, the ECP was received by the Air Force. During 2-4Q FY 78, the Air Force incorporated JSWDL requirements into the Modular Integrated Communication and Navigation System (MICNS) Request For Proposal, which was released to industry in August 1978. Harris Corporation was awarded the MICNS contract.

2. FY 1980 Program: A supplemental agreement to the PLSS contract will be negotiated, incorporating the JSWDL ECP and continuing the design effort initiated by change order during this period. The PLSS contractor will begin work on an aircraft data link pod for the reception of jam-resistant imagery transmissions from the GBU-15.

3. FY 1981 Planned Program: A Preliminary Design Review for the pod and GBU-15 JSWDL terminals will be held in July 1981. GBU-15 weapon system operator evaluation of jam-resistant TV image quality will be conducted under an Army simulation contract with Hughes Aircraft Company. JSWDL antenna testing on a mockup of the GBU-15 will be conducted by Lockheed Missile and Space Corp. at Rome Air Development Center. Government furnished equipment will be purchased. Fabrication of JSWDL components will be initiated.

4. FY 1982 Planned Program: A Critical Design Review of the pod and GBU-15 JSWDL terminals will be held in February 1982. Fabrication of JSWDL components will be completed, and the video modules from the Army MICNS will be integrated with the command link, Distance Measuring Equipment (DME), and radio frequency modules. Qualification testing of the entire data link will begin.

5. Planned Program to Completion: JSWDL qualification testing will be completed. JSWDL/GBU-15 integration and flight testing utilizing the Cruciform Wing Weapon (CWW) will be conducted. Production planning will be completed and a product decision for the use of JSWDL on the GBU-15 CWW will be obtained. Operational testing and correction of deficiencies will be completed. Production initiated in FY 83 will lead to availability of first production hardware in CY 1985.

6. Milestones: Not Applicable

Project: #2589
Program Element: #64742F
DoD Mission Area: Electronic Warfare and Counter C_3, #257

Title: Joint Service Weapon Data Link (JSWDL)
Title: Precision Location Strike System
Budget Activity: Tactical Programs, #4

7. Resources: ($ in thousands)

FY 1979 Actual	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimate Costs
2,400	1,300	0*	0	0	3,700

* Continue required development as part of PLSS, Project 1190.

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimate Costs
Project 2589, Joint Service Weapon Data Link (JSWDL)	0	2,400*	100*	3,100	10,600	16,200

* Project 2589, JSWDL is a new project in FY 1980 but was a part of Project 1190, PLSS in FY 1979.

The FY 1980 estimate for the FY 1981 project requirement was $3,100 thousand. The FY 1981 request of zero thousand is a decrease of $3,100 thousand. This project reduction is due to rephasing and restructuring the total program as a result of the FY 1980 budget constraints and that the development of a PLSS anti-jam data link will be continued as a part of PLSS, Project 1190, in FY 1981 and beyond.

Budget Activity: Electronic Warfare Counter C^3 #257

Program Element: #64742F Precision Location Strike System

Test and Evaluation Data

1. Development Test and Evaluation: TAF Required Operational Capability (ROC) No. 314-74, Location Strike System. ! May 74, outlined the requirement for detection, identification, location, and strike of emitters. It also stated the requirement for a capability to strike radiating and non-radiating targets in all weather conditions.

Precision Location Strike System (PLSS) mission and description: The PLSS will provide the tactical forces with an all-weather, standoff precision strike system capable of attacks against tactical targets (e.g., headquarters, command and control facilities, airfields, and bridges) located in the PLSS electronic grid, while providing integrated near-real time detection, location and destruction of the enemy's defense system in a dense emitter and jammer environment. The PLSS will be able to and to operate in conjunction with other signal intelligence and reconnaissance systems to provide cueing and direct strikes for those systems. Electromagnetic emitter information collected by a triad of aircraft will be data linked to a ground Central Processing Subsystem (CPS) for processing and evaluation. Potential target information will be forwarded to appropriate combat control elements which will direct tactical strike aircraft to the target area. The CPS will provide steering and weapon release commands to the strike aircraft and, after weapon release, will control guided ordnance to the target. Unguided ordnance will be released so that the weapons' trajectories will carry them to the target. Possible follow-on applications include CPS guidance, and cruise weapons and missiles and the acquisition of targeting data for Army surface-to-surface missiles and artillery.

Two contractors were reviewed thru source selection process from Sep 76 to Jun 77 for Full-Scale Development (FSD). The contract was awarded to Lockheed Missiles and Space Company (LMSC), Inc. A Defense System Acquisition Review Council (DSARC) II review, held on 26 Jul 77, resulted in Deputy Secretary of Defense approval for FSD on 1 Sep 77. Go ahead for FSD was given to LMSC on 2 Sep 77. Decision Coordinating Paper (DCP) #129 schedule thresholds are as follows: (1) Preliminary Design Review (PDR) complete, Jan 79; (2) Critical Design Review (CDR) complete, Dec 79; (3) Start DT&E (Field Tests), Jun 81; and (4) Complete IOT&E, Aug 82. The PDR threshold has been breached and the others will be breached because of (1) increases in the difficulty and/or magnitude of various program tasks, (2) changes in the scope of the program, and (3) reduction in the PLSS FY80 RDT&E budget.

Development Test and Evalution (DT&E) accomplished to date consists of "breadboard" tests conducted by the prime contractor or his subcontractors to reduce the technical risks of developing FSD hardware. The results of these tests will be documented by June 1980

2. Operational Test and Evaluation: The PLSS initial operational test and evaluation (IOT&E) phase is tentatively scheduled to commence in Mar 83 and be complete in Dec 83. It will be conducted at the US Air Force Tactical Fighter Weapons Center Range Facility, Nellis AFB, NV. This will allow use of the emitter environment on the Nellis

and Naval Weapons Center (NWC), China Lake, CA ranges. The full-scale development equipment to be evaluated is not expected to differ significantly from the production equipment.

a. The Air Force Test and Evaluation Center (AFTEC) will direct the IOT&E portion of the combined development test and evaluation (DT&E)/IOT&E, using a team of fully trained Air Force operations and maintenance personnel and resources from Air Force Systems Commnd (AFSC), Tactical Air Command (TAC), Air Force Logistics Command (AFLC), and Air Training Command (ATC).

b. The purpose of the IOT&E phase will be to determine the operational effectiveness and suitability of the PLSS when employed in its operational configuration. This data will be used to input to the Defense System Acquisition Review Council (DSARC) III decision scheduled for Mar 84.

c. Operational scenarios will be established to evaluate the ability of the system to identify and locate emitters, direct F-4 strike aircraft to deliver guided and unguided ordnance, and interface with command, control, and communications (C^3) such as the Tactical Air Control System (TACS). The capability of PLSS to accurately track and control multiple weapon and delivery aircraft will be assessed. The survivability of the Airborne Vehicles (ARVs) and strike aircraft will be evaluated. In addition, survivability of the PLSS ground components will be assessed.

d. An assessment of interoperability with other defense suppression systems, to include degradation from friendly electromagnetic interference, will be conducted. Degradation of location and strike accuracy, resulting from electronic countermeasures, will be evaluated. Evaluations of system reliability, maintainability, availability, and logistics supportability will also be conducted.

3. System Characteristics: The following are goals for critical parameters to be evaluated during DT&E/IOT&E. They do not represent the total list of parameters to be tracked and managed by the Air Force.

Parameter	Objectives	Demonstrated Performance
Probability of:		
Location (1)		
Identification (2)		
Frequency Coverage		
Range (3)		
Accuracy (R/D=1) (4)		
Strike		
Location		
System		
Mission Reliability (5)		
Mission Completion		
Success Probability		

1. Probability of location refers to the capability to locate emitters within the area of interest which radiate for a minimum time. Minimum times by class are:

Testing to be conducted in a benign ECM environment.

2. Probability of identification refers to the correct identification of those emitters located by the PLSS.

3. Range for operation of data link and distance measuring equipment is defined as the line-of-sight distance between Precision Location Strike System terminals; i.e., Central Processing Subsystem to Airbrone Relay Vehicles (ARV), ARV to Site Navigation Subsystems, and ARV to Vehicle Navigation Subsystems and Weapon Navigation Subsystems. Range for emitter location is defined as the distance on the perpendicular bisector of the ARV baseline measured from the baseline to the emitter of interest.

4. Range (R) is defined, for this parameter, as the distance on the perpendicular bisector of the ARV baseline measured from the baseline (D) to the emitter/target of interest. For test purposes, these accuracy goals/thresholds are specified for a geometry of

5. Mission reliability is the probability of mission success as defined in the Reliability Annex (Annex C to the DCP).

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 64746F
DOD Mission Area: Defense Suppression, #224

Title: Expendable Drones
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5,790	4,700	5,600	4,000	Continuing	Not Applicable
2942	Harassment Vehicle (LOCUST)	5,790	4,700	5,600	4,000	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The increasing costs of sophisticated defense suppression systems have caused the United States and North Atlantic Treaty Organization (NATO) partners to exploit the unique capabilities provided by large numbers of cheap, expendable, simple, unmanned systems to effectively suppress the expanding enemy air defense radar threat. This Program Element provides the United States share of funding for the joint development of an anti-radar defense suppression mini-drone with the Federal Republic of Germany. This system, referred to as LOCUST, is required by the United States and German Air Forces to augment other defense suppression resources. This requirement has been endorsed strongly by the commanders of Tactical Air Command, Pacific Air Forces and United States Air Force Europe, Test results and analysis show a low cost expendable LOCUST mini-drone can be developed which is ground launchable by a small team of men, pre-programmed to and attack the radar with a high probability of rendering the radar inoperable. Tests show the LOCUST Vehicle warhead has at least a percent probability of disabling a if detonated within the area of expected accuracy of the system. Because it is a single system to fulfill a common requirement, it will contribute to NATO weapon standardization.

BASIS FOR FY 1981 RDT&E REQUEST: The LOCUST Vehicle program was initiated in FY 1979 with competitive United States contract awards for a low-cost anti-radar seeker. The anti-radar seeker became a part of the Joint LOCUST Vehicle program after the Memorandum of Agreement (MOA) was signed. The United States Air Force and the German Federal Ministry of Defense MOA provides for the joint development of the LOCUST Vehicle, including integration of the anti-radar seeker. This request represents the United States FY 1981 share for the joint development program.

OTHER APPROPRIATION FUNDS: Not Applicable.

Project: #2942 — Title: Harassment Vehicle (LOCUST)
Program Element: #64746F — Title: Expendable Drones
DOD Mission Area: Defense Suppression, #224 — Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The purpose of the LOCUST Vehicle development program is to provide a low-cost, expendable system which can provide a persistent threat to damage and defeat enemy air defense radar systems. This weapon system is needed to augment other United States and German Air Force electronic warfare defense suppression systems required to counter increased quantities, sophistication and concentration of enemy air defense radars. The most important aspect in the LOCUST Vehicle concept is to use large numbers of low-cost expendable mini-drones to complement more expensive systems. These drones will be ground-launched and programmed to fly where enemy radars are known to be operating. Once in the target area, the LOCUST Vehicles establish a loiter pattern, waiting for enemy radars to begin transmitting. Each vehicle will After launch, the drones operate autonomously, requiring no data link for command and control. Because of its size, characteristics, and profile, it will not be vulnerable to most anti-aircraft systems. Prior to preparation for launch, LOCUST Vehicles are maintained in storage similar to conventional munitions. When required, they are transported to the launch area in storage containers where they are quickly fueled, checked, programmed, and launched. The key to the LOCUST Vehicle concept is to acquire a sufficient level of capability at a low cost. A unit design-to-cost goal of $14,000 has been established for a full up (fly-away) system. Funds will be requested in FY 1982 to begin procurement of advanced tooling to support initial production in FY 1983. Sufficient tests and analysis have been performed during a United States Air Force/German Air Force feasibility demonstration to provide confidence that the LOCUST Vehicle will perform its mission efficiently and effectively.

RELATED ACTIVITIES: The LOCUST Vehicle is an outgrowth of a Defense Advanced Research Project Agency (DARPA) mini-drone demonstration program. Advanced development of mini-drone technology, applicable to LOCUST Vehicle requirements, is being performed in Program Element (PE) 63739F, Advanced Drone/Remotely Piloted Vehicle Development. The Army (PE 62732A, Remotely Piloted Vehicle (RPV) Support Technology; PE 63725A, Remotely Piloted Vehicles/Drones and PE 64730A, RPV) has drone programs directed toward reconnaissance and surveillance which may be applicable to future mini-drone missions. Coordination of these efforts is maintained through the Joint Technical Coordinating Group under the Joint Logistics Commanders and the Office of the Secretary of Defense. Federal Republic of Germany participation in LOCUST Vehicle feasibility demonstration testing has been through a Memorandum of Agreement (MOA). A new MOA has been negotiated which formalizes German participation in full-scale development. Procurement of the LOCUST system will be accomplished in PE 27246F, Expendable Drones, at the completion of full scale development.

WORK PERFORMED BY: The Aeronautical Systems Division of the Air Force Systems Command at Wright-Patterson Air Force Base, OH, is the government agency responsible for this Program Element. The primary contractor for the feasibility demonstration of the LOCUST Vehicle was Melpar, Falls Church, VA. Advanced LOCUST Vehicle investigations and testing have been conducted by Melpar, Falls Church, VA; Northrop Corporation, Newbury Park, CA; and Lockheed Missile and Space Company Incorporated, Sunnyvale, CA, under the direction of DARPA. Other United States industry sources which

have been participating in definition of the LOCUST Vehicle system include: Teledyne Brown Engineering, Huntsville, AL; Motorola Military Radio, Scottsdale, AZ; Texas Instruments, Dallas, TX; Airborne Instrument Laboratories, Long Island, NY; and General Dynamics, Pomona, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: An existing mini-drone was configured with a passive sensor and logic system to demonstrate feasibility (the essential elements) of an autonomous system to attack enemy radars. Initial LOCUST Vehicle flight testing was conducted at Nellis Air Force Base, NV. Testing of United States and German candidate warheads was conducted at Eglin Air Force Base, FL. Final flight demonstration testing was completed at Meppen, Germany in March 1977. The results of the actual tests, computer simulations, and analyses indicate the warhead has a percent probability of disabling an radar if the LOCUST Vehicle impacts within of the system. The actual flight tests and simulations show the expected impact accuracy of the LOCUST Vehicle is less than The requirement and concept of employment for the LOCUST Vehicle was expanded and updated in October 1976. The requirement represents the joint United States/German Air Forces' needs for this system. Because of Congressional funding limitations in FY 1978, United States activity on the LOCUST Vehicle was limited to concept definition studies which were conducted through forward financing of remaining FY 1977 funds. Parallel United States and German efforts continued in FY 1978 in preparation for beginning joint full-scale development in FY 1979. United States definition efforts included: requirements and effectiveness studies, vulnerability modeling of target radar systems, warhead optimization, effectiveness analysis with other defense suppression systems, seeker system optimization, fueling and storage concepts. Program instability during the FY 1979 budget process delayed preparation of the Joint Program Memorandum of Agreement (MOA) with Germany. In order to accelerate the system acquisition, the program plan was revised to initiate United States development of a low-cost anti-radar seeker while MOA negotiations/coordination continued. Dual competitive anti-radar seeker contracts were awarded June 1979. The Office of Secretary of Defense, State Department, and Office of Management and Budget provided the Air Force authorization in September 1979 to conclude final negotiations of the MOA with the German Federal Ministry of Defense.

2. FY 1980 Program: Contract awards for development of the air vehicle, support systems, and integration of the anti-radar seeker is anticipated in June 1980. Competitive development of the anti-radar seeker will continue.

3. FY 1981 Program: Joint development of the LOCUST Vehicle airframe, warhead, navigation system, and flight controls, launcher and integration of the anti-radar seeker will continue during FY 1981. The United States and German industry will share in these development efforts in accordance with the MOA. An MOA will be prepared with German Federal Ministry of Defense for joint production of the LOCUST Vehicle to begin initial negotiations in FY 1982.

Project: #2942 Title: Harassment Vehicle (LOCUST)
Program Element: #64746F Title: Expendable Drones
DOD Mission Area: Defense Suppression, #224 Budget Activity: Tactical Programs, #4

4. FY 1982 Planned Program: Planned efforts include completion of Development Test and Evaluation and the initiation of Operational Test and Evaluation necessary to allow a production decision. The Memorandum of Agreement with the German Federal Ministry of Defense for joint production of the LOCUST Vehicle will be concluded. Long-lead tooling procurement for initial LOCUST procurement will be initiated.

5. Program to Completion: Production will be initiated of the LOCUST Vehicle to provide sufficient quantities of low-cost expendable mini air vehicles to support United States and German air defense suppression needs. LOCUST Vehicle system improvements will be incorporated as required by developing and integrating advanced technology systems in response to revised threat and mission needs.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT						
2942	Harassment Vehicle (LOCUST)		3,800	4,700	2,600	Continuing	Not Applicable

The Air Force increased the funding in FY 1979 by $1,990 thousand and FY 1981 by $3,000 thousand to award dual contracts for both the anti-radar seeker and LOCUST Vehicle development. The FY 1981 increase also includes an adjustment for higher than previously planned inflation. Production funding has been delayed one year to match coresponding delays in program initiation due to Memorandum of Agreement negotiations/coordination between the Air Force and Germany.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64750F
DoD Mission Area: Tactical Air Reconnaissance #255

Title: Intelligence Equipment
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	12,881	18,300	16,600	13,000	Continuing	Not Applica
1174	Intelligence Security Equipment	384	1,000	900	900	Continuing	Not Applica
1955	DOD Indications & Warning	5,474	7,200	7,900	6,700	Continuing	Not Applica
2053	Foreign Technology Division Intelligence Processes	1,939	4,100	4,700	3,500	Continuing	Not Applica
2165	COMPASS PREVIEW	4,284	3,200	1,000	700		20,000
2322	Radar Prediction System	300	2,800	1,200	500		5,901
2631	Penetration Analysis			900	700	400	2,000

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element (PE) supports United States Air Force (USAF) operating commands by performing the engineering development of ground equipment used to process, integrate, display distribute intelligence data. This equipment will reduce the time required for the exploitation of intelligence data meet the needs of Air Force agencies producing strategic, tactical, and scientific and technical intelligence. The equipment will also improve the efficiency of those units producing air target materials and those engaged in counter the foreign intelligence threat to the USAF mission.

BASIS FOR FY 1981 RDT&E REQUEST: These funds are requested to continue development efforts to improve the timeliness and accuracy of intelligence products provided to the operational commanders, the research and development planners, the National Command Authorities. FY 81 funds will improve US capabilities to: (1) produce a warning of foreign threats, (2) evaluate foreign weapons systems, (3) exploit digital imagery, (4) produce radar predictions, and (5) perform penetration analysis. Funds will also be used to develop equipment to assist in countering the foreign surveillance threat and improve the collection of foreign intelligence utilizing human resources.

OTHER APPROPRIATION FUNDS: None.

Program Element: #64750F
DoD Mission Area: Tactical Air Reconnaissance #255

Title: Intelligence Equipment
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: The objectives are to develop hardware and software for the exploitation of data, and the production of target materials to improve existing capabilities presently being employed by various operating commands. Also, equipment and techniques will be developed to support units involved in countering the enemy surveillance threat to the Air Force mission and to assist in the collection of foreign intelligence through the utilization of human resources. The program objectives are accomplished through the following projects:

1174 Intelligence Security Equipment - Develops equipment and techniques to counter foreign surveillance threats. The project also develops unique equipment and techniques to support the Air Force mission for collection of foreign intelligence through the utilization of human resources.

1955 DoD Indications and Warning (I&W) - Improves the existing capability by modernizing the Air Force I&W centers at Strategic Air Command, Aerospace Defense Command, Military Airlift Command, and Alaskan Air Command to provide compatibility with the National Military Intelligence Center modernization effort. Provides a capability to rapidly correlate available all-source intelligence data, and develop indications and warning of threats to assist the National Command Authorities (NCA) in managing a crisis situation.

2053 Foreign Technology Division (FTD) Intelligence Processes - Improves the FTD capability to acquire, evaluate, analyze, and report on foreign scientific and technical information and material. These improvements will assist in responding to intelligence requirements vital to the operational commanders, research and development planners, and national level agencies.

2165 COMPASS PREVIEW - Develops a test-bed digital imagery exploitation device for Air Force softcopy conceptual validation testing.

2323 Radar Prediction System - Develops and implements an automated system that will produce a prediction of a radar scope display of specific geographic areas. This radar prediction is generated from a digital data base and primarily supports the aircraft crew members in mission planning for strike and reconnaissance (F-111, F/RF-4), or air drop delivery (C-130).

2631 Penetration Analysis - Develops a capability to provide timely and accurate penetration analysis for aircrew mission planning. This system will allow many various mission routes to be assessed based on the effects of terrain masking, jamming, and the flight path through lethal areas of enemy defenses.

Program Element: #64750F
DoD Mission Area: Tactical Air Reconnaissance #255

Title: Intelligence Equipment
Budget Activity: Tactical Programs #4

RELATED ACTIVITIES: Intelligence program activities of joint service interest are coordinated through the Defense Intelligence Agency. Exploratory and advanced development activities related to this program are conducted under Program Element (PE) 62702F, Command Control and Communications and 63789F, Command, Control, and Communications Advance Development. Other related Air Force Activities include PEs 31011G(F), Cryptologic Activities; 31021F, Intelligence Production Activities; 31022F, Scientific and Technical Intelligence; 31025F, Intelligence Data Handling Systems; and 27431F, Tactical Air Intelligence System Activities.

WORK PERFORMED BY: The Air Force manager is the Rome Air Development Center, Griffiss AFB, NY. Major contractors are Planning Research Corporation, McLean, VA; INCO Incorporated, McLean, VA; BETAC Corporation, Burlington, MA; General Electric Company, Daytona Beach, FL; Northrop Corporation, Hawthorne, CA; Computer Science Corporation, Falls Church, VA; GTE Sylvania, Mountain View, CA; International Computing Company, Bethesda, MD; and Pattern Analysis and Recognit Corporation, Rome, NY.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments:

Project 1174 Equipment developed for maintaining security of intelligence information and to assist in the collect of foreign positive intelligence utilizing human resources. Completed development of a chemical mark system Initiated development of a miniaturized secure transmitter, mobile antenna, range-gated television system, and covert alarm device. Initiated design of countermeasures receiver.

Project 2053 Completed system study to improve foreign airframe analysis. Completed prototype development and tes ing of electronic warfare and command, control, and communications threat analysis systems. Initiate efforts to upgrade the Foreign Technology Division's (FTD) analytical capabilities for photo, telemet space, and missile systems. Completed some system engineering efforts to improve the data processing services within FTD.

Project 2165 Detailed system specifications were developed in FY 1975. Fabricated a COMPASS PREVIEW functional mo up for in-depth test and evaluation of the test-bed design. Fabrication began in late FY 1976 and continued through FY 1979. Work was completed to develop an interface buffer for receiving inputs fr the

Project 2323 Completed validation phase and initiated full scale development of the Radar Prediction System.

See Separate Descriptive Summary for Project 1955.

Program Element: #64750F Title: Intelligence Equipment
DoD Mission Area: Tactical Air Reconnaissance #255 Budget Activity: Tactical Programs #4

2. FY 1980 Planned Program:

Project 1174 Complete efforts initiated in 1979. Begin development of one-way data link, special recorder, automated special printing techniques, and audio processor.

Project 2053 Upgrade efforts for photo analysis and telemetry analysis will be completed resulting in a system upgrade specification. System engineering efforts will continue to address the problems of providing improved data services at reasonable costs. Work will commence in developing the system specification for the Information Support System, a full upgrade of the Foreign Technology Division's (FTD's) main computers. An effort is planned to develop a computer performance measurement system to better measure automated data processing equipment utilization trends. Efforts will be initiated to improve analysis of maneuverable re-entry vehicles, rocket engines, ballistic missile forecasting, and directed energy weaponry. Airframe analysis studies will continue in the areas of navigation and weaponry subsystems.

Project 2165 Complete COMPASS PREVIEW test-bed development and integration, install at Headquarters Strategic Air Command and interface with the and Program Assisted Console for Evaluation and Review System data base. Initiate testing to validate utility of softcopy exploitation and operational concepts.

Project 2323 Continue Radar Prediction System full scale development and test planning.

See Separate Descriptive Summary for Project 1955.

3. FY 1981 Planned Program:

Project 1174 Complete efforts initiated in 1980. Initiate development of countermeasures receiver.

Project 2053 The initiatives started in FY 80 to improve total foreign threat analysis methodologies will be completed up to the functional description and/or specification stages. FTD systems integration efforts will continue. New starts include the major prototype activities in support of FTD's 1985 Information Support System.

Project 2165 Complete testing of COMPASS PREVIEW test-bed device.

Project 2323 Complete development and conduct developmental and operational testing of Radar Prediction System.

Project 2631 Initiate development of penetration analysis capability.

See Separate Descriptive Summary for Project 1955.

Program Element: #64750F
DoD Mission Area: Tactical Air Reconnaissance #255

Title: Intelligence Equipment
Budget Activity: Tactical Programs #4

4. FY 1982 Planned Program:

Project 1174 Complete development of countermeasures receiver. Initiate development of miniaturized addressable transceiver and microwave covert communications system.

Project 2053 System approach for upgrading the Foreign Technology Division's main computers will be defined. Computer networking and prototype activities will continue into the test and evaluation stage. The initial phase of computer performance measures development will be completed. New starts will begin to improve other areas of weapon system analysis.

Project 2165 Apply test results, in conjunction with results of other Department of Defense and government agency test programs, to define Air Force softcopy imagery exploitation requirements and concepts of operation.

Project 2323 Complete radar prediction system operational testing and correct system deficiencies.

Project 2631 Continue development and begin testing of penetration analysis capability.

See Separate Descriptive Summary for Project 1955.

5. Program to Completion: This is a continuing program

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	13,700	12,800	18,300	16,000	Continuing	Not Applicable
1174	Intelligence Security Equipment	335	400	600	600	Continuing	Not Applicable
1955	DoD Indications & Warning	5,450	5,400	6,600	7,300	Continuing	Not Applicable
2053	Foreign Technology Division Intelligence Processes	2,155	2,100	4,100	3,700	Continuing	Not Applicable
2165	COMPASS PREVIEW	5,159	4,200	4,200	3,200	1,700	24,059
2323	Radar Prediction System	601	700	2,800	1,200	500	5,899

Program Element: #64750F
DOD Mission Area: Tactical Air Reconnaissance #255

Title: Intelligence Equipment
Budget Activity: Tactical Programs #4

The FY 1981 request is 0.6 million dollars more than estimated in the FY 1980 Descriptive Summary. In Project 1955, a 0.6 million dollar increase in FY 1981 estimated costs provides improvements to the Military Airlift Command and Alaskan Air Command indications and warning capabilities. Support to these commands is in addition to that previously planned for Strategic Air Command and Aerospace Defense Command. In Project 2053, a 1.0 million dollar increase is required to prototype and develop specifications for the Foreign Technology Division's 1985 Intelligence Support System. In Project 2165, total costs have decreased by four million dollars and FY 1981 costs have decreased by 2.2 million dollars. COMPASS PREVIEW has been reduced in scope from a full prototype system development effort to a limited development effort to produce a test-bed device to be used for softcopy conceptual validation test and evaluation. Test results will be used for defining Air Force softcopy exploitation requirements and initial concepts of operations. A new start, Project 2631, is planned for FY 1981 at a cost of 0.9 million dollars. This effort was not included in the FY 1980 request.

Project: #1955 Title: DOD Indications and Warning
Program Element: #64750F Title: Intelligence Equipment
DoD Mission Area: Tactical Air Reconnaissance #255 Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: This project provides for the implementation of an improved Department of Defense (DoD) Indications and Warning (I&W) capability. Improvements will be made to the existing I&W equipment to support the correlation of all-source intelligence data. Improvements to the Air Force I&W Centers are directly related to the Defense Intelligence Agency (DIA) modernization program for the National Military Intelligence Center (NMIC). Improving the Air Force I&W Centers is necessary to allow internetting of computers between the Air Force I&W centers and the NMIC. The objectives of this project are to: provide for the rapid and reliable analysis of I&W intelligence, provide assessments of the I&W intelligence and the resulting implications concerning national interest, and provide the National Command Authorities with timely and accurate assessments to assist in determining a national course of action. New technologies have evolved that permit rapid analysis of multi-source data and remote access to other intelligence data bases to assure the use of all available information to postulate an indication of future events. These technologies will be incorporated into I&W centers to permit more rapid assessment and reporting of changing indicators.

RELATED ACTIVITIES: Intelligence program activities of joint service interest are coordinated through DIA. Implementation activity is conducted under Program Element (PE) 31025F, Intelligence Data Handling Systems. Exploratory development activities related to this project are conducted under PE 62702F, Command Control and Communications.

WORK PERFORMED BY: The Air Force manager is Rome Air Development Center, Griffiss AFB, NY. Major contractors are Planning Research Corporation, McLean, VA; INCO Incorporated, McLean, VA; BETAC Corporation, Burlington, MA; and Pattern Analysis and Recognition Corporation, Rome, NY.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Implementation plans for improving the I&W capabilities at Strategic Air Command (SAC) and Aerospace Defense Command (ADCOM) were updated. Conducted integration analysis and software/hardware developments to internet the Air Force I&W centers with the NMIC. Began modernization of the SAC and ADCOM I&W capabilities. At SAC, efforts to provide communications support for formal message traffic, direct I&W support, bulk data electronic transmission, and external data base access networks were implemented. Applications programs for analyst terminals have been developed to improve data handling and data base access capabilities. ADCOM improvements included defining and developing indication routines for missile, air and space activity. ADCOM has successfully implemented the Advanced Indicator Structure within the ADCOM Intelligence Center operational environment. Efforts common to both commands included multi-source data base processing techniques, decision analysis techniques, and integration design of the DoD I&W network.

2. FY 1980 Planned Program: Improvements will continue at SAC and ADCOM. At SAC, efforts will be directed toward linking the Program Assisted Console for Evaluation and Review System and Operational Intelligence Support System so that analysts are provided with multi-system access. At ADCOM, work will continue on integration of satellite attack warning and space object identification capabilities into the I&W Center for rapid, all-source correlation of space

activity. Initial work will begin to design the architecture for an integrated Aerospace Defense Command (ADCOM) analysis capability to support intelligence threat assessments in the mid-80's. Efforts to upgrade the Indications and Warning (I&W) capabilities of the Military Airlift Command (MAC) and Alaskan Air Command (AAC) will be started.

3. FY 1981 Planned Program: Strategic Air Command (SAC), ADCOM, MAC, and AAC I&W modernization will continue. Technologies such as plain-English text query, interactive data base access, threat indicator algorithm development, and automatic update of data files will be applied to satisfy operational requirements at SAC and ADCOM. SAC and ADCOM network expansion will be continued to allow analyst-to-analyst communications within the world-wide Department of Defense I&W network. At ADCOM, automated multiple sensor correlation capabilities for supporting space, missile, and air warning and attack characterization will be provided. Efforts at MAC and AAC will focus on transitioning applicable SAC and ADCOM I&W capabilities to satisfy the MAC and AAC I&W requirements.

4. FY 1982 Planned Program: Continue SAC, ADCOM, MAC, and AAC I&W modernization efforts. Develop techniques and software for correlation of imagery intelligence with other multi-source intelligence within the I&W Centers.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	5,474	7,200	7,900	6,700	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
RDT&E	5,450	5,400	6,600	7,300	Continuing	Not Applicable

FY 1981 costs are 0.6 million dollars more than estimated in the FY 1980 Descriptive Summary. Increased funding is needed to support MAC and AAC I&W requirements.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64751F
Title: Intra-Theater Imagery Transmission System (IITS)
DOD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	500	200	2,200	500		4,602

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Intra-theater Imagery Transmission System (IITS) program will develop a system to electrically transmit high priority reconnaissance imagery (already analyzed and annotated by photo interpreters) to theater commanders, mission planners and strike crews. Presently, imagery support to the close air support and interdiction missions is provided by hard copy courier methods, which are too slow for time-sensitive targets. Timely imagery support via IITS will enhance ordnance and tactics selection, as well as target orientation fo strike crews. IITS will use existing and planned tactical communications as the transmission medium.

BASIS FOR FY 1981 RDT&E REQUEST: Provides funds to complete test planning, prototype system fabrication and to perform a System Test and Evaluation (T&E) in Europe. The T&E will confirm system operation over existing European communications.

OTHER APPROPRIATION FUNDS: None.

Program Element: #64751F
DOD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255

Title: Intra-Theater Imagery Transmission System (IITS)
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: The Intra-theater Imagery Transmission System (IITS) will be a secure ground dissemination system which will provide the capability to transmit high priority reconnaissance imagery needed for effective command and control of theater warfare. The system will accept finished intelligence products (already analyzed and annotated by photo interpreters), such as photo, infrared (IR), radar and side looking airborne radar imagery, and distribute these to users in the theater. It is planned to operate over Defense Communication System (DCS) Autovon during the Initial Operational Test and Evaluation (IOT&E), DCS Autodin and Tactical Communications when the production models are fielded, and eventually over the higher quality communications planned for the 1980's. The transmission time goal is ten minutes or less per image over a telephone bandwidth communications circuit. The inadequacy of current courier deliveries forces the theater commanders, mission planners and strike crews to either accept delays of hours and sometimes days, or rely upon incomplete or obsolete information to perform their jobs. In order to optimize interoperability and equipment commonality, the IITS will use the tactical facsimile (TACFAX) device being developed by the Navy under the Tactical Digital Facsimile (TDF) Program (Program Element (PE) 28010N, project XO 723-CC). The TDF program is part of the Joint Tactical Communications Program (TRI-TAC). The TACFAX will be integrated with communications security and interface devices to permit operation over existing tactical communications.

RELATED ACTIVITIES: This system will be capable of transmitting imagery from existing and planned in-theater and worldwide sources. It will be capable of providing imagery to the other services. The system requirements have been reviewed by the other services to eliminate duplication of effort and to insure the ability to share imagery. The production units will be purchased under PE 27431F Tactical Air Intelligence System Activities, FY 82-84, estimated at $15M. Air Force Communications Command will provide communications interface and installation.

WORK PERFORMED BY: Electronic Systems Division, Hanscom AFB, MA is responsible for program management. MITRE Corp., Burlington, MA is providing technical support. Datalog Corp., Melville, NY is the development contractor for the TRI-TAC TACFAX.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A study of the imagery dissemination requirements of all services was completed in 1975. The full scale engineering development program for IITS was cancelled by the Air Force in May 1978 in favor of using the TRI-TAC TACFAX to form the basis for an IITS, thus reducing the development cost. Funds were transferred to the Navy to purchase eight TACFAX terminals to be used for IITS integration and testing.

2. FY 1980 Program: Design and fabricate interface equipment assemblies to integrate TACFAX, modems and encryption equipment into a prototype IITS. Planning for the Air Force European testing of IITS will also be completed.

Program Element: #64751F
DOD Mission Area: Tactical Surveillance, Reconnaissance, and Target Acquisition, #255

Title: Intra-Theater Imagery Transmission System (IITS)
Budget Activity: Tactical Programs #4

3. FY 1981 Program: Accept delivery of the prototype IITS assemblies and perform a system Initial Operational Test and Evaluation (IOT&E) to evaluate the communications interfaces and network performance including interoperability with Tactical communication and host country communication media (if possible), and to test the Tactical Air Force's (TAF's) operational scenarios, evaluating the performance of the IITS under real operational conditions in the tactical environment United States Air Forces Europe (USAFE).

4. FY 1982 Program: Turn over the prototype terminals to USAFE as an Interim Operational Capability. Develop detailed integration designs and plans for the production equipment.

5. Program to Completion: The Research and Development (R&D) portion of the program will be completed in FY 1982. Program Element (PE) 27431 will fund the purchase of the production IITS terminals for the users from FY 1982 through FY 1984.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,170	1,900	200	500		3,947

FY 1979 RDT&E funds were reduced 1,400 thousand dollars because of a program delay, generated by a restructuring of the program. This reduced the funding requirements for that year, shifting the effort into FY 1980 and 1981. FY 1981 R&D funds were increased 1,700 thousand dollars to accomplish the delayed IOT&E. Five hundred thousand dollars were "moved" from FY 1981 to FY 1982 due to the overall program delay. These funds are to complete production units designs and complete residual R&D efforts for the program. The net change is 655 thousand dollars.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 64754F
DOD Mission Area: Tactical Command & Control #254

Title: Joint Tactical Information Distribution System (JTI
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	41,700	54,600	71,600	85,100	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to develop a highly jam resistan secure digital information distribution system for use in a tactical combat environment. The Joint Tactical Inform tion Distribution System (JTIDS) is a joint development employing time division multiple access and spread spectr techniques. JTIDS will provide sufficient interconnectivity and capacity to permit rapid and secure exchange of t necessary command, control and status information among all equipped elements in the tactical theater.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for the continued full scale development of a fight terminal and the necessary equipments to incorporate the terminal into first line fighter aircraft.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #64754F
DOD Mission Area: Tactical Command & Control #254

Title: Joint Tactical Information Distribution System (JTIDS)
Budget Activity: Tactical Program #4

DETAILED BACKGROUND AND DESCRIPTION: There is currently no system in operation which provides the necessary, real-time information about the dynamic combat environment. Currently, information upon which to base critical operational decisions normally exists somewhere within a combat area, but may not always be available to the force element needing the data. The decision-maker, therefore, must base decisions on an incomplete knowledge of the current combat situation. Consequently, there is an urgent requirement for a system that will distribute essential information to all elements of the force. The system must secure the message traffic, work in a sophisticated jamming environment, and prevent hostile forces from intercepting and using the transmitted information. The Joint Tactical Information Distribution System (JTIDS) satisfies these requirements.

JTIDS will be structured to operate as an information distribution network into which tactical users transmit command and control, surveillance, position and status, or other significant combat information at specific time intervals. All of this information is immediately available to each net participant who may select for display or storage that portion of the information in which he is interested. The system will interconnect the E-3A aircraft, ground and shipboard command, control and surveillance centers, and combat and support aircraft.

The JTIDS program provides for the development, fabrication, and test of prototype terminal equipment for various applications and the demonstration of the readiness of the system for production. Also included in the program is the design, prototype fabrication, and test of the necessary interface equipment to permit the incorporation of JTIDS into first line fighter aircraft.

RELATED ACTIVITIES: JTIDS is a joint program, with the Air Force serving as lead agency. Development is managed by a jointly manned program office. Development, prototype fabrication, and test of terminal equipments for various applications of the services will be funded under this program element and will be conducted in conjunction with the other programs with which JTIDS equipments will ultimately be integrated.

WORK PERFORMED BY: The JTIDS Joint Program Office is located at the Electronic Systems Division, Hanscom AFB, MA. Work is also being done at the Aeronautical Systems Division, Wright Patterson AFB, OH; and the Electromagnetic Compatibility Analysis Center, Annapolis, MD.

Initial system design and fabrication of prototype terminals for the E-3A is under contract to Hughes Aircraft Company, Fullerton, CA, under a subcontract to the E-3A contractor, the Boeing Company, Seattle, WA. Other major contractors include: MITRE Corp, Bedford, MA, system engineering support; Singer-Kearfott, Little Falls, NJ, fighter class terminal; International Business Machines (IBM), Owego, NY, surface terminal; International Telephone and Telegraph Corp (ITT), Nutley, NY, advanced capability terminals; McDonnell Douglas Aircraft Corp, St Louis, MO, and General Dynamics Corp, Fort Worth, TX, fighter cockpit integration studies; and ARINC Research Corp, Annapolis, MD, design-to-cost studies.

Program Element: #64754F
DoD Mission Area: Tactical Command & Control #254

TITLE: Joint Tactical Information Distribution System (JTIDS)
Budget Activity: Tactical Programs #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Advanced development of the basic time division multiple access technique was completed under Program Element (PE) 63706F, Advanced Command and Control Capability, and PE 63727F, Advance Communication Technology. The operational feasibility, flexibility, and potential of the system was demonstrated in Europe in conjunction with the E-3A Airborne Warning and Control System brassboard operational test in April 1973. The development of prototype JTIDS terminals for E-3A aircraft was completed. Development of JTIDS terminals for ground, ships, and fighter aircraft was initiated. A Joint Program Office (Air Force, Navy, and Army) was established to manage the program. A flight and bench test program was conducted with the Federal Aviation Administration to demonstrate the compatibility with other systems in the same frequency band. Fighter aircraft integration studies and concept definition studies for manpack terminal application were conducted. Fighter terminal prototypes were delivered to the government and development testing was initiated. Development of the necessary hardware and software to integrate JTIDS into ground command and control centers was conducted.

2. FY 1980 Program: Competitive full scale development contracts for the fighter terminal will be awarded. Development of the necessary hardware and software integrate JTIDS into the F-15 will be initiated. Developmetal and initial operational test and evaluation of the ground interface equipment will be completed. Development of fail-safe provisions to assure continued electromagnectic compatibility with air traffic control equipments operating in the same position of the frequency spectrum will continue.

3. FY 1981 Planned Program: Competitive full scale development of the fighter terminal will continue. Development of the necessary aircraft integration equipment for the F-15 and F-16 will continue. Incorporation of the new joint service approved message standard will be initiated. A production decision on the ground interface equipment will be made.

4. FY 1982 Planned Program: Full scale development of the fighter terminal and aircraft integration equipments will continue. Software modifications to incorporate the new message standard will also continue.

5. Program to Completion: Development of the fighter terminal and integration equipment will be completed and flight testing will be conducted in the F-15 in 1983. Production of the fighter terminal and F-15 interfacing equipment will be initiated in FY 1984. Production of the interface equipment for integration of the fighter terminal into the F-16 will be initiated in FY 1985. The first JTIDS-equipped F-15 and F-16 will be operational in FY 1986 and FY 1987, respectively.

Program Element: #64754F
DoD Mission Area: Tactical Command & Control #254

TITLE: Joint Tactical Information Distribution System (JTIDS)
Budget Activity: Tactical Programs #4

6. Milestones:

A.	Waveform Decision		Feb 1976
B.	Initial E-3A Prototype Delivery		Jun 1977
C.	Start Surface Terminal Development		*Jun 1977
D.	Start Fighter Terminal Full Scale Development	(Jul 1979)*	Aug 1980
E.	Surface Terminal Production Decision		4QCY 1980
F.	Fighter Terminal Production Decision	(3QCY 1982)*	Mar 1984

*Date presented in FY 1980 Descriptive Summary

Revised program direction from the Office of the Secretary of Defense regarding the technology to be employed in the fighter terminal development has resulted in a slip in the fighter terminal program of approximately one year.

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	30,132	51,600	54,600	60,800	Continuing	Applicable

Recent revised program direction from the Office of the Secretary of Defense has resulted in a rephasing of the development cycle for the fighter terminal. This direction has also established a requirement to fund two teams of two contractors on a leader-follower basis to assure an adequate production base for the complex Joint Tactical Information Distribution System (JTIDS) equipment and to maintain contractor competition into production thereby providing the lowest possible procurement cost. The program restructure and the need to fund competitive contractor teams has resulted in the program cost differences between data presented in FY 1980 and FY 1981 requests.

Budget Activity #7 - Tactical Programs #4

Program Element #64754F - Joint Tactical Information Distribution System (JTIDS)

Test and Evaluation Data

1. Development Test and Evaluation: The Joint Tactical Information Distribution System (JTIDS), PE 64754F, will develop a highly jam resistant, secure digital information distribution system for use in a tactical combat environment. This joint development effort is a merger of the earlier efforts of Air Force (SEEK BUS) and Navy development programs. The feasibility of Time Division Multiple Access (TDMA) was explored during the March 1973 E-3A brassboard flight test. Further development testing will be scheduled to verify the design and demonstrate the system capabilities through a series of compatible and interrelated testing activities. Engineering tests will be an integral part of the program. Both contractor and government tests will be conducted to fully verify all system capabilities. These tests will occur throughout the development cycle of each class of terminal. An extensive flight and bench test program to demonstrate the compatibility of JTIDS with air traffic control equipments operating in the same portion of the frequency spectrum has been completed. These tests, which were conducted under the auspices of the Office of Telecommunications Policy, Executive Office of the President, in conjunction with the Federal Aviation Administration, demonstrated that JTIDS can co-exist with the other systems in the band without harmful interference provided the JTIDS terminal and system duty cycle is limited to 20 percent and 40 percent, respectively. In-plant and flight tests of the Class 1 terminal on the E-3A aircraft have evaluated net entry, synchronization, and operation and anti-jamming margin of the systems. Additional testing of the Class 1 Terminal was conducted by the SHAPE Technical Centre in 1978. These tests verified that multipath propagation and doppler shift did not cause any adverse degradation with JTIDS in the full anti-jam mode. Performance specifications were met under laboratory jamming conditions. Contractor acceptance testing of advance development models of the Class 2 terminal were completed late in 1978. Bench and flight testing of these Class 2 terminals was completed in late 1979 and reports are in preparation. The terminals are being installed in aircraft pods to be used on tactical fighters in mid-1980 for tactics and concept testing. The developmental test and evaluation of the Adaptable Surface Interface Terminal began in November 1979 and will continue through August 1980. Class 2 full scale development terminals will be tested on four Air Force F-15 aircraft, two Navy E-2s and a Navy Land Based Test Site in 1983.

2. Operational Test and Evaluation: JTIDS test and evaluation is a multiservice (Army, Navy, Air Force, and Marine Corps) combined development test and evaluation/initial operational Test and Evaluation (DT&E/IOT&E) effort. Some service unique testing will also be conducted. The Air Force Test and Evaluation Center (AFTEC) will conduct IOT&E for the Air Force and be the lead agency for multiservice IOT&E. The other service Operational Test and Evaluation (OT&E) organizations are the United States Army Operational Test and Evaluation Agency (USAOTEA), the Navy Operational Test and Evaluation Force (OPTEVFOR) and the Marine Corps Operational Test and Evaluation Activity (MCOTEA). The purpose of the IOT&E will be to assess the operational effectiveness and operational suitability of JTIDS airborne, shipborne, and ground terminals, and the ability of JTIDS to support both individual and joint service concepts in an operational environment.

a. Joint Tactical Information Distribution Sytem (JTIDS) Test and Production Milestones:

E-3A/JTIDS Advanced Development Model (ADM) terminal Operational Test & Evaluation/Initial Operational Test & Evaluation (IOT&E)	May-Jun 78
ASIT Full-Scale Engineering Development (FSED) terminal OT&E/IOT&E	Nov 79-Aug 80
POD ADM terminal OT&E/IOT&E -	Mar-Aug 80
Adaptable Surface Interface Terminal (ASIT) production decision	Oct 80
E-3A/JTIDS FSED terminal OT&E/IOT&E	Sep-Nov 81
Class 2 (fighter) FSED terminal OT&E/IOT&E	1983-84
Class 3 ADM terminal OT&E/IOT&E	To be determined

b. E-3A/JTIDS Testing (E-3A Enhancemnts).

(1) Testing for the E-3A enhancement program which includes JTIDS is conducted as a combined DT&E/IOT&E. The E-3A System Program Office is managing the DT&E portion and AFTEC is managing the IOT&E portion. During May/June 1978, a preliminary evaluation of the JTIDS time-division-multiple-access (TDMA) system was conducted using an ADM terminal. The purpose of the test was to determine communications coverage, E-3A system performance with JTIDS, and to provide an initial estimate of the operational effectiveness/suitability of this planned enhancement. Major emphasis was placed on assessing the resistance of JTIDS to electronic countermeasures (ECM). The test demonstrated and the potential to greatly enhance digital information distribution. Problems associated with the establishment of the JTIDS net and net operations were identified during testing and are subsequently being addressed by the Joint Program Office under a Net Management Study effort. The results of the E-3A/JTIDS IOT&E were reported in the AFTEC E-3A JTIDS Terminal IOT&E Report, December 1978. The operational suitability evaluation was limited consisting essentially of over-the-shoulder observation of contractor efforts.

(2) Additional operational effectiveness and operational suitability test and evaluation using a preproduction terminal designated the Hughs Improved Terminal (HIT) is scheduled for 15 September to 1 November 1981 during the E-3A Block 10 IOT&E. At that time, a more comprehensive operation suitability evaluation will be possible due to the expected availability of technical orders and support equipment during the IOT&E.

c. Adaptable Surface Interfact Terminal (ASIT) Testing.

(1) The IOT&E of the preproduction Full Scale Engineering Development (FSED) ASIT will be conducted by the Air Force Test & Evaluation Center (AFTEC), assisted by the Marine Corps Operational Test and Evaluation Agency (MCOTEA), in a multiservice combined DT&E/IOT&E. The ASIT is designed to interface with existing command and control systems which use the Tactical Digital Information Link B (TADIL B).

(2) ASIT IOT&E is to be conducted at Eglin Air Force Base (AFB), Florida, and Marine Corps Air Station Beaufort, South Carolina, from November 1979 to August 1980. Principal units/facilities to which the ASIT will b interfaced will be an Air force message processing central, an Air Force control and reporting center, an Air Nationa Guard control and reporting post, an Army AN/TSQ-73 air defense command and control system, and a Marine Corps tac tical air operation center.

(3) The ASIT consists of two principal subsystems. The first is a translator processor (computer) which con verts existing tactical air control system/tactical air defense system (TACS/TADS) messages passed over TADIL B int their JTIDS equivalents. The second subsystem is the HIT terminal which performs signal transmission, reception, a related digital processing of the JTIDS signal. Midway through the test (May 1980), the primary ASIT computer will upgraded to make it representative of the higher capability equipment planned for production. While the contract will operate the equipment during the latter stages, military personnel will assume this role during the latter stage Maintenance however, will be performed exclusively by contractor personnel with military personnel limited to over-th shoulder observation. This is necessitated by the expected lack of technical data, representative support equipmen and hands-on maintenance training, and can be expected to limit the operational suitability portion of the evaluatio Test results will be used for the ASIT production decision planned for October 1980.

d. Pod Advanced Development Model (ADM) IOT&E. A preliminary evaluation of JTIDS implementation in fighter aircraft will be conducted during Mar-Aug 80 in conjunction with the ASIT tests. A Singer-Kearfott AN/URQ-28 Advan Development Model (ADM) JTIDS terminal and associated support equipment will be installed in an AN/ALQ-76 pod. T pod is designed for use only aboard maverick-capable aircraft, and makes use of their existing controls, displa and pylon interfaces. Three such pods will be flown aboard F-4 and A-10 aircraft to evaluate the contribution JTIDS in defensive counterair, close air support, and air interdiction mission roles. While the pod is inten primarily to give early hands-on fighter experience with JTIDS, the test will also reveal whether there is suffici utility in a pod terminal to proceed to full-scale engineering development.

e. Class 2 (fighter) Terminal Initial Operational Test & Evaluation (IOT&E.) An IOT&E will be conducted o preproduction, internal installation, fighter terminal in F-15 aircraft beginning in 1983 and in F-16 aircraft dur 1984. Based on preliminary planning, these tests will be conducted primarily in the Eglin Air Force Base area w other ranges used as needed.

f. Class 3 Terminal IOT&E. The Class 3 terminal development and IOT&E have been deferred because of prog funding limitations; therefore, its IOT&E is yet undefined.

3. System Characteristics	Objectives	Demonstrated to Date
Frequency	- 960-1215MHz	960-1215Mhz
Range	- 300nm (1200nm with relay)	300nm
Capacity	- 57.6 kbps	57.6 kbps
Users	- 2-2000	3
Message Error Rate	- 10-2	10-2
Anti-jam Margin		
Range Accuracy	- 30 feet (RMS) at 150 nm	
Reliability/Maintainability	- Being Defined	

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 64757F
DOD Mission Area: Electronic Warfare and Counter C^3, #257

Title Systems Protection
Budget Activity Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,800	1,900	2,200	2,500	1,100	10,500

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program assesses though analysis and testing the electromagnetic vulnerability of USAF systems and facilities to a new damage mechanism (carbon fibers).

BASIS FOR FY 1981 RDT&E REQUEST: Begin engineering design and development of an area carbon fiber detector; update vulnerability assessment models; begin transition of exclusion, hardening and decontamination techniques; start work on a protection design handbook; and develop aircraft burn and explode fiber containment techniques.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: # 64757F
DOD Mission Area: Electronic Warfare and Counter C^3, #257

Title Systems Protection
Budget Activity Tactical Program #4

DETAILED BACKGROUND AND DESCRIPTION: This program is the Air Force portion of the DOD Tri-Service HAVE NAME program. HAVE NAME was a classified limited access program to characterize the carbon fiber threat; determine electrical and electronic systems vulnerabilities; determine effective protective measures for these systems; and to evaluate the

RELATED ACTIVITIES: None.

WORK PERFORMED BY: The program managed by the Air Force Systems Command through the Rome Air Development Center, Griffiss Air Force Base NY. Contractors for the program activities included the MITRE Corporation, Bedford MA and TRW, Redondo Beach CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Efforts to date have included understanding the theories, properties and effects of the carbon fiber phenomena; determing testing techniques and vulnerability analyses; characterizing the threat to military systems; and developing accidental release procedures and a small portable carbon fiber detector.

2. FY 1980 Program: Funding will complete the survivability and vulnerability analysis of Air Force equipment and facilities, the laboratory investigation of protection methods and field testing and verification of protection techniques.

3. FY 1981 Planned Program: Develop aircraft burn and explode fiber containment techniques, begin to transition laboratory decontamination and hardening techniques to field applications, initiate development of a fixed area detection system, update vulnerability assessment models and start work on a protection design handbook.

4. FY 1982 Planned Program: Continue transition of decontamination and hardening techniques, the protection handbook, review and update as necessary systems specification and standards and continue development of an area detector for field use.

5. Program to Completion: Complete in FY 1983 all work on the area carbon fiber detector, the transition of hardening and decontamination techniques, the protection handbook and the necessary update of specifications and standards.

6. Milestones: Not applicable.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data: Not applicable, no change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 64779F Title: Joint Inceroperability of Tactical Command and Control Systems (JINTACCS)
DOD Mission Area: Tactical Command and Control #254 Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	4,025	4,900	13,039	11,183	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: JINTACCS is a joint interoperability program to provide improved operational effectiveness of Service (Army, Navy, Air Force, Marine Corps) tactical command and control systems planned for use in support of joint operations through the 1980s. Air Force objectives are to: develop interface design standards with the other services; modify affected Air Force equipments; participate in testing and joint operational effectiveness demonstrations (OEDs) and recommend joint standards for adoption by NATO.

BASIS FOR FY 1981 RDT&E REQUEST: The FY 81 request provides for the continuation of interface planning, analyses and design. Systems integration and test planning will continue, system modifications will be performed, test support provided and Air Operations Compatibility & Interoperability testing and Intelligence Operational Effectiveness Demonstrations will be initiated.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 64779F Title: Joint Interoperability of Tactical Command and Control Systems (JINTACCS)
DOD Mission Area: Tactical Command and Control #254 Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: JINTACCS was established in August 1977 as the successor to the Ground and Amphibious Military Operations (GAMO) Program. Its purpose is to improve the operational effectiveness of the Service (Army, Navy, Air Force and Marine Corps) command and control systems used in support of Joint Operations through the 1980s. Also incorporated are the intelligence facilities of the National Security Agency and the Defense Intelligence Agency. Consideration of NATO interoperability was added in 1978. The Services and Agencies are utilizing the program to develop common interface standards and to modify their command and control equipment and procedures as necessary to insure systems interoperability, compatibility and operational effectiveness. To facilitate management, the program is divided into functional segments including intelligence, air operations, amphibious operations, fire support, and operations control. Within the Air Force, the primary command and control facility interfaces to be analyzed and defined are the Tactical Air Control Center (TACC), Control and Reporting Center/Post, Direct Air Support Center, Airborne Warning and Control System, Airborne Battlefield Command and Control Center and the TACC/Intelligence. An Air Force test facility identified as the Participating Test Unit is being established to evaluate Air Force modified command, control and communications (C^3) elements and to support compatibility & interoperability testing and operational effectiveness demonstrations.

RELATED ACTIVITIES: This program element supports Air Force participation in the JINTACCS Program (with the Army as the Joint Chiefs' of Staff Executive Agent). Services and agency activities are governed by jointly agreed upon and JCS-approved documentation including the Technical Interface Concepts, and Technical Interface Design Plans. The Air Force Tactical Air Forces Interoperability Group (TAFIG) as coordinating authority and the Air Force Systems Command program office maintain coordination with program managers for the Tactical Air Control System Improvements Program (485L), JTIDS, E-3A, TIPI, and TRI-TAC.

WORK PERFORMED BY: TAFIG is coordinating authority for Air Force participation in the JCS JINTACCS Program. Technical and Engineering responsibility is assigned to the Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA. The Tactical Air Command provides operational support, including a Participating Test Unit at Langley AFB, VA to support compatibility & interoperability testing and operational effectiveness demonstrations. The primary JINTACCS support contractor is MITRE, a Federal Contract Research Center, located at Bedford, MA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Support for the development of the JINTACCS Technical Interface Design Plans and Technical Coordinating Committees continues. Studies were initiated for the planning, analysis and design of the intra-Air Force interfaces as well as interfaces between Air Force intelligence elements and other Service facilities. Test-only modifications were completed for the intelligence segment and compatibility and interoperability testing was initiated. An Air Force Participating Test Unit was established at the Air Force Tactical Systems Interoperability Support Center at Langley AFB, VA.

Program Element: #64779F Title: Joint Interoperability of Tactical Command and Control Systems (JINTACCS)
DoD Mission Area: Tactical Command and Control #254 Budget Activity: Tactical Programs #4

2. FY 1980 Program: Interface planning, analysis and design efforts will continue during FY 1980 as will modification of test-only hardware and software. Test planning and support will be provided for compatibility and interoperabilit testing and operational effectiveness demonstrations. Technical Interface Design Plans - Test Edition should be completed.

3. FY 1981 Planned Program: Technical Interface Design plans will be refined. The air operations segment testing will begin in the second fiscal quarter and the intelligence operational effectiveness demonstration is scheduled for the third fiscal quarter. System modifications to support the testing of the remaining segments (amphibious, fire support and operations control) will continue. Test planning and support will be provided.

4. FY 1982 Planned Program: Continue to refine Technical Interface Design Plans and to perform impact analysis and system integration. Operations control segment testing will be initiated during the second fiscal quarter.

5. Program to Completion: The remaining functional segments for the joint systems will be tested for compatibility and interoperability and will be followed by operational effectiveness demonstrations. The technical interface design plans will be updated and subsequently incorporated as standards into appropriate JCS publications. Test completion is scheduled for 1985.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: ($ in thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT	1,400	4,500	4,900	7,800	Continuing	Not Applicable

The increase in FY 1981 requirements represents the JINTACCS portion of the acquisition of a Simulation, Monitor, Anelysis, Reduction and Test System (SMARTS) capability for the Air Force Participating Test Unit. In order to consolidate all JINTACCS test support requirements under PE 64779F the JINTACCS program was modified to incorporate the acquisition of the SMARTS test support system. The procurement of the SMARTS within PE 27416F was cancelled and a corresponding reduction was made in that Program Element. The test support system will also assist in software maintenance for the Tactical Air Control System at the Air Force Tactical Systems Interoperability Support Center at Langley AFB, VA.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27128F
DoD Mission Area: Counter Air, #221

Title: F-4 Squadrons
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1970 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,000	500	7,300	6,100	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The F-4G/APR-38 Wild eeasel repreesents the only lethal defense suppression weapons system in the Air Force inventory. This system is specifically designed to automatically detect, identify, locate, and destroy hostile radar emitters by the use of anti-radiation missiles, standoff guided munitions, or conventional F-4 weapons. The F-4G is classically employed in the counter-air role as an esccort for a penetrating strike force or, independently as a hunter-killer force against targets of opportunity.

BASIS FOR FY 1981 RDT&E REQUEST: Engineering design and development of system updates are required to maintain the F-4G/APR-38 capability at a level commensurate with the ever increasing hostile radar threat environment. Engineering development of threat updates is on a priority basis to the stated needs of the tactical air force. Threat updates will be grouped to ease aircraft configuration control during F-4G modification periods, the first of which is expected to begin in 1986. Threat updates and various aircraft mods require similar engineering efforts to maintain the F-4G simulator currency.

OTHER APPROPRIATION FUNDS:

Procurement/Quantity	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
Aircraft Procurement (3010) (Quantity)	70,800/29					328,300/116 400
Missile Procurement (3020)						
Operations & Maintenance (3400) (Installation)	4,400	3,700	900			15,700

Program Element: #27128F
DoD Mission Area: Counter Air, #221

Title: F-4 Squadrons
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The USAF initially encountered radar controlled surface-to-air missile (SAM) weapons systems in North Vietnam in 1965. Wild Weasel configurations of the F-105 and F-4C were developed from off-the-shelf hardware as a quick reaction counter to this threat. The SAM and radar controlled antiaircraft artillery (AAA) threat has continued to expand in both quantity and quality since then. Development of the F-4G Wild Weasel was initiated in 1970 as a counter to this increasingly hostile threat environment. The F-4G/APR-38 system provides a cockpit display which identifies the type of threat (SAM, AAA, etc.), the azimuth to that threat and, It employs a phase interferometer antenna system to provide highly accurate target azimuth and elevation direction finding (DF) information, 360 degrees about the aircraft. Digital computer controls allow the location of a designated target to be carried in memory if the tracking emitter is shut down; the DF information is of the quality necessary to successfully execute blind delivery of area weapons via the memory function. With the information available in the cockpit, the aircrew has a wide range of attack options. They can engage the target with anti-radiation missiles, including the high speed anti-radiation missile (HARM), provided the threat radar continues to emit, or execute a guided munitions or conventional munitions delivery in the memory mode if the tracking radar shuts down. Intelligence data suggests the threat will continue to increase in complexity and technical sophistication. This program will develop the updates necessary to maintain the F-4G as a viable weapons system through the 1980s. In order to maintain the currency of the F-4G simulator, engineering development efforts are required to install the ARN-101 into the simulator and to develop the required software interface.

RELATED ACTIVITIES: Air Force advanced and engineering development program elements (PE 63718, 64738, 64739) are currently developing the generic electronic warfare technologies necessary to counter the advanced threat radar. The Air Force and Navy are jointly developing the Airborne Self-Protection Jammer System (PE 64737). The imaging infrared (IIR) Maverick and HARM are both programmed for interface with the F-4G (PE 27162). New Inertial Navigation System, ARN-101, is being installed by Air Force Logistics Command as a Class IV modification and will be interfaced with the APR-38 under the PE. The above referenced programs are responsible for funding and developing the required interfaces for the F-4G/APR-38 system; however, PE 27128F will insure overall system compatibility/integration.

WORK PERFORMED BY: Ogden Aerospace Logistics Center, Utah is responsible for the management of F-4G enhancement programs. Air Force Systems Command; Air Force Test and Evaluation Center, Kirtland AFB, NM; and Tactical Air Command, Langley AFB, VA are jointly responsible for the testing of the F-4G. AFSC is responsible for the subsystem and interface development of F-4G/APR-38 enhancements.

Contractors: Airframe - McDonnell-Douglas, St. Louis, MO
Receiver - IBM, Owego, NY

Program Element: #27128F
DoD Mission: Counter Air, #221

Title: F-4 Squadrons
Budget Activity: Tactical Programs, #4

Display - LORAL, New York, NY
Processor - Texas Instruments, Austin, TX
Simulator - Singer-Link, Binghamton, NY

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Initial contracts to develop the APR-38 Receiver system for integration into the F-4D airframe were awarded in December 1970; F-4D Development Test and Evaluation flight testing was completed in FY 1974. In January 1974, the Air Force Council expanded the program's scope for the following reasons: (a) force structure projections: (b) F-4D vice F-4E airframe service life; and (c) intelligence information gained from the 1973 Mid-East conflict. This redirection added a special warning receiver function, inflight recorder, and ground playback station; doubled computer memory capacity to increase the threat handling capability; converted to the F-4E aircraft; and, for logistical support considerations, redesignated the weapons system the F-4G. F-4G Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E), continued on the above mentioned items with flight test completion in August 1976. The IOT&E identified system deficiencies which necessitated returning the aircraft to DT&E. These software were: (1) low-band location accuracy; (2) signal processing, prioritizing and display; (3) special warning function; and (4) built-in-test. Follow-up DT&E/IOT&E began in September 1976 and was satisfactorily completed in February 1977. Full scale production of the F-4G was approved in March 1977.

The first production F-4G was delivered to Tactical Air Command in October 1977 and verification flight testing was satisfactorily completed in February 1978. The second aircraft was delivered in January 1978. These two aircraft entered Follow-On Test and Evaluation on 6 February 1978; testing was satisfactorily completed on 28 July 1978. Production aircraft are delivering at the rate of three per month with the last (116th) F-4G to be completed in May 1981. Tactical Air Command achieved Initial Operational Capability in April 1979 when the first squadron (24 Primary Aircraft Authorization (PAA)) was declared combat ready. The Full Operational Capability will be achieved in Planned force structure beddown includes: (a)

With the exception of the ground playback station, all planned development for the basic F-4G was completed with FY 1977 funds. Finalization of the ground playback station was continued in FY 1979.

Program Element: #27128F
DOD Mission: Counter Air, #221

Title: F-4 Squadrons
Budget Activity: Tactical Programs, #4

A threat update program was initiated in FY 1978 to ensure the F-4G maintains a viable operational capability against the constantly expanding threat environment. Specific updates being addressed include:

(3) increased computer capability; (4) component technology and technique updates to reduce system operations and maintenance costs; (5)

In FY 1979, the engineering development and design feasibility studies initiated in 1978 were completed and the resulting data assembled for evaluation.

2. FY 1980 Program: FY 1980 actions will be limited to evauation of available data and preparation for full scale engineering development.

3. FY 1981 Planned Program: APR-38 Update. The final planning, specification development and analysis of past studies and tests will continue in preparation for engineering development of a system design to incorporate the following threat updates into the F-4E Wild Weasel weapons system; (a)

(d) increased computer capacity, (e) component technology update, (f) Engineering development and kit production of the first F-4G/ARN-101 simulator installation will be initiated pending kit proof installation in

4. FY 1982 Planned Program: Full scale engineering of the first improvements will be initiated. Studies of the next update cycle will be initiated. Installation of the first ARN-101 kit into the F-4G simulator will be completed.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data: Not applicable

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27129F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: F-111 Squadrons
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	100	1,400	7,300	8,000	11,400	44,000
No projects		(8,200)*	(7,800)*				(68,385)*

* Funded under Program Element (PE) 64709F Improved Tactical Bombing, Project 2056, PAVE TACK. Includes funding through FY 1980.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Research and Development effort was to develop and test a modification to the F-111A/E aircraft to replace the current analog AN/AJQ-20A bombing/navigation system (BNS) with a digital BNS. Conversion to a digital BNS would have enhanced reliability/maintainability, reduced support costs, improved weapon delivery capability and accuracies, and ensured F-111 A/E weapon system flexibility in its role in the Tactical Force structure through the late 1990's. The initial engineering study revealed the F-111 A/E digital bomb/navigation update was too expensive for the projected increase in combat capability. The Air Force has decided to terminate the effort for other more cost effective programs for the tactical forces. Meanwhile, the remaining effort within the PAVE TACK Project has been transferred from PE 64709 Improved Tactical Bombing, to this Program Element. This program provides funds for the PAVE TACK Forward Looking Infrared target acquisition and laser designator/ ranger development to enable tactical aircraft to deliver precision guided and unguided weapons during day, night, and limited adverse weather conditions. One of the most pressing deficiencies in the Air Warfare Mission Area is the limited ability to interdict the enemy's forces at night and beneath the low ceilings of the European Theater. These limitations also restrict the Air Force's ability to exploit minimum altitude aircraft tactics. The PAVE TACK system responds directly to these mission needs of the early 1980s.

BASIS FOR FY 1981 RDT&E REQUEST: The Video Augmented Tracking System (VATS) will be fully integrated into the PAVE TACK pod. The integrating Contractor will complete his software develoment and the initial in-house testing. The VATS operational flight program final reassembly will be accomplished and the PAVE TACK operational test program will be modified to include the VATS design. The VATS support equipment design will be completed.

Program Element: #27129F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: F-111 Squadrons
Budget Activity: Tactical Programs, #4

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimated	FY 1981 Estimated	FY 1982 Estimated	Additional to Completion	Total Estimated Cost
Procurement (3010)						
PAVE TACK Pods	54.5	97.1				240.8
Quantity	48	78				149
PAVE TACK F-111F Modification	34.0	30.8	20.9			100.5
Quantity	33	34	28			96

Program Element: #27129F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: F-111 Squadrons
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The F-111 force represents a unique capability to conduct specialized attack missions during daytime, darkness and adverse weather. The F-111 aircraft constitutes a viable element of the Air Force combat capability into the late 1990's. The successful completion of interdiction, close air support and offensive counter-air missions against the known threat requires acurate target acquisition before effective weapons delivery can be accomplished. Target acquisition, designation and attack capabilities currently exist for day visual conditions; however, deficiencies remain during night and adverse weather conditions. The PAVE TACK project which is being transferred to this PE was developed to provide a precise night and limited adverse weather target acquisition system common to F-4 and F-111 aircraft. A Forward Looking Infrared (FLIR) sensor, laser target designator/ranger, common stabilized and slewable optics for the FLIR and laser and necessary digital control electronics are contained in a pod carried on the F-4 aircraft centerline and semi-submerged in the F-111 weapons bay. The F-4 and F-111 digital avionics permit flexible integration of the navigation equipment, weapons delivery computer, the radar and PAVE TACK sensors and guided weapons. PAVE TACK equipped aircraft are therefore capable of performing accurate low altitude high speed air-to-surface attack missions at night and during limited adverse weather using a variety of available weapons. PAVE TACK production for the F/RF-4 was initiated in July 1977; F-111F production started in August 1978. The remaining FY 1980 effort to be accomplished in PE 64709F includes correction of deficiencies identified during development and initial operational tests, completing the operational flight program and F-111F simulator software integration and support, completing development of a video augmented tracking system and providing maintenance support of the development assets as they are used to support initial flight crew training in advance of production hardware deliveries.

RELATED ACTIVITIES: The Air Force common Forward Looking Infrared (FLIR) sensor used in the PAVE TACK pod was developed in Program Element (PE) 64710F, Reconnaissance Equipment. The development tasks conducted in PE 64728F, Tactical LORAN/F/RF-4 Digital Avionics, were critical to the success of the F-4 PAVE TACK program. PE 64733F, Surface Defense Suppression, has provided weapons integration support for the development of a single Group A aircraft wiring kit for PAVE TACK and guided weapons for the F-111F. The integration approach will allow for an efficient one time modification of the F-111F. The Video Augmented Tracking System (VATS), initially developed under PE 63203F, Advanced Avionics for Aircraft, has transitioned into the PAVE TACK project for integration and flight demonstration. VATS full scale development will be completed with the PAVE TACK project.

WORK PERFORMED BY: All Air Force effort is being managed by the Aeronautical Systems Division, Wright-Patterson AFB, OH. The initial engineering study on upgrading the F-111A/E from the current analog system to a Digital bomb/navigation system was performed by General Dynamics, Fort Worth, TX. The PAVE TACK contractors include: PAVE TACK Pod, F-4 Integration, Ford Aerospace, Newport Beach, CA (Prime Contractor); FLIR, Texas Instruments, Dallas, TX; Laser, International Laser Systems, Orlando FL; F-4/F-111 Cockpit Display, Texas Instruments, Dallas, TX and General Electric Corp, Utica, NY; F-111 Integration, General Dynamics, Forth Worth, TX. Flight test responsibility has been assigned to the Armament Division at Eglin AFB, FL.

Program Element: #27129F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: F-111 Squadrons
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: During FY 1977 studies were conducted by Air Force Logistics Command and Air Force Systems Command on the feasibility of modification of the AN/AJQ-20A Bomb Navigation System (BNS) to provide for carriage/delivery of modern weapons at supersonic speeds by the F-111A/E. Results of these studies concluded that refurbishment of the AN/AJQ-20A analog system was not cost effective. Replacement of the AN/AJQ-20A with a digital BNS was deemed to provide not only the capability for carriage/delivery of current inventory weapons by the F-111A/E but also provide growth capability for future systems. The initial engineering study revealed that F-111 A/E digital bomb/navigation update was too expensive for the projected increase in combat capability. The Air Force has decided to terminate the effort for other more cost effective programs for the tactical forces. The remaining effort within the PAVE TACK Project has been transferred from PE 64709, Improved Tactical Bombing, to this Program Element. The PAVE TACK pod development and F/RF-4 combined development and initial operational test and evaluation were completed in April 1977. Pod production and F-4 aircraft modification direction was provided in July 1977. The F-111F interface design and prototype hardware fabrication were completed with two test aircraft delivered, one in August 1977 and one in September 1977. The PAVE TACK F-111F development and initial operational tests began in September 1977 and were completed in September 1978. The F-111F aircraft modification direction was provided in August 1978. The F-111F flight test was completed in December 1979.

2. FY 1980 Program: The FY 80 program provides for development of a Video Augment Tracking System (VATS) and contractor maintenance support for VATS testing as well as supporting continued flight training of TAC crew in advance of production systems availability. VATS will reduce operator workload by 75% during critical target tracking phase of mission allowing operator to assist in survivability tasks. VATS responds to operator concerns expressed during DT&E/IOT&E. The basic production pod configuration contains all provisions for VATS.

3. FY 1981 Planned Program: The Video Augmented Tracking System (VATS) will be fully integrated into the PAVE TACK pod. The integrating Contractor will complete his software develoment and the initial in-house testing. The VATS operational flight program final reassembly will be accomplished and the PAVE TACK operational test program will be modified to include the VATS design. The VATS support equipment design will be completed.

4. FY 1982 Planned Program: The Video Augmented Tracking System will complete Development Test and Evaluation and Initial Operational Test and Evaluations. The system discrepancies, if any, will be corrected and reevaluation initiated.

Program Element: #27129F
DoD Mission Area: Interdiction/Naval Strike, #223

Title: F-111 Squadrons
Budget Activity: Tactical Programs, #4

5. Program to Completion: Flight testing will be initiated during the first quarter of FY 1981 and continue throgh FY 1982. A production/modification decision will be made near the end of flight testing and the modification program for implementation of the fully tested and qualified modification will begin in FY 1983.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2,600*	2,000	18,900	21,400	20,300	65,500
No projects				(5,800)**	(7,900)**	(8,600)**	(22,300)**

* Funded under Program Element 64212F Aircraft Equipment Development.
** Transferred from Program Element 64709F Improved Tactical Bombing, Project 2056, PAVE TACK.

The funding in FY 1980 and subsequent years has been reduced to reflect the Air Force decision not to proceed with digital update of the F-111 A/E bomb/navigation system. Approximately one-half million dollars will be required to terminate the existing update program. The Air Force will request reprogramming authority for the remaining FY 80 funding (approximately $17.5M). The task remaining in this program element is the auto-tracker modification (VATS) for the PAVE TACK.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27130F
Title: F-15 Squadrons
DOD Mission Area: Counter Air #221
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Estimated Costs
TOTAL FOR PROGRAM ELEMENT		11,990	500	9,100	9,600	26,600	2,141,890

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The F-15 is a high performance, highly maneuverable fighter equipped with a long range look-down radar and a balanced mix of air-to-air weapons to provide an outstanding close-in visual and medium range all-weather kill capability. Designed specifically to gain and maintain air superiority against post-1975 threat aircraft, the F-15 will significantly upgrade United States Air Force Tactical Forces supporting the counter-air and tactical support missions. Equipage of the active force with the F-15 contributes to Reserve force modernization by releasing F-4s from the active component for conversion to Reserve and Guard units.

BASIS FOR FY 1981 RDT&E REQUEST: The FY 1981 request includes funds to continue the FY 1980 efforts including flight test of electronic warfare system and radar software updates, completion of support equipment development, and F-15/ Advanced Medium Range Air-to-Air Missile integration and compatibility tests. Also included is development and test of other essential improvements in F-15 avionics interfaces and the secondary power system.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982[1]/ Estimate	Additional[2]/ to Completion	Estimated Costs
Procurement (3010)	1,387,300	1,052,700	860,600	956,300	654,300	12,079,400*
(Quantities)	(78)	(60)	(30)	(30)	(30)	(729)

* Includes initial spares

1/ Includes $63.9M for Air Defense F-15, Program Element (PE) 12116F, peculiar ground support equipment and initial spares.
2/ Includes $2.2M for Air defense F-15 (PE 12116F) peculiar ground support equipment.

Program Element: #27130F Title: F-15 Squadrons
DOD Mission Area: Counter Air #221 Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: Until deployment of the F-15, the F-4E was our finest air-to-air fighter. However, the F-4 has marginal capability in air combat against the MIG-21, models of which are expected to remain in the Soviet Block inventory through the 1980s. In addition, three new interceptors; the Flagon, Foxbat and Flogger are operating in significant numbers in Soviet tactical forces. Thus the fighter threat during the 1975-1989 period will range from simple, highly maneuverable, day visual fighters to all-weather interceptors with advanced fire control systems. The F-15 has the maneuverability, armament, and fire control system to meet this post-1975 threat. Holder of eight world time-to-climb records, the F-15 combines an advanced pulse doppler radar for long range detection and tracking with a mix of radar and infrared missiles and a 20mm rapid-fire cannon to provide a close-in visual and medium range all-weather kill capability. The F-15 has four model designations, the F-15A/B/C/D. The F-15C and its two-seat version, the F-15D, incorporate radar signal processor and Production Eagle Package (PEP) 2000 improvements. The programmable signal processor provides the capability to rapidly reprogram the radar via software changes and permits improved electronic counter counter measure performance, higher resolution, and the introduction of new radar modes, such as the track-while-scan when developed. PEP 2000 provides an additional 2000 pounds internal fuel, provisions for conformal fuel tanks, and increases maximum takeoff weight by 12,000 pounds. The single-seat A and two-seat B models do not have these improvements. The F-15 significantly upgrades the United States Air Force Tactical Forces performing combat air patrol, escort, and fighter-sweep missions. It has replaced the F-4E as our primary air superiority fighter in the force structure. Equipage of active forces with the F-15 and the resultant transfer of the F-4 is helping to continue modernization of Reserve and Guard forces.

RELATED ACTIVITIES: The Tactical Electronic Warfare System for F-15 application is being developed in Program Element (PE) #64739F, Tactical Protective Systems. AIM-9L, AIM-9M, AIM-7F and AIM-7M (Advanced Monopulse Seeker) air-to-air missiles are being developed and procured for use on the F-15 under P.E. #27161F, Tactical Air Intercept Missiles. The Joint Tactical Information Distribution System (JTIDS) is being developed for use on multiple aircraft including the F-15 under P.E. #64754F, JTIDS. The Advanced Medium Range Air-to-Air Missile is being developed under P.E. 64314F and 63370F&N.

WORK PERFORMED BY: The F-15 development program is being managed by the F-15 Program Office, Aeronautical Systems Division, Wright-Patterson Air Force Base, OH. McDonnell-Douglas Corporation, St. Louis, MO, is the prime contractor for development and production of the F-15 aircraft. Pratt & Whitney Division of the United Aircraft Corporation, West Palm Beach, FL, is the engine contractor. Hughes Aircraft Company, Culver City, CA is the radar subcontractor to McDonnell-Douglas Corporation.

Program Element: #27130F
DOD Mission Area: Counter Air #221

Title: F-15 Squadrons
Budget Activity: Tactical Programs #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The F-15 is an outgrowth of the F-X program which originated in 1965 with an Aeronautical Systems Division effort to develop a "representative" F-X design. This effort culminated in an advanced fighter point-design study released in July 1966. While the Concept Formulation Paackage for the Advanced Tactical Fighter (F-X) was approved by the Secretary of the Air Force in August 1967 and supplemented in August 1968, significant controversy remained over F-X design criteria. The question of flexible versus specialized (air superiority) capability was deferred to the contract definition phase for a final tradeoff decision. In September 1968, Requests for Proposal were released to industry; four responses were received. In December 1968, contracts were awarded to three of these manufacturers for "contract definition" of the aircraft. Based on its technical and cost proposal, McDonnell-Douglas Corporation was announced "winner" of the F-X competition in December 1969. Airframe, engine and avionic requirements were specified and McDonnell-Douglas charged with overall system responsibility for the development and production of the F-15. Earlier, in August 1968, Air Force had released contracts for advanced engine development. After evaluating the proposals of two manufacturers, the Air Force selected Pratt & Whitney aircraft in March 1970 to develop and produce the F-15 engine. Finally, McDonnell-Douglas awarded a subcontract to Hughes in September 1970 for development of the F-15 radar. The remainder of this paragraph summarizes the significant events in the F-15 program from the beginning of full scale development in January 1970 to date. The air vehicle critical design review and the avionics equipment development review were completed in April and June 1971, respectively. From July 1971, efforts were directed to fabrication of components and flight test airplanes and extensive ground testing of subsystems. Three demonstration milestones were completed in February 1972, including the Engine/Inlet Compatibility Test, the Structural Test Major Subassemblies, and the Engine Preliminary Flight Rating Test (PFRT) Milestones. To obtain increased engine efficiencies over the PFRT engine (Series I configuration) the Air Force decided, in March 1972, to use the alternate design being carried as a parallel effort. This engine became Series II, the configuration planned for Military Qualification Tests and subsequent production. On 26 June 1972, at the "Roll Out" ceremony, the F-15 was officially christened the "Eagle". First flight occurred on 27 July 1972 beginning a highly successful flight test program. The flying qualities Air Force Preliminary Evaluation was completed in September 1972, with favorable results. The initial Airborne Avionics Performance Milestone was completed on 2 December 1972. Two structural demonstration milestones were completed in January 1973, including the Fatigue Test One Lifetime and Static Test to Critical Conditions. The Defense Systems Acquisition Review Council (DSARC) held on 15 February 1973 approved production go-ahead for the first F-15 wing. The F100 engine endurance qualification test, delayed beyond planned completion date of February 1973 by technical problems, was successfully completed on 12 October 1973. All major structural testing milestones were met when the fatigue tests to three and four lifetimes were completed in October 1973 and February 1974, respectively, and static tests for the major critical conditions were completed in March 1974. The increased production rate tooling DSARC was held on 17 January 1974 and approval was granted to proceed with the FY 74 production of 62 aircraft and for the purchase of the increased tooling to produce it. The Air Force Development, Test and Evaluation began at Edwards AFB in February 1974. The second wing DSARC was held on 15 October 1974 and

approval was given for the FY 75 procurement of 72 aircraft. The first two production aircraft were delivered to Tactical Air Command in November 1974. The External Stores Flutter Release Milestone was completed in August 1974. With the exception of a single aircraft conducting limited armament follow-on testing, all contractor Development, Test and Evaluation was completed in November 1974. F-15 Follow-on Test and Evaluation started in March 1975 and was completed in July 1976. All high angle-of-attack and spin testing was completed in August 1975. The Initial Operational Capability (IOC) for the first training squadron was delayed from July 1975 to September 1975 due to a strike at McDonnell-Douglas. The IOC for the first operational squadron was in October 1976.

The Equipment Qualified Milestone was completed in March 1977 and the Aerospace Grouund Equipment In-Place Milestone was completed in May 1977. Flight evaluation of the Air Intercept Missile Evaluation/Air Combat Evaluation changes to the computer software, of F-15/F-16 radar mutual interference tests, and of the AIM-9L integration effort was completed in 1978. Air Force Development, Test, and Evaluation (AFDT&E) of the AN/ALR-56 Radar Warning Receiver "New Threat" program was completed in 1978. Contractor Development, Test, and Evaluation (CDT&E) and AFDT&E of the Jet Fuel Starter air start capability was completed in 1978. Development of the F-15 C/D model, Production Eagle Package 2000 improvement (2,000 lbs additional internal fuel, provisions for conformal fuel tanks, and capability for higher takeoff gross weight), which was initiated in mid-1976, continued into 1979. CDT&E and AFDT&E of the C/D model began in February and May 1979, respectively. Development and test of the programmable signal processor (PSP), which began in 1978, continued throughout 1979. Finally, testing under the F100 Engine Component Improvement Program (CIP), including solutions to the F100 stall/stagnation problem continued throughout 1979.

2. FY 1980 Program: The RDT&E funding of $.5 million is being used for management and engineering support of flight test evaluations of electronic warfare hardware/software threat updates, integration and certification tests of improved air-to-air weapons (AIM-9M and AIM-7M), development and test of the radar PSP, and continuation of F100 engine CIP testing.

3. FY 1981 Planned Program: The FY 1981 request of $9.1 million will be used to continue the FY 1980 efforts, including flight test of electronic warfare system and radar software updates, completion of organizational, intermediate, and depot test equipment development, and F-15/Advanced Medium Range Air-to-Air Missile integration and compatibility tests. Other essential improvements to F-15 avionics interfaces and the secondary power system will be developed and tested.

4. FY 1982 Planned Program: The FY 1982 RDT&E request is $9.6 million. These funds will be used to continue efforts begun in prior fiscal years and to initiate development of improvements to the aircraft cooling and electrical systems, principally in support of the Joint Tactical Information Distribution System.

5. Program to Completion: The FY 1983-1985 RDT&E funding request of $26.6 million will be used to continue weapon system certification and F100 engine CIP testing. Additionally, development and test of software improvements to electronic warfare systems, radar, and test support equipment will be completed.

Program Element: #27130F
DOD Mission Area: Counter Air #221

Title: F-15 Squadrons
Budget Activity: Tactical Programs #4

6. Milestones:

		Date
A.	Award Total System Development Contract	Jan 70
B.	Preliminary Design Review	Sep 70
C.	Critical Design Review	Apr 71
D.	Engine Preliminary Flight Rating Test	Feb 72
E.	First Flight	Jul 72
F.	Long Lead Release (Production Approval)	Oct 72
G.	First Wing Full Release	Feb 73
H.	Engine Qualification Test	Oct 73
I.	Fatigue Test-3 Lifetimes	Oct 73
J.	Increase Production Rate	Jan 74
K.	Begin Air Force Development, Test and Evaluation	Feb 74
L.	Fatigue Test-4 Lifetimes	Feb 74
M.	Second Wing Release	Oct 74
N.	First Aircraft to Tactical Air command	Nov 74
O.	Initial Operational Capability (First Tng Sq)	Sep 75

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
FY 80 Pres Budget	62,700	10,000	500	5,000	0	2,099,500

Last year's budget ended F-15 RDT&E funding in FY 1981. Subsequently, the FY 1981 request was increased to $9.1 million and FY 1982-1985 funds were added. The funding was added because of a combination of factors including, three year delay in Program Management Responsibility Transfer, extension of the F-15 production line until May 1985, introduction of a major model change (F-15 C and D) in June 1979 and a software programmable radar in May 1980, and the need to continuously update the radar, electronic warfare system and support equipment to counter the postulated threat. Additionally, outyear funding enables development of operational enhancements.

Budget Activity: Tactical Programs #4

Program Element: 27130F F-15 Squadrons

Test and Evaluation Data

The F-15 test program was composed of Contractor Development Test and Evaluation (CDT&E), Air Force Development Test and Evaluation (AFDT&E), Air Force Initial Operational Test and Evaluation (IOT&E) and Follow-on Test and Evaluation (FOT&E). The purpose of CDT&E and AFDT&E was to provide necessary test and analysis data to assure that an operational air superiority weapon system would be available at the earliest practical time. Test objectives addressed compliance with specifications, established performance capabilities, evaluated handling qualities, etc. IOT&E was conducted throughout Development Test and Evaluation (DT&E) to evaluate the operational capability and suitability of the F-15 weapon system. A portion of Tactical Air Command's (TAC) IOT&E involved their participation in 11 F-15 Air Force Preliminary Evaluations (AFPE). Additionally, seven Initial AFDT&E were conducted during DT&E to permit Air Force Flight Test Center (AFFTC) and TAC pilots to evaluate contractor fixes of mandatory correction items discovered during AFPEs and to accomplish early Air Force developmental and operational test objectives. Eighteen F-15As and two F-15Bs (two-seat version) were dedicated to the DT&E/IOT&E tests.

1. Development Test and Evaluation: As of 31 July 1979, the Air Force and McDonnell Douglas DT&E test teams had accumulated over 6600 test flights and 7548 flight hours on F-15 test aircraft during the 87 months of F-15 DT&E. Major activities during CY 1978 and CY 1979 included Tactical Electronic Warfare System (TEWS) AFDT&E, Air Intercept Missile Evaluation/Air Combat Evaluation computer software change evaluations, F100 engine stall/stagnation and component improvement tests, F-15/F-16 radar mutual interference tests, improved 20MM ammunition tests, programmable signal processor (PSP) CDT&E, F-15 C/D model DT&E, and numerous evaluations of weapon system improvements designed to satisfy recommendations resulting from earlier testing. The remainder of this paragraph summarizes the significant DT&E accomplishments in the F-15 program from the beginning of full scale development in January 1970 to date. The air vehicle critical design review and the avionics equipment development review were completed in April and June 1971, respectively. From July 1971, efforts were directed to fabrication of components and flight test airplanes and extensive ground testing of subsystems. Three demonstration milestones were completed in February 1972, including the Engine/Inlet Compatibility Test, the Structural Test Major Subassemblies, and the Engine Preliminary Flight Rating Test (PFRT) Milestones. To obtain increased engine efficiencies over the PFRT engine (Series I configuration) the Air Force decided, in March 1972, to use the alternate design being carried as a parallel effort. This engine became Series II, the configuration planned for Military Qualification Tests and subsequent production. F-15 first flight occurred on 27 July 1972 beginning a highly successful flight test program. The flying qualities AFPE was completed in September 1972, with favorable results. The initial Airborne Avionics Performance Milestone was completed on 2 December 1972. Two structural demonstration milestones were completed in January 1973, including the Fatigue Test One Lifetime and Static Test to Critical Conditions. The F100 engine endurance qualification test, delayed beyond planned completion date of February 1973 by technical problems, was successfully completed on 12 October 1973.

Budget Activity: Tactical Program #4

Program Element: 27130F F-15 Squadrons

All major structural testing milestones were met when the fatigue tests to three and four lifetimes were completed in March 1974. The Air Force Development Test and Evaluation (AFDT&E) began at Edwards AFB in February 1974. The external Stores Flutter Release Milestone was completed in August 1974. With the exception of a single aircraft conducting limited armament follow-on testing, all Contractor Development, Test, and Evaluation (CDT&E) was completed in November 1974. All high angle-of-attack and spin testing was completed in August 1975. The Equipment Qualified Milestone was completed in March 1977 and the Aerospace Ground Equipment In-Place Milestone was completed in May 1977. Flight evaluation of the Air Intercept Missile Evaluation/Air Combat Evaluation changes to the computer software, F-15/F-16 radar mutual interference tests, and the AIM-9L integration effort was completed in 1978. AFDT&E of the AN/ALR-56 Radar Warning Receiver "New Threat" program was completed and an interim flight test report published in 1978. The New Threats consisted of three major improvements. One feature allows the ALR-56 to sort out and analyze capability. A second modification gives increased capability to detect threats that are The final change, termed were demonstrated. However, the software tape still had New Threat related problems as well as some carry-over deficiencies from the current Operational Flight Program. Further development and testing is required before release. In 1978, CDT&E and AFDT&E of the Jet Fuel Starter air start capability was completed. Testing under the F100 Engine Component Improvement Program, including solutions to the F100 stall/stagnation problem, continued throughout 1978 and into 1979. Development of the F-15 C/D model, Production Eagle Package 2000 improvement (2,000 lbs additional internal fuel, provisions for conformal fuel tanks and capability for higher takeoff gross weight), which was initiated in mid-1976, continued into 1979. CDT&E and AFDT&E of the C/D model began in Feb and May 1979, respectively. Finally development and test of the programmable signal processor for the F-15 radar, which began in 1978, continued into 1979. Maintainability and reliability testing of the F-15 Weapon System was a special subject of Operational Test and Evaluation as discussed below.

2. Operational Test and Evaluation:

a. Initial Operational Test and Evaluation (IOT&E): The F-15 IOT&E was part of a combined IOT&E/Air Force and contractor Development Test and Evaluation (DT&E) conducted at Edwards AFB, CA, using data from contractor and Air Force DT&E sorties flown July 1972 through 30 June 1975. The IOT&E was USAF directed, Tactical Air Command conducted, and Air Force Test and Evaluation Center monitored. The IOT&E provided estimates of system operational effectiveness and suitability in support of Defense System Acquisition Review Council decisions related to increased production rate. Specific test objectives addressed both air-to-air and air-to-ground mission roles. 4460 sorties were flown in the 2.5 year effort. Major findings were:

(1) The aircraft had superior handling and flight characteristics. Improvements were requested to cockpit situation awareness cueing to assist pilots in taking full advantage of the aircraft capabilities.

(2) Pilot workload was satisfactory, but certain fire control automation was requested for the close-in engagement.

(3) AIM-7F/F-15 interface was satisfactory. Carriage problems and cueing errors were noted in AIM-9E testing.

(4) F-15 was an effective platform for air-to-ground ordnance delivery.

(5) The continual change of hardware and software throughout the test program precluded establishment of a data base for reliability assessments. The immaturity of the built-in-test and non-delivery of major segments of test equipment were major limiting factors in the overall suitability evaluation.

b. Follow on Test and Evaluation (FOT&E): The F-15 FOT&E was an independent test and evaluation managed by the Air Force Test and Evaluation Center (AFTEC) and conducted by the 58th Tactical Fighter Training Wing at Luke AFB, Arizona. The objectives of FOT&E were to verify the operational effectiveness and suitability, which included assessment of the logistical supportability, life cycle costs, and identification of desirable modifications or trade-offs for the production F-15 System. The FOT&E commenced in March 1975 and finished in July 1976 using a total of 1111 F-15 sorties and approximately 900 support sorties. Evaluation sorties were flown by AFTEC and Tactical Air Command pilots. Maintenance was performed by Air Force personnel.

c. The F-15 was found to be an excellent weapon system for air-to-air combat. The long-range, look-down capability of the radar made it extremely effective in intercept operations and allowed it to enter most engagements from a position of advantage. However, there were several major operational deficiencies identified during FOT&E which were felt to limit the full operational capability of the F-15A. The major operational deficiencies identified were (1) unreliable fuel supply to the engines in the event of aircraft electrical failure, (2) fuel transfer problems, (3) unreliable landing gear indications, (4) fire control system problems and (5)
The F-15 Program Office has taken action to correct each of these deficiencies. Improvements in the emergency boost pump ground check switch and the emergency power system are being incorporated into production aircraft and have been retrofitted into all previously delivered F-15s to eliminate unreliable fuel supply during electrical failures. Problems associated with fuel transfer pump malfunctions were corrected by providing more detailed information to the pilot on actions to be taken when a transfer malfunction occurs. A review was also initiated to determine whether additional cockpit cues of this malfunction were required. Action resulting from this problem was closed in April 1977. The landing gear position indicating system was corrected by minor engineering changes approved in October 1976 and February 1977. These changes have been in all production aircraft since February 1977 and were also retrofitted into all previously delivered F-15s. Fire control system problems were corrected by a central computer operational flight program update. Finally, solution to the problem has been identified and the fix has been included in the Program. Production effectivity is scheduled for December 1979.

d. Test estimates of reliability/maintainability indicated that the F-15A will be malfunction free on 20 percent of the sorties. It will return from a mission with the capability of further missions 50 percent of the time. Testing resulted in an estimate of 40 maintenance manhours per flying hour. The manpower requirements necessary to support a 72 aircraft wing were estimated at approximately 1000 authorizations.

e. In addition to the above testing, an Initial Operational Test and Evaluation (IOT&E) of the F-15 Tactical Electronic Warfare System was conducted by the US Air Force Tactical Air Warfare Center, Elgin AFB, Florida. The resources of the Armament Development and Test Center, the Naval Weapons Center, and the 6512 Test Squadron, Air Force Systems Command were used during the test. The test was conducted simultaneously with AF and contractor Development, Test, and Evaluation (DT&E) from February 1974 through October 1976. The IOT&E, USAF-directed and AFTEC-monitored, was comprised of 325 sorties. The purpose of this IOT&E was to evaluate the capability of the F-15 Tactical Electronic Warfare System (TEWS) to protect the aircraft against surface-to-air and air-to-air threats. Air Force personnel performed organizational-level maintenance for the F-15 TEWS. However, intermediate- and depot-maintenance support was accomplished entirely by contractor engineers and technicians using interim special test equipment. Major conclusions are (1) basic system operation was verified

f. The TEWS has the potential to give the fighter pilot an electronic warfare (EW) capability far superior to that of previous tactical EW systems. A number of equipment design changes and software modifications have been implemented to correct both the functional deficiencies and to provide additional capability. These changes and modifications are currently being tested by the USAF Tactical Air Warfare Center in an extension of the previous DT&E/IOT&E. A report on this testing is scheduled for late 1979.

3. Systems Characteristics: The F-15 is an advanced tactical fighter developed for the air superiority mission. It is a twin engine, single place, fixed swept wing airplane characterized by high thrust-to-weight and low wing loading for superior acceleration and maneuverability. The F-15 is equipped with a balanced mix of air-to-air weapons, ranging from medium range all-weather missiles to rapid-fire 20mm cannon and provides an outstanding capability against the postulated enemy air threat.

Budget Activity: Tactical Program #4

Program Element: 27130F F-15 Squadrons

	DEVELOPMENT ESTIMATE	DEMONSTRATED PERFORMANCE
A. Operational		
1. Max Mach No @ Alt (Sust./Burst)	2.3/2.5	2.3/2.5
2. Max Mach No. @ Sea Level (Sustained)	1.2	1.16
3. Design Maximum Load Factor (80% Int fuel), g	7.33	7.33
4. Maximum Buffet-Free Maneuver g (M0.8, 30K ft), g		
5. Energy Maneuverability (Ps), fps		
a. M0.9, 30,000 ft, 5g. Mil Pwr		
b. M0.6, 10,000 ft, 5g. Max Pwr		
c. M0.9, 10,000 ft, 1g. Max Pwr		
d. M0.9, 10,000 ft, 5g. Max Pwr		
e. M0.9, 30,000 ft, 5g. Max Pwr		
f. M1.6, 35,000 ft, 5g. Max Pwr		
B. Technical		
1. Design Mission Take-off Weight, lb	40,000	41,491
2. Take-off Wing Loading, lb/ft	66	68
3. Uninstl. SLS Max. Thrust to Take-off Wt. Ratio		

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27131F (64225F) Title: A-10 Squadrons
DOD Mission Area: Close Air Suport/Battlefield Interdiction,#222 Budget Activity: Tactical Programs,#4

RESOURCE (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	17,955	17,800	13,600	5,400	9,600	454,900

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The A-10 is a single place, twin turbofan aircraft specifically designed for the Close Air Support (CAS) mission. High survivability is a primary design feature. It has a high velocity, rapid fire, 30 millimeter(mm) gun for increased target kill effectiveness and can carry a large and variable external load of conventional ordnance. Aircraft speeds range from 120 knots to a maximum of 450 knots. The A-10 is designed to operate in the European threat environment which includes a high density of 23mm antiaircraft weapons and infrared heat seeking and radar-guided ground-to-air missiles. The primary mission of the A-10 is to attack targets in close proximity to friendly forces in support of the ground battle.

BASIS FOR FY 1981 RDT&E REQUEST: The FY 1981 request will continue follow-on testing of chaff/flare and radar warning systems. Follow-on fatigue tests will continue to verify changes required as a result of more severe operational usage. The request also includes funds to continue flight tests and laboratory and engineering support to resolve correction of service revealed problems.

OTHER APPROPRIATION FUNDS:

Aircraft Procurement(3010) 1/	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
A-10	809,300	894,800	493,200	415,400	876,200	5,528,000
(Quantity)	(144)	(144)	(60)	(46)	(92)	(825)

1/ Includes initial spares

Program Element: #27131F
Title: A-10 Squadrons
DOD Mission Ares: Close Air Support/Battlefield Interdiction,#222
Budget Activity: Tactical Programs,#4

DETAILED BACKGROUND AND DESCRIPTION: The A-10 is a specialized aircraft designed for the Close Air Support (CAS) mission. It will replace aging or less effective aircraft in CAS. Studies performed between 1967 and 1969 led to a firm definition of the mission requirements and an optimized set of aircraft characteristics. The development of the A-10 was initiated, using a competitive prototype approach, with "design-to-cost" management goals. The A-10 is a single place, twin turbofan aircraft. High survivability is a primary design feature. The A-10 has been designed to operate in the intense anti-aircraft artillery (AAA) environment that is anticipated to be employed by enemy forces. The European threat environment includes a high density of 23 millimeter (mm) AAA weapons, infrared heat seeking and radar guided ground-to-air missiles. The aircraft has been hardened to counter the Soviet 23mm weapons and will carry those infrared and electronic countermeasures known to counter Soviet surface-to-air missile threat. The A-10 has an austere basing and extended air loiter capability. This aircraft has both a standoff and close-in capability to defeat enemy armor. The A-10 will utilize the Maverick missile when standoff tactics are employed and the GAU-8 30mm gun for close-in attack of enemy armor. The A-10 is highly maneuverable and can carry a large and flexible external ordnance payload.

RELATED ACTIVITIES: The A-10 utilizes the General Electric TF34-100 engine which is a modification of the TF34-400 engine developed by the Navy for the S-3A (Anti-Submarine Warfare Aircraft), Program Element (PE) 24215N. The TF34-100 engine was developed by the Air Force for A-10 application and includes several cost saving features. The A-10 Program Office and Navy have worked closely to ensure a high degree of commonality between both engine models. The A-10 is the first weapon system to use the GAU-8 30mm gun system, developed under PE 64605F. The A-10 Program Office has overall management responsibility for the GAU-8. The cost of the gun development as related to integration and testing with the A-10 are borne by the A-10 element. The A-10 will also employ the Maverick AGM-65 (Tactical Air-to-Ground Missile), PE 27313F. Weapon System Trainers for the A-10 are being developed in PE 64227F. The Standard Inertial Navigation System being developed under PE 64201F is planned for integration into the A-10. The $15.0M for PE 64201F is not shown in the A-10 RDT&E although the A-10 Selected Acquisition Report has included these costs in the A-10 Development.

WORK PERFORMED BY: This program is managed by the A-10 System Program Office, Aeronautical Systems Division, Wright-Patterson Air Force Base, OH. The prime contractor for the A-10 is Fairchild Republic Company, Farmingdale, L.I., NY. The GAU-8 30mm gun contractor is General Electric, Burlington, VT. The TF34-100 engine is managed by the Deputy for Propulsion, Aeronautical Systems Division. The engine contractor is General Electric, Lynn, MA.

Program Element: #27131F: Title: A-10 Squadrons
DOD Mission Area: Close Air Support/Battlefield Interdiction,#222 Budget Activity: Tactical Programs,#4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The A-10 was selected for development as the result of a prototype competition ending in December 1972. Comparative analyses showed that the A-10 would be more than twice as cost-effective as other candidate aircraft in supporting ground forces in a European environment. DOD approval was granted and the A-10 development contracts were awarded on 1 March 1973. The detailed design refinement of the A-10 began, and prototype aircraft testing and TF34-100 development continued. The subassemblies for the first test aircraft entered fabrication in December 1973 and were placed in the fuselage assembly jig in January 1974. The static test article also entered fabrication in January 1974. In response to Congressional direction on the FY 1974 budget, the quantity of Developement, Test and Evaluation (DT&E) aircraft in FY 1974 was reduced from ten to six and a fly-off between the A-10 and A-7 was conducted. The A-10 was declared the winner in June 1974. The engine completed qualification testing in October 1975. The first DT&E aircraft was delivered in February 1975. The prototype aircraft completed testing in in June 1975. DT&E testing was initiated in February 1975. Originally planned DT&E testing was completed in September 1977. Initial operational capability of the first operating squadron was accomplished October 1977. Follow-on DT&E testing of directed aircraft enhancements (Inertial Navigation System, internal chaff/flare system and ALR-69 radar warning system) is in progress. Work has begun on modifying the DT&E aircraft to an Air Force Logistics Command (AFLC) supportable configuration. These aircraft will be used within Air Force Systems Command for follow-on A-10 testing and mission support testbed aircraft. Follow-on fatigue testing was initiated to verify changes required as a result of more severe operational usage.

2. FY 1980 Planned Program: Funds will be used to complete modification of the DT&E aircraft to an AFLC supportable status. Stores testing and Air Force Flight Test Center support with DT&E aircraft will continue. Integration efforts for enhancements (ALR-69 radar warning system, Inertial Navigation System and chaff/flare system) will be continued. Follow-on fatigue tests are planned to verify changes required as a result of more severe operational usage.

3. FY 1981 Planned Program: Complete follow-on testing of chaff/flare and radar warning systems to increase their operational effectiveness against the expected European threat. The follow-on fatigue life extension program will continue to determine if the A-10 fatigue life can be economically extended. The funding will also provide basic support for flight test and laboratory and engineering efforts to resolve service revealed problems.

4. FY 1982 Planned Program: Includes effort to provide minimum sustaining flight test, laboratory and engineering support to resolve service revealed problems and evaluate potential avionics enhancements such as Joint Tactical Information Distribution System, Global Positioning System and night attack systems. Basic support for flight test and laboratory and engineering efforts to resolve revealed problems will continue.

5. Program to completion: Follow-on development efforts are planned through FY 1985. RDT&E efforts will generally be directed toward expanding capabilities and resolving service revealed problems.

Program Element: #27131F — Title: A-10 Squadrons
DOD Mission Area: Close Air Support/Battlefield Interdiction,#222 — Budget Activity: Tactical Programs #4

6. Milestones:

		DATE
A.	Award full-scale dev/prod contract	Mar 73
B.	Critical Design Review	May 74
C.	Complete GAU-8/A prototype demonstration	May 74
D.	Production Readiness Review	May 74
E.	DSARC IIIA & long lead production release	Jul 74
F.	Engine Qualification Test Complete	Oct 74
G.	First flight DT&E aircraft	Feb 75
H.	Fatigue test one lifetime complete	Oct 75
I.	First Production Delivery	Nov 75
J.	DSARC IIIB major production decision	Feb 76
K.	Initial Operational Capability	Oct 77
L.	Activate USAFE Base	Jan 79
M.	Complete Follow-on Development Program *(Sep 84)	Sep 85

* Date presented in FY 1980 Descriptive Summary. Additional fiscal year (FY 1985) is provided to flight tests and laboratory and engineering support to resolve corrections of service revealed problems.

7. Resources: N/A

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	17,600	18,000	17,800	12,000	11,700	450,100

The 1981 request was increased $1.6 million for additional test requirements. FY 1982-1985 funding was increased $2.3 million for outyear planning estimate for potential follow-on development and inflation adjustments. A prior year reduction reduces the estimated total cost to a net $4.8 million increase.

Budget Activity: Tactical Programs #4

Program Element: #27131F A-10 Squadrons

Test and Evaluation Data

1. Development Test and Evaluation: In 1966, the Chief of Staff of the Air Force directed that action be taken to develop a new aircraft specialized for the Close Air Support (CAS) mission. This direction reflected the need for an aircraft which would replace aging or less effective aircraft used in CAS and to provide optimum CAS at least cost. This requirement still exists and will be satisfied by the A-10. Contractor studies performed in 1967 and Air Force studies conducted in 1968 and 1969 led to a firm definition of the mission requirements and an optimum set of aircraft characteristics and avionics requirements. The development of the A-10 was initiated, using a competitive prototype approach, with "design-to-cost" management goals. The objectives of the prototype phase were to demonstrate that the primary characteristics of an optimum CAS weapon system could be achieved and to gain confidence that the weapon system could be procured at a relatively low cost. The objectives of the prototype phase were met within the forecast cost and on schedule. On 28 February 1973, the Department of Defense approved the development of the A-10, and the Air Force awarded contracts to Fairchild Republic Co. (airframe) and General Electric Co. (TF34 engine) for this effort.

An extensive review of the A-10 program was accomplished in July 1974 to determine if the A-10 was ready to enter low rate production. A detailed assessment of the test program and a review of the A-10's production readiness posture were made. The results of these reviews culminated in the approval to procure 52 A-10 production aircraft and release of $39 million for long lead funding for the initial procurement.

The TF34-100 engine completed qualification testing in October 1974. Continued testing of the two prototype aircraft until June 1975 supported the development program. The first DT&E aircraft was delivered in February 1975. The sixth and last DT&E aircraft was delivered in September 1975. These aircraft were used to test the following areas: aerodynamic performance, freedom from flutter, 100% air loads, armament systems, subsystems, climatic/adverse weather testing and initial operational tests. The performance thresholds were met or exceeded with the exception of forward air strip takeoff and landing distance. These parameter values were assessed and found to have little impact on the A-10's operational utility. All major test milestones required prior to the full rate production decision were accomplished. The bomb and strafe accuracy tests have demonstrated the A-10's excellent weapon delivery capability. The A-10 technical risks were minimized prior to production go ahead. Follow-on DT&E testing is continuing for stores certification and avionics enhancements. The static article has sucessfully demonstrated freedom from permanent deformation at design limit load and the ability to withstand ultimate strength (1.5 times limit load). The A-10 was certified to 6000 hours service life in May 1976; however, current operational usage is more severe than forecast in the design testing resulting in a reduction in the test validated service life to 4500 hours. Two fatigue test failures have resulted in the cold work of some 1400 fastener holes in the center wing section and the possible thickening of outer wing section skin panels. A fatigue failure in December 1979 with micro cracks known for the previous 600 hours confirmed the inspection interval and will provide additional data to determine the retorfit requirements

for the outer wing. Additional testing is being conducted to reestablish and validate the 6000 hours service life with the more severe operational usage.

Follow-on DT&E testing of selected enhancements (internal chaff/flare, inertial navigation system and ALR-69 radar warning system) is now in progress. Work has started on modifying the DT&E aircraft to an AFLC supportable configuration. These aircraft will be used within Air Force Systems Command for follow-on testing requiring the use of A-10 aircraft.

2. Operational Test and Evaluation: Phase I initial operational test and evaluation (IOT&E) of the A-10 was conducted in conjunction with development test and evaluation (DT&E) of the prototype YA-10 aircraft from March 1973 through June 1975. Phase II IOT&E, using six preproduction aircraft and later three production aircraft, began in April 1975 and was completed in March 1976. Limited aircraft availability prohibited evaluation of multiship employment concepts and tactics; however, adequate data were available to make an assessment of the A-10A aircraft.

The combined DT&E/IOT&E for the preproduction aircraft was conducted at the Edwards AFB , George AFB, and Nellis AFB ranges. An Air Force Test and Evaluation Center (AFTEC) test team composed of personnel from AFTEC, Tactical Air Command, Air Force Logistics Command, and Air Training Command conducted the IOT&E portion of the test. The purpose of the IOT&E was to evaluate the military utility, operational suitability, and effectiveness of the A-10 preproduction aircraft. Missions were flown to evaluate the aircraft, airborne performance, and handling qualities; pilot workload; air refueling capability; weapons delivery accuracy; defensive combat maneuvering capability; and night/weather operations. In addition, the close air support missions (support of troops, convoy escort, preparatory attacks, armed reconnaissance, and combat search and rescue) were evaluated. The interface of the GAU-8 gun with the A-10 was a primary objective. Data were gathered and analyzed to evaluate the A-10 survivability, reliability, maintainability, and maintenance training requirements.

Follow-on operational test and evaluation (FOT&E) was accomplished in two phases. Phase I, conducted by AFTEC and the 355th Tactical Fighter Wing, commenced in August 1976 and was completed in February 1977. This phase involved six production aircraft flying 388 sorties. Test location was Davis-Monthan AFB with deployments to Nellis AFB and McChord AFB for accomplishment of surge and low visibility test objectives. Based on the results of Phase I FOT&E, AFTEC has concluded that the production A-10A can perform the close air support mission better than any existing aircraft in the USAF inventory. Although some aircraft performance thresholds were missed, the overall performance is satisfactory in the context of tailoring loads and tactics to the specific missions. Primary weapons include the AGM-65 Maverick missile and the 30mm gun. The 30mm gun is a superior weapon when attacking current Warsaw Pact front line armor. Excellent accuracy is achieved even when firing beyond 4000 feet slant range.

Lack of sophisticated avionics has relegated the aircraft to daytime usage in a high threat environment. With low altitude target ingress, dead reckoning navigation causes excessive pilot workload. Therefore, an inertial navigational system is needed. In the low ceiling/visibility environment, the aircraft's capability to attack small passive targets is unmatched by any other aircraft in the inventory.

The A-10A is well suited to forward operating location operations. Medium weight takeoffs and landings resulted in average distances of 2175 feet and 1600 feet respectively. The simplicity of the aircraft and the self-contained power unit combine to aid in quick and safe turnaround operations.

Aircraft reliability, as measured by mean time between failure (MTBF) was excellent. The MTBF of 1.8 hours was better than the predicted value of 1.34 and the Decision Coordinating Paper number of 1.78. Maintainability, as measured in maintenance manhours per flying hour (MMH/FH) closely approximated the predicted value of 26.0 MMH/FH. Availability was also satisfactory with the flying rate slightly below the prediction of 61 percent.

Major deficiencies identified during the test were inadequate stability augmentation, unsatisfactory night lighting and a limited use head-up display (HUD). The first two deficiencies have been corrected, and work is continuing on the HUD. The above information is from the Phase I FOT&E Final Report dated May 1977.

PHASE II FOT&E, conducted by the Tactical Air Command and the 354th Tactical Fighter Wing using operational squadron aircraft, began in January 1978 and terminated in June 1978. FOT&E was conducted at Myrtle Beach AFB, SC with deployment/employments to Shaw AFB, SC and Savannah Airport, GA. The objectives of Phase II FOT&E were to verify the data gathered during Phase I as applied to an operational squadron and to document the A-10 weapon system capability when employed in squadron strength operating from both a permanent base and deployed in forward operating locations. This latter objective included the operation under normal and surge sortie rates. Aircraft availability was very good during the test, especially in view of system maturity. Reliability and maintainability were very good. Phase II test values were 21.78 maintenance man-hours per flying hour and a mean time between failure of 4.47 hours; predicted values were 21.00 and 1.78, respec tively. Aircrew training requirements were completed with relative ease due to aircraft availability. The 24 primary aircraft authorized A-10 squadron with its mobility support package showed an excellent capability to mobilize, deploy, and perform its mission under normal and surge sorties from both a fixed base and deployed forward operating locations.

3. System Characteristics: The significant A-10 performance parameters with the Decision Coordinating Paper goal/threshold values are shown below:

	PERFORMANCE THRESHOLDS		
ITEM	GOAL	THRESHOLD	CURRENT
Forward Airstrip 1/			
Take-off (ft)	2000	2200	2000
Landing (ft)	2000	2200	1750 5/
Airspeed			
Cruise at 5000 ft (KTAS)	300	285	336 5/

Aerodynamic Load Factor 2/			
Sustained at 150 KT (g)	1.9	1.7	1.9
Sustained at 275 KT (g)	3.1	2.8	3.1 5/
Loiter at 250 NM Radius (hr)			
Close Air Support Mission 3/	1.8	1.6	1.8
Anti-Armor Mission 4/	1.8	1.6	1.8 5/
Bombing Accuracy, MK82 (CEP) (mil)	15	17.0	13.6 6/
Strafing Accuracy (CEP) (mil)	10	11.5	4.0 6/

NOTE: All values for tropic day conditions. The "current" values reflect the best estimate or, if available, demonstrated values with all configuration changes included.

1/ 4 MK82, 750 rds of 30mm ammo and fuel for 50 NM cruise to tgt, 30 min loiter, combat, 150NM return to base, and land with fuel reserve
2/ 6 MK82, 750 rds of 30mm ammo, fuel for 300 NM, land with fuel reserve
3/ 16 MK82, 750 rds of 30mm ammo, fuel for combat and land with fuel reserve
4/ 6 Mavericks, 1350 rds of 30mm ammo, two ECM pods, full chaff/flare system, same mission profile as CAS mission
5/ Estimated
6/ Demonstrated

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27133F (64229F)
DOD Mission Area: Counter Air #221

Title: F-16 Squadrons
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	92,210*	27,800	42,300	8,000	9,100	915,400

*Does not include $13.7 million reprogrammed to ATLIS II.

BRIEF DESCRIPTION OF PROGRAM ELEMENT AND MISSION NEED: This program will satisfy mission need for a lightweight, high performance, multimission fighter capable of performing a broad spectrum of tactical air warfare tasks at an affordable cost. The F-16 is designed for high sortie rates with rapid turnaround, minimum manpower/logistics burden, and exceptional air combat maneuvering performance coupled with a potent air-to-surface weapons delivery capability. The F-16 will replace aging F-4s in the active inventory as well as modernize the Reserve Forces.

BASIS FOR FY 1981 RDT&E REQUEST: This request will support continued F-16 airframe, radar, engine, and stores certification flight tests. Test efforts will focus on those areas that are being identified during initial field operations and on development of an emergency backup fuel pump.

OTHER APPROPRIATION FUNDS ($ in thousands):

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Aircraft Procurement** (3010)	1,462,000	1,656,500	1,877,300	1,506,700	9,345,700	17,549,900
(Quantity)	(145)	(175)	(180)	(120)	(663)	(1,388)

**Includes initial spares.

Program Element: #27133F (64229F)
DOD Mission Area: Counter Air #221

Title: F-16 Squadrons
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: The F-16 Multimission Fighter will provide the Air Force with a means of modernizing and expanding the Tactical Fighter Force under tight fiscal and manpower constraints. Department of Defense efforts to improve the total acquisition process of major weapons systems resulted in increased emphasis on prototyping which led to initiation of the Lightweight Fighter (LWF) prototype program in April 1972. As the LWF prototype program progressed, a growing awareness of the operational performance, capability, and cost advantages offered by the YF-16 and YF-17 resulted in the Air Force decision in April 1974 to pursue development of a missionized LWF to be included in the tactical fighter force structure. At the same time, European interest in the LWF as an F-104G replacement in the 1978-1985 time frame offered the additional potential of foreign military sales and increased North Atlantic Treaty Organization (NATO) force effectiveness. The F-16 will offset the quantitative advantages of threat forces as well as provide the theater commander the flexibility to counter changing tactical situations.

RELATED ACTIVITIES: The following program elements contain development efforts which are applicable to the F-16: Program Element (PE) 27161F, Tactical Air Intercept Missile (AIM-9L/AIM-9M); PE 64602F, Armament/Ordnance Development (Multiple Stores Ejector Rack - MSER); PE 63370F, Advanced Medium Range Air-to-Air Missile; PE 63249F, Night Attack Program; PE 64201F, Aircraft Avionics Equipment Development (Project 2519, Radar Programmable Signal Processor); and PE 64212, F100 Engine Diagnostic System (EDS). In addition, PE 64268F, Component Improvement Program, funds improvements for the F100 engine which is used in both the F-16 and F-15.

WORK PERFORMED BY: The F-16 Program Office of the Aeronautical Systems Division, Wright-Patterson Air Force Base, OH, has management responsibility for the F-16 program. The major contractors are General Dynamics, Fort Worth, TX - F-16 airframe; Pratt & Whitney, East Hartford, CT - engine. Major United States subcontractors include Westinghouse, Baltimore, MD - radar; Singer Kearfott, Little Falls, NJ - inertial navigation set; Bendix, South Bend, IN - unified fuel control; Sundstrand Aviation, Rockford, IL - starter and constant speed drive; Delco Electronics, Goleta, CA - fire control computer; Menasco Manufacturing, Fort Worth, TX - landing gear; Hamilton Standard, Winsor Locks, CT - augmentor fuel pump, electronic engine control; and AiResearch Manufacturing, Torrance, CA - flap drive and emergency power unit. In addition to these, there are over 6,400 first tier United States subcontractors. Major European subcontractors include Fabrique Nationale, Belgium - engine; SONACA, Belgium - assembly; FOKKER, The Netherlands - center fuselage and assembly; DISA, Denmark - gear box module and simulator; Kongsberg Vapenfabrikk, Norway - inertial navigation set, fan drive; and Elliott Brothers, England - head-up display. A total of 29 major subcontracts have been placed in Europe.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In January 1975, the General Dynamics YF-16 was selected as the winner of the prototype flyoff between the YF-16 and the Northrop YF-17. Pratt & Whitney was selected as the engine contractor. In November 1975, Westinghouse was selected as the radar contractor after a flyoff competition with Hughes. The first Full Scale Development (FSD) aircraft was delivered in December 1976 and the last of the eight FSD aircraft was delivered in June 1978. More than 4,500 test hours have been flown using prototype and preproduction aircraft. The F-16 was approved for full rate production by the Defense Systems Acquisition Review Council in October 1977 and

the first production aircraft was delivered in August 1978. Twenty-nine contracts totaling more than $1.5 billion were signed by the end of FY 1978 with our European co-producers and assembly lines in both Belgium and The Netherlands started producing European aircraft. During 1978, Iran and Israel signed agreements with the United States to purchase 160 and 75 aircraft, respectively; Iran cancelled its order in 1979. In January 1979, the first United States Air Force F-16 unit was activated at Hill AFB, UT, and the first F-16 (European co-produced) was delivered to Belgium. During February through May 1979, the Air Force deployed three full scale development F-16s to Europe for development and operational testing of the aircraft in its intended environment. The results were highly satisfactory. The key problems identified were in radar performance and weapons delivery accuracy. Fixes have been incorporated. For the first year of operational service the F-16 performed at or above Tactical Air Command standards in sortie utilization rates and reliability and maintainability.

2. FY 1980 Program: The FY 1980 procurement request funds 175 aircraft and the advanced buy for 180 aircraft in FY 1981. The U.S. production rate will reach 15 aircraft per month, the planned maximum. European assembly lines will be producing six aircraft per month. Israel, the first Foreign Military Sales customer, will receive the first of their 75 aircraft in January 1980 for training at a United States site. The first in-country Israeli delivery will occur in July 1980. Extensive operational flight testing will continue through a multinational team composed of representatives of the four European participating countries (Belgium, Denmark, The Netherlands, and Norway) and the United States. Each country is providing aircraft, spares, and personnel. The development program will concentrate on additional airframe, avionics, and weapons certification testing. Development testing of the Avionics Intermediate Shop will be completed. Initial development will be started on a programmable signal processor (PSP) to improve the air-to-air and air-to-surface capabilities of the F-16 to give it the performance necessary to counter the threat expected in the mid-1980's and beyond.

3. FY 1981 Planned Program: The FY 1981 procurement request funds 180 aircraft and the advanced buy for 120 aircraft in FY 1982. The U.S. production rate will taper to a rate of 10 aircraft per month after the first 650 aircraft are produced. The first 650 aircraft are part of the Memorandum of Understanding the United States has with the European Governments for co-production and industrial participation and are, therefore, "fixed" to a production schedule by contractual agreements. The Air Force is decreasing the follow-on production rate because of funding constraints. With the FY 1981 procurement program, the Air Force will be incorporating structural and wiring provisions on the production line F-16 to prepare the aircraft to employ the Advanced Medium Range Air-to-Air Missile (AMRAAM) and to carry an Electro Optical/Forward Looking Infrared or laser-designator externally mounted pod. These systems will significantly improve the airplane's multimission performance by giving it a beyond-visual-range missile capability and an under-the-weather night attack option in the mid-1980s. The FY 1981 development program will include additional airframe testing and stores certification testing. Pratt and Whitney will begin development of an emergency backup fuel pump for the F100 engines to give it the additional safety margin critical for a single engine aircraft. The development effort for the PSP will continue.

4. FY 1982 Planned Program: The planned FY 1982 procurement request will be for 120 aircraft and advanced buy for 120

aircraft in FY 1983. Under consideration are additional capability improvements for the F-16 to include provisions for an improved environmental control system, Joint Tactical Information Distribution System, and an internal electronic countermeasures system. Development and integration funding requirements for these capability improvements will be addressed in the FY 1982 budget request. Maintaining operability with the European partners will be a key consideration in whatever configuration changes are approved. The need for these improvements is based on Air Force analyses of the capabilities the F-16 will need in the mid-1980s and beyond.

5. Program to Completion: Delivery of 10 aircraft per month will continue into the late 1980s for a total United States procurement of 1,388 aircraft. Outyear development efforts will focus on follow-on testing and aircraft upgrade.

6. Milestones:

		Date
A.	Source Selection/Award Development Contract	Jan 1975
B.	Defense Systems Acquisition Review Council (DSARC) II	Mar 1975
C.	European Long Lead Funds Released	Jun 1976
D.	Delivery First Full Scale Development Aircraft	Dec 1976
E.	DSARC IIIA (Long Lead Release)	Jan 1977
F.	DSARC IIIB (Production)	Oct 1977
G.	First Aircraft to Tactical Air Command	Jan 1979
H.	First European Aircraft	Jan 1979
I.	Initial Operational Capability (IOC)	
J.	Delivery of 651st Aircraft	Sep 1983
K.	Delivery of Last F-16 (1,388)	*(Dec 1987) Feb 1990

*Date presented in FY 1980 Descriptive Summary.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
FY 1980 Descriptive Summary	169,060	107,900	27,800	41,900	14,400	936,600

The $15.7 million difference between the FY 1979 estimate of $107.9 million and the FY 1979 actual of $92.2 million represents funds reprogrammed into other programs. The funds became available because of rephasing of the F-16 back-up fuel pump development and weapons certification testing. The FY 1981 increase represents an adjustment for inflation; the increases in the "Additional to Completion" column represent additional weapons certification testing as well as inflation adjustments. The reduction in total estimated costs is the net effect of the various adjustments and includes prior year deletion of engine diagnostic system development and minor revisions in cost estimates.

Budget Activity: #4, Tactical Programs

Program Element: 27133F (64229F), F-16

Test and Evaluation Data

1. Development Test and Evaluation: General Dynamics is the prime contractor for airframe and support equipment development and Pratt & Whitney is responsible for continued development of the F100 engine. Most of the major development testing on the basic aircraft, subsystems, and support equipment has been completed. As of December 1979, approximately 4,755 hours have been flown on prototype and full scale development aircraft. Performance and stability and control testing indicate that the aircraft can meet design specifications and be employed effectively throughout the flight envelope. The F-16 has demonstrated that it can carry, and employ, a varied mix of weapons including air-to-air ordnance, air-to-surface guided missiles, conventional bombs, and nuclear weapons. The F-16 radar meets basic specifications and can be used effectively to deliver air-to-air and air-to-ground weapons. Ground testing results indicate an airframe life of at least 8,000 hours. As would be expected in any development program, there have been changes required to correct problems identified during the test program. Fixes have been designed, tested, and incorporated into the production aircraft. The only major area of concern regarding the development activities is the susceptibility of the F100 engine to compressor stalls followed by stagnations and durability limitations. Although the F-16 engine has not stagnated with the engine operating in the design operational flight envelope, stagnations have occurred outside of the envelope and, if uncorrected, could be a problem in combat. These problems were initially experienced on the F-15 which has two F100 engines. With the incorporation of planned fixes, which have been tested, the current F-15 stall/stagnation rate of 2.0 incidents per 1,000 engine flight hours should be reduced. The F-16 incorporated all fixes to date. Tests of engine modifications are still being conducted. The last of the development aircraft was delivered in June 1978 and the systems and configuration are representative of the first production aircraft. The first production aircraft was delivered in August 1978 and the first F-16 unit was activated at Hill AFB, UT, in January 1979. As the aircraft is introduced into the Air Force inventory, testing will become more oriented toward areas relating to operational employment. All weather testing in desert and tropical climates is completed. Alaskan cold weather tests and an evaluation in European weather conditions were completed in early 1979. Testing to evaluate engine inlet icing problems is currently underway. Results of the European Test and Evaluation give high confidence to the ability of the F-16 to operate successfully in the European environment.

Future flight tests will include certification of additional weapons, continued systems integration tests, and evaluation of fixes for previously identified deficiencies. The major test activity in follow-on development will be evaluation of the enhancement of aircraft systems necessitated by threat evolution. Reliability and Maintainability (R&M) testing has been an integral part of the development effort and the F-16 currently indicates it can meet R&M goals established at program approval.

2. Operational Test and Evaluation:

a. The initial operational test and evaluation (IOT&E) was conducted in conjunction with the development test and evaluation (DT&E) from January 1977 to October 1977. The IOT&E results supported a production recommendation to the

Budget Activity: #4, Tactical Programs

Program Element: 27133F (64229F), F-16

Defense Systems Acquisition Review Council (DSARC) IIIB. Follow-on test and evaluation (FOT&E), Phase I, was completed in January 1979.

b. The purpose of the operational test and evaluation (OT&E) is to evaluate the operational suitability and effectiveness of the F-16 weapon system. The radar/heads-up display/fire-control system interface will be evaluated in air-to-air missions against projected simulated threat aircraft and in air-to-surface attack missions. Air-to-air weapons such as the AIM-9 and M61 gun will be fired at realistic maneuvering targets. Day and night evaluation of the F-16 air refueling capability will be accomplished. The F-16's performance and handling characteristics will be qualitatively and quantitatively evaluated while performing basic fighter maneuvers (BFM) and air combat maneuvers (ACM) against current and projected simulated threat aircraft. The electronic countermeasures (ECM) capability and electromagnetic interference (EMI) susceptibility of the F-16 will be evaluated. In addition, the operational suitability will include: reliability and maintainability to include maintenance support factors, potential maintenance safety hazards, and determination of training requirements and operating and support costs.

c. The combined development test and evaluation (DT&E)/initial operational test and evaluation (IOT&E) was conducted primarily at Edwards AFB, CA. Other test sites were Nellis Test Range, NV; China Lake, CA; Alaska; El Centro, CA; Yuma, AZ; Panama, CZ; and Eglin AFB, FL. An Air Force Test and Evaluation Center (AFTEC) test team composed of personnel from AFTEC, Tactical Air Command, Air Force Logistics Command, and Air Training Command is conducting the OT&E portion of the combined tests. Test resources were incrementally increased to a total of 11 aircraft of which 8 were preproduction aircraft and 3 were production. Additionally, a combined Air Force Systems Command/AFTEC European Test and Evaluation (ET&E) with three aircraft was conducted from February to May 1979. Test sites included Bodo AFB, Norway; Skyrdstrup AB, Denmark; Hahn AB, Germany; and Alconbury AB, UK.

d. FOT&E Phase II will be conducted at Hill AFB, UT, and in Europe from January 1979 through December 1980. Tactical Air Command is responsible for operational effectiveness, and AFTEC will further evaluate operational suitability. The AFTEC assessment will include reliability/maintainability data generated by all F-16 aircraft assigned to Hill AFB.

e. F-16 FOT&E/Tactics Development and Evaluation (TD&E) Phase II commenced on 2 January 1979 at Hill AFB, UT. This FOT&E/TD&E is being carried out jointly by the Air Forces of Belgium, Denmark, The Netherlands, Norway, and the United States. The FOT&E/TD&E Phase II has been designated as the Multinational Operational Test and Evaluation (MOT&E). The MOT&E consists of two parts: Part I will be accomplished in the United States (Hill AFB) from January 1979 through June 1980, and utilize test facilities and ranges at the following locations: Utah Test and Training Range, UT; White Sands Missile Range, NM; and the Nellis Range Complex in Nevada. Part II will be carried out in Europe, from locations within the countries of the European Participating Air Forces (EPAF) between July and December 1980. In both parts of the MOT&E program a mix of United States Air Force and EPAF production aircraft will be used, with a maximum of 10 F-16s used as test assets during Part I. Tactical Air Command is responsible for the operational effectiveness and tactics development objectives; AFTEC is responsible for the suitability assessment.

Budget Activity: #4, Tactical Programs

Program Element: 27133F (64229F), F-16

f. The purpose of the Multinational Operational Test and Evaluation (MOT&E) is to refine estimates of F-16 operational effectiveness, assist in evaluating configuration changes, develop tactics and operating concepts for F-16 employment, and assess the operational suitability of the aircraft. Training of the multinational test team was accomplished between January 1979 and July 1979. Operational effectiveness and tactics testing remain to be completed.

g. Air Force Test and Evaluation Center (AFTEC) flew 467 front seat and 98 back seat sorties during initial operational test and evaluation (IOT&E)/follow-on test and evaluation (FOT&E). This included six months of testing on two near production configured full scale development aircraft and seven aircraft-months on the first three production aircraft. Operational test and evaluation (OT&E) included beyond-visual-range missions with F-4 and T-38 aircraft; operational comparisons, basic fighter maneuvers, and air combat maneuvers with F-4E, F-5, A-37, and T-38 aircraft; night and day air-to-surface bombing and strafe; air-to-air gunnery against towed targets; and AIM-9J/L firings against BQM-34, PQM-102,and QH-50 drones.

h. Weapons system performance was overall satisfactory. Major operational effectiveness deficiencies by the end of of IOT&E/FOT&E and status were as follows:

(1) Improvements were incorporated during European Test and Evaluation (ET&E) and were satisfactory.

(2) Corrections are identified in Engineering Change Proposal (ECP) 206 and will be evaluated during MOT&E.

(3) Deficiencies were verified during ET&E. An accuracy test program is underway during follow-on development testing.

(4) Poor reliability of jet fuel starter: Satisfactory performance was demonstrated during ET&E, but problems still exist. Extensive changes are in work and will be further evaluated during MOT&E.

i. Reliability and maintainability (R&M) estimates indicated an overall satisfactory rating. The IOT&E/FOT&E assessments for late full scale development (FSD) and production aircraft projected satisfactory mean time between maintenance (MTBM) and maintenance man-hours per flying hour (MMH/FH) for the mature F-16. Average F-16 MTBM (for inherent failures) of 0.87 hours compared very favorably with the F-4 and A-7D mature average of 1.0 at the end of FSD. F-16 MMH/FH of 35.7 nearly equalled the mature F-4's 35. Corrective actions to fix major discrepancies affecting R&M goals; i.e., chafing and routing the aircraft wiring, high rate of fuel leaks, and excessive fuel venting due to heat expansion were incorporated and were satisfactory during ET&E. Damage or loss in flight of nonmetallic panels is no longer a problem due to replacement with metal panels. Concerns remaining at the end of IOT&E/FOT&E included high could-not-duplicate rates for built-in-test/self-test; high repair times for environmental control, hydraulic/

pneumatic, auxiliary power, flight control, and fuel systems; and supportability of the hydrazine emergency power unit. Further evaluation of these areas will continue during Multinational Operational Test and Evaluation (MOT&E) as the F-16 weapon system matures.

j. During the European Test and Evaluation (ET&E), the F-16 was exercised through a wide variety of realistic operational mission scenarios to provide an early assessment of its effectiveness and suitability when operated in its intended environment. One hundred forty-two sorties were flown for an effective sortie rate of 0.78. This was well above the planned rate of 0.50. Overall F-16 performance was highly satisfactory. The aircraft performed exceptionally well during air combat maneuvers, F-15/F-16 composite operations, tactical air-to-surface missions, and conventional nuclear weapon deliveries with practice munitions. Combat air patrol, nuclear strike, and sea surveillance missions were satisfactory. Radar sea modes performance was excellent during sea surveillance missions. Taxi, takeoff, and landing on icy surfaces presented no major problems.

k. Operational effectiveness deficiencies noted during ET&E included the following:

(1) Engine icing during ground operations: At near freezing temperature, induction icing occurred when the engine ingested standing water. Although this creates the potential for engine damage, none was observed during the test. Numerous fixes in work include: (a) pilot manual selection of anti-ice, (b) heat intake strut, and (c) evaluation of various isophobic coatings for surfaces on which ice forms.

(2) Inadequate lighting for night air refueling: Satisfactory solutions have been identified.

(3) Fuel venting during air refueling: Cause believed to be sticking shuttle valve. A redesign is being worked.

(4) False radar targets: Caused by radar side lobes reflecting off the earth's surface and a frequency instability in the main beam. Interim fixes were installed during ET&E, and final solutions are in test.

(5) ET&E software updates provided significant improvement. Further corrections are being evaluated during MOT&E.

(6) Software changes are being evaluated by MOT&E. Progress is evident.

(7) pilot selectable fix is in development.

(8) Inaccuracies were observed during follow-on test and evaluation (FOT&E) and verified during European Test and Evaluation (ET&E). A test program is now underway during follow-on full scale development.

(9) This deficiency was identified late in the FOT&E program. Corrections are being implemented through Engineering Change Proposal 206 and will be evaluated by Multinational Operational Test and Evaluation (MOT&E).

(10) Fire control/navigation panel (FCNP) difficult to operate by pilot: FCNP is being relocated to the left console, and some control panel switches are being reconfigured. This deficiency will be further evaluated during MOT&E.

1. F-16 reliability and maintainability during ET&E was satisfactory to excellent. Mean time between maintenance (inherent) was 1.39 hours, and maintenance man-hours per flying hour was 17.3. Aircraft flyable rate was excellent at 82 percent. This compares with the end FOT&E rate of 54 percent. Problems included low reliability of the radar digital signal processor and low power radio frequency units, and a high rate of nonduplicatable avionics/electrical malfunction indications. A hydrazine spill resulted in recommendations for several procedural, hardware, and protective equipment improvements. Operations from five different NATO shelter types were satisfactory.

3. Systems Characteristics:

Technical Information:

Length (ft)	49.5
Wing Span (w/missiles) (ft)	32.8
Operating Weight (empty) (lbs)	16,126 1/
Internal Fuel (lbs)	6,972
Current Max Takeoff Gross Weight (lbs)	35,400
Max Payload w/Full Internal Fuel (lbs)	12,302
Engine Thrust (lbs)	23,759

1/ Projected Block II weight (aircraft #160).

Budget Activity: #4, Tactical Programs

Program Element: 27133F (64229F), F-16

Performance Thresholds (F-16 Development Concept Paper):

	Threshold	Performance Demonstrated
Radius - Air Superiority Mission (NM)		
Radius - Air-to-Surface Mission (NM) 1/		
Sustained Turn Rates		
1.2 Mach/30,000 ft (°/sec)		
1.2 Mach/30,000 ft (G)		
0.9 Mach/30,000 ft (°/sec)		
0.9 Mach/30,000 ft (G)		
Acceleration Time		
0.9-1.6 Mach/30,000 ft (sec)		
Max Controllable G		
0.8 Mach/40,000 ft (G)		
Ferry Range (NM)	2000	2168

1/ Assumes maximum gross weight increased to 35,400 pounds.

Other Characteristics:		
Takeoff Distance (Air-to-Air Mission) (ft)	--	--
Landing Distance (ft)	--	--
Mission Reliability (%)	85	--
Mean Flight Time Between Failure (hrs)	1.75	--
Radar Detection Range, 2 sq meter Target (look up/look down)		

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 27161F
DOD Mission Area: Counter Air, #221

Title: Tactical Air Intercept Missiles
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4,200	1,100	3,600			42,681
419J	AIM-9M SIDEWINDER	4,200	400	500			25,681
1132	AIM-7M SPARROW		700	3,100			17,000

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program has as its main objective the development and acquisition of the AIM-9L SIDEWINDER and AIM-7F SPARROW air-to-air missiles. In addition efforts to provide an improved seeker, reduced smoke rocket motor and closed cycle cooler for the AIM-9L and an improved Monopulse Seeker and active fuze for the AIM-7M are included in this program element. The AIM-9L and AIM-7F product improvements have been redesignated the AIM-9M and AIM-7M respectively. The increased capabilities provided by the AIM-9L and AIM-7F missiles support Air Force air superiority requirements.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funding to continue Air Force participation in the AIM-7M and AIM-9M Full Scale Development programs. Operational flight test and evaluation of these improved missiles will be completed during this period.

OTHER APPROPRIATION FUNDS:

	FY 1979 ACTUAL	FY 1980 ESTIMATE	FY 1981 ESTIMATE	FY 1982 ESTIMATE	ADDITIONAL TO COMPLETION	TOTAL ESTIMATED COST
AIM-9L/M (3020) 1/	96,400	86,900	45,655 2/	43,110	53,737	533,402
Quantity	(2,500)	(2,050)	(260)	(280)	(260)	(9,360)
AIM-7F/M (3020) 1/	122,800	124,600 3/	118,541	122,613	70,959	910,213
Quantity	(1,500)	(1320) 4/	(910)	(960)	(530)	(8,445)

1/ Includes Initial Spares
2/ AIM-9M Production Initiated
3/ AIM-7M Production Initiated
4/ FY80 Congressional authorization of full 1320 missile request received; $20M reduction may preclude procurement of total quantity. AIM-7M procurement is planned to begin in FY 80 with up to 660 AIM-7M missiles. The balance will be AIM-7F missiles within the $124.6M funding limit.

Program Element: # 27161F
DOD Mission Area: Counter Air, #221

Title: Tactical Air Intercept Missiles
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The AIM-7F SPARROW is an air-to-air missile using semi-active radar guidance with an external configuration similar to previous AIM-7 SPARROW missiles. This improved missile is designed for aircraft with either pulse doppler or continuous wave radar systems and features an improved solid state guidance system, larger warhead, improved fuze, and significantly improved reliability compared with previous SPARROW missiles. The AIM-7F will provide increased capability and extended range to cope with the postulated threat of mixed groups of attacking bombers and fighters which cannot be effectively countered with existing midrange air-to-air missiles. This program will provide an improved, mid-range air-to-air missile to-air combat. The AIM-7M will provide improvement over the AIM-7F with an advanced monopulse seeker and an active radar fuze. These improvements will result in increased performance in electronic countermeasures and clutter environments.

The AIM-9L SIDEWINDER is an air-to-air "dogfight" missile using infrared guidance. This improved solid state missile will provide an all aspect launch, increased seeker sensitivity and tracking stability, improved inner boundary and high altitude performance and improved maximum operating time. This program will provide an improved dogfight missile for the F-15 and F-16 aircraft. The AIM-9M will include an advanced seeker for improved infrared countermeasure and background performance, a closed cycle cooler to reduce logistics problems, and a reduced smoke rocket motor.

RELATED ACTIVITIES: The AIM-7F and AIM-9L are joint Service efforts with the Navy as Executive Service (Program Element 25668N). An Air Force Project Manager is located with each of the Navy Project Officers and is assigned as the Deputy Project Manager. Management agreements have been formulated in Joint Management Charters for each of the programs.

WORKED PERFORMED BY: AIM-7F SPARROW - Naval Air Systems Command, AIM-7F Project Office (PMA-262), Washington, D.C. Missile Guidance Control - Raytheon, Lowell, MA and General Dynamics, Pomona, CA., Propulsion - Hercules, Cumberland, MD, AIM-9L SIDEWINDER - Naval Air Systems Command, AIM-9L Project Office (PMA-259), Washington, D.C., Missile Guidance and Control - Raytheon, Lowell, MA and Ford Aerospace, Newport Beach, CA, Rocket Motor-Hercules, Cumberland, MD and Bermite, Saugus, CA. Reduced Smoke Motor - Air Force Rocket Propulsion Laboratory, Edwards AFB, CA - Thikol, Huntsville, AL, Closed Cycle Cooler - Flight Dynamics Laboratory, Wright-Patterson AFB, OH - Hughes Aircraft, Canoga PK, CA.

Program Element: # 27161F
DOD Mission Area: Counter Air, #221

Title: Tactical Air Intercept Missiles
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Air Force joined the AIM-7F program in March 1971 with initial Research Development Test and Evaluation funding for the pro rata share of the AIM-7F design simplification program. The Naval Technical Evaluation of the AIM-7F was completed in February 1972 and the Initial Operational Test and Evaluation (IOT&E) was started at that time. The IOT&E was completed in December 1972 and a limited production Defense System Acquisition Review Council (DSARC) was held in February 1973. The joint Service IOT&E Phase II was started in August 1973 and completed in September 1974. A DSARC III was held on 1 October 1974 and a release for the FY 75 procurement was issued on 21 October 1974. Testing of the AIM-7F on the F-15 aircraft began in December 1974 as part of the F-15 Development, Test and Evaluation/IOT&E, (DT&E/IOT&E) and completed in April 1976. The F-15/AIM-7F Follow-on Test and Evaluation (FOT&E) started in April 1976 and completed in July 1977. The AIM-7F/F-15 FOT&E continued with a captive carry reliability program in FY 1978. Full Scale Development decision for the AIM-7M was made in April 1978.

The AIM-9L Research and Development Program began in June 1971. In April 1972 a pre-engineering model of the AIM-9L successfully impacted a QF-9 target. The Engineering Test Phase was completed in July 1973. The Development Test and Evaluation of the AIM-9L was completed in May 1974 and the program moved into a Joint Service Technical Evaluation in August 1974. The Joint Technical evaluation was completed in March 1975. The Joint Service Operational Evaluation/Initial Operational Test and Evaluation (OPEVAL/IOT&E) began in December 1974 and completed in January 1976. A DSARC III was held in January 1976 and a release for the FY 1976 procurement was issued on 28 Feburary 1976. The AIM-9L FOT&E Phase I was started in August 1977 and was completed in 1978. A full rate production decision was made April 1978. Engineering test of the AIM-9M was initiated in FY 1978.

Design, fabrication, and laboratory/environmental testing of the AIM-9M and AIM-7M continued during FY 1979. DT&E firings of the AIM-9M were continued. Design, development, and testing of the AIM-9M reduced smoke rocket motor and closed cycle cooler were also continued through this period.

2. FY 1980 Program: The AIM-7M and AIM-9M IOT&E programs will be initiated in FY 1980. A long lead procurement decision for the AIM-7M is planned mid-FY 1980 with a limited production decision to be made when IOT&E results warrant.

Program Element: # 27161F
DOD Mission Area: Counter Air, #221

Title: Tactical Air Intercept Missiles
Budget Activity: Tactical Programs, #4

3. FY 1981 Planned Program: The AIM-7M and AIM-9M Initial Operational Test and Evaluation programs will be completed in FY 1981. Defense Systems Acquisition Review Council DSARC III for AIM-7M will occur late FY 1981 leading to a full rate production decision. Production decision for the AIM-9M is planned early FY 1981.

4. FY 1982 Planned Program: No Research, Development, Test and Evaluation (RDT&E). Both AIM-7M and AIM-9M to be in production.

5. Program to Completion: Production planned through FY 1985.

6. Milestones:

		Date
AIM-7F/M		
A.	DSARC III	Oct 1974
B.	Prototype Aerospace Ground Equipment Deliveries	Mar 1975
C.	F-15/AIM-7F Development Test and Evaluation (DT&E)/Initial Operational Test and Evaluation (IOT&E)	Apr 1976
D.	AIM-7F Available for Inventory	Mar 1976
E.	F-15/AIM-7F Follow-on Test and Evaluation	Jul 1977
F.	AIM-7M DSARC II	Apr 1978
G.	Complete AIM-7M DT&E/IOT&E	Mar 1981
H.	Aim-7M Production Decision	Sep 1980
AIM-9L/M		
A.	Engineering Initiated	Aug 1971
B.	Begin DT&E	Apr 1972
C.	Begin Technical Evaluation	Aug 1974
D.	Begin Operational Evaluation/(IOT&E)	Dec 1974
E.	Production DSARC III	Jan 1976
F.	FY 1976 Production Contract	Apr 1976
G.	Ground Equipment RDT&E Complete	May 1977
H.	AIM-9M DT&E Complete	Jan 1979
I.	AIM-9M IOT&E Complete	Sep 1980
J.	AIM-9M Production Decision	Dec 1980

Program Element: # 27161F
DOD Mission Area: Counter Air, #221

Title: Tactical Air Intercept Missiles
Budget Activity: Tactical Programs, #4

7. Resources: not applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Complete	Total Estimate Cost
	Total for Program Element	2,781	3,500	1,100	3,200		41,581
419	AIM-9L/M SIDEWINDER	2,781	3,500	400	500		24,981
1132	AIM-7F/M SPARROW			700	2,700		16,600

The AIM-9M program funding was increased by $700,000 in FY 1979 to cover a cost overrun caused by closed cycle cooler development problems. The AIM-7M program funding was increased by $400,000 in FY 1981 for Air Force Test and Evaluation Center initial operational test and evaluation.

Budget Activity: Tactical Programs, #4

Program Element: #27161F (AIM-7F/M)

Test and Evaluation Data

1. Development Test and Evaluation: Raytheon began Contractor Demonstration Testing (CDT) of the AIM-7F in March 1968. After seven unsuccessful firings a major redesign effort was initiated which took 11 months to complete. In an effort to expedite the testing and make up for lost time, a combined CDT and Navy Technical Evaluation (NTE) was conducted. The combined CDT/NTE start in December 1969 and was completed in February 1972. Forty-two missiles were fired during evaluation. missiles guided to within feet of the target. of the launches failed to guide and were no-tests. Also, there were fuze failures during this CDT/NTE of the prototype AIM-7F. of the guidance failures were design related and were due to defective components of poor production workmanship. The fuze failures were design related. The guidance deficiencies were corrected and the fuze design was improved before beginning the Initial Operational Test and Evaluation (IOT&E)/Operational Evaluation (OPEVAL). No specific reliability or maintainability data were generated during the Development Test and Evaluation.

In January 1975, the Navy and Air Force commenced the SPARROW advanced monopulse missile program (AIM-7M). The AIM-7M is designed to improve the SPARROW capability in the low altitude/look down/heavy clutter and Electronic Countermeasures (ECM) environments while maintaining comparable performance in other areas. The AIM-7M program started with procurement of five advanced monopulse seeker units, from each of two contractors and competitive testing of these seekers. Five missile firings were performed. One launch was a no test because of an aircraft malfunction; however successful launches of each contractor's hardware, including by each, demonstrated DSARC II was approved in May 1978 and Full Scale Development was initiated. Hardware delivery is scheduled for December 1979.

2. Operational Test and Evaluation:

a. The initial operational test and evaluation/operational evaluation (IOT&E/OPEVAL) of the AIM-7F SPARROW missile was a joint Navy/Air Force project to evaluate the missile throughout its operational envelope. The test agencies were the Air Test and Evaluation Squadron Four (VX-4) for the Navy and Tactical Air Warfare Center (TAWC) for the Air Force. Tests were conducted at the Pacific Missile Test Center Range CA, Naval Weapons Center Range, China Lake CA, and the Range at Eglin AFB FL. All flight testing and missile handling after initial delivery was accomplished by assigned Navy and Air Force personnel.

b. Phase I of the OPEVAL of the AIM-7F began in February 1972 with a captive-flight carry program by VX-4. Actual firings began in May 1972. The results of this phase, which was divided into five areas, are summarized below:

Budget Activity: Tactical Programs, #4

Program Element: #27161F (AIM-7F/M)

	Test	Attempts	Launch	Success	Fail	No. Test	% Success
Maximum Range Nonmaneuvering	01	7					
Minimum Range Maneuvering	02	8					
Maximum Range Manuvering	03	3					
Look Down Clutter Maneuvering	04	6					
Multiple Target Capability	05	1					
TOTAL		25					

c. During Operational Evaluation (OPEVAL) Phase I, completed in December 1972, a total of 29 missiles were captive carried for about 2100 flight hours. The observed MFHBF (Mean Flight Hour Between Failure) for all missiles in the captive-carry program was 117 hours. This was significantly better (by a factor of approximately three) than the reliability being demonstrated by the AIM-7E-2 in operational use. However, the data were not directly comparable because the AIM-7F missiles under test were prototype while the AIM-7E-2 missiles were hard tooled production items.

d. Defense Systems Acquisition Review Council (DSARC IIIA) was held in February 1973 subsequent to the Phase I OPEVAL Tests. As a result of this review, DoD authorized release of FY 1973 procurement funds for procurement of 150 AIM-7F missiles to be used in additional weapons systems test and evaluation. Production approval for service use was deferred pending results of the Phase II OPEVAL, completed during September 1974, and subsequent DSARC IIIB decision. The missile tested in the latter part of Phase II was essentially the same as the missile that will go into production.

e. Phase II OPEVAL firing tests concentrated on stressing high altitude, lookdown in clutter, and Electronic Countermeasure (ECM) shots. Additional reliability testing was done in a 6,451 hour captive-missile flight test program. The firing phase of the program was divided into five areas and included 25 missile firings. The results of the firing program in this phase are summarized below:

	Test	Attempts	Launch	Success	Fail	No. Test	% Success
High Altitude/High Mach	01	4	4				
Minimum Range Maneuvering	02	4	4				
Mixmum Range Maneuvering	03	5	5				
Look Down in Clutter	04	9	9				
EMI/ECM Environment	05	3	3				
TOTAL		25	25				

f. Captive carry reliability tests indicate a mean flying hours before failure (MFHBF) of 467 hours or 80% of missiles in up status after 100 hours of captive carry. Decision Coordinating Paper (DCP) threshold is 65%. This represents approximately a nine to one improvement over the AIM-7E.

g. Subsequent to the Phase II OPEVAL, the Defense Systems Acquisition Review Council (DSARC) IIIB convened 1 October 1974. The DSARC principals recommended and the Secretary of Defense approved, the AIM-7F for production. The DSARC IIIB decision included requirements for further testing to be concluded in the high altitude region against high-Mach targets using the F-14 and F-15 aircraft and additional captive-carry flight testing to further define the MFHBF. The Navy captive-carry test program (4500 hours) began with the delivery of production missiles in January 1976 and is in progress.

h. Between June 1975 and April 1976, fifteen missile launches were conducted in the AIM-7F compatibility portion of the F-15 Development, Test and Evaluation/Initial Operational Test and Evaluation. missiles successfully intercepted their targets, missiles failed, and there were no tests. One of the failures resulted from A radome problem was discovered as a result of the miss and has been corrected.

i. The Air Force Test and Evaluation Center (AFTEC) initiated the follow-on operational test and evaluation (FOT&E) with the F-15 and AIM-7F in April 1976. The purpose of this test was to verify operational effectiveness and operational suitability. Thirty-four missile firings have been accomplished to complete the firing portion of this evaluation issiles successfully intercepted their targets, were failures, and there were missile no-tests.

Success-ful firings were accomplished against a BOMARC at feet traveling at Mach; fighter targets pulling up to g's; target dropping chaff; and targets flying as low as feet above the ground. The FOT&E success rate according to DCP-89 criteria was for fuzing and a warhead lethality assessment of

j. AFTEC is continuing FOT&E to assess the captive-carry reliability of the production AIM-7F missiles. This extended captive-carry (ECC) program is being accomplished on F-15 aircraft at the 1st Tactical Fighter Wing, Langley AFB, VA. The program began in January 1977 and the estimated completion date has been extended to April 1980. This extended captive-carry program has been divided into three phases. Phase I evaluated CS-block, Raytheon-produced missiles, and was completed in April 1978. This phase accrued over 3200 captive-carry hours on 15 missiles with two relevant failures and determined that the DCP-89A thresholds for incoming and captive-carry reliability were exceeded. Phase II of this evaluation began in April 1978 to perform the same evaluation on fifteen second source, General Dynamics produced AIM-7F missiles. This phase was terminated by AFTEC in March 1979 when it became evident that these missiles could not meet the DCP-89A reliability criteria. Before termination, AFTEC has assessed eight relevant reliability failures in 1328 hours, a MFHBF point estimate of 143.7 hours and an 80% lower

confidence Ievel (LCL) of II6.7 hours. Both estimates fell well short of the DCP-89A criteria of 348 hours point estimate and 240 hours 80% LCL for MFHBF. The main problems detected were immaturity in manufacturing processes and Quality Control procedures which are documented in the April 1979 AFTEC AIM-7F Extended Captive Carry (ECC) report. Emphasis was placed on improving the production and inspection processes at the General Dynamics Pomona California Plant and, subsequently, a Phase III captive-carry evaluation of the latest production General Dynamics missiles was initiated in May 1979. The purpose of Phase III ECC was to continue to evaluate the second-source product reliability to verify the effectivity of contractor-implemented manufacturing changes.

k. A joint Air Force/Navy Initial Operational Test and Evaluation/Operational Evaluation (IOT&E/OPEVAL) of the DSU-I6-B Active Radar Fuze was conducted to determine the operational effectiveness and suitability of the active fuze incorporated in the AIM-7F. The captive-carry reliability part of the test program began in March 1976 and the test firings were completed in February 1977. Testing was accomplished using early production block AIM-7F missiles which were retrofitted with the active fuze. Firings were accomplished after approximately 100 hours of captive carry time was accumulated on each missile. Thirteen of the fifteen missiles allocated were fired and two were retained for post captive-carry investigative purposes. Valid fuze test conditions were achieved in six firings. Aircraft, missile, and target problems accounted for the fuze no-tests. Operational effectiveness was assessed in varying aspect/maneuvering target conditions, low altitude targets in clutter, and fuze capability in the electromagnetic countermeasures (ECM) environment. Overall assessment of the active fuze testing concluded that it was more capable than the semi-active fuze. The operational suitability of the active fuze was excellent. No failures of the fuze or arming train occurred during the 1500-hour captive-carry program. The IOT&E final report, published in September 1977, supported the capability and suitability of this fuze over the current semi-active fuze.

l. A joint Air Force/Navy AIM-7M IOT&E/OPEVAL (OT-IIIC) will be conducted by AFTEC and OPTEVFOR beginning in August 1980 following the AIM-7 Contractor Test and Evaluation (CTE) and Joint Test and Evaluation (JTE) phases. Testing will include 20 scheduled operational launches and instrumented captive carry testing to evaluate operational effectiveness objectives. Additionally, suitability evaluations will be conducted by maintenance personnel through an extensive captive carry program. The IOT&E/OPEVAL will be completed by February 1981.

3. Systems Characteristics:

a. AIM-7F

Operational	Objectives/Threshold	Demonstrated Performance
Speed Max (Mach)		
(Mach at Launch)		

Budget Activity: Tactical Programs, #4

Program Element: #2761F (AIM-7F/M)

Operational	Objectives/Threshold	Demonstrated Performance
Range		
(a) Max (naut, miles)		
(b) Min (feet)		
(a) Max (feet)		
(b) Min (feet)		
Reliability		
(a) Initial accept		
(b) 100 hr captive carry		
Accuracy: % within 25 ft		
Kill Probability		To be determined
Use of Type Aircraft	F-4, F-14, F-15	F-4, F-14, F-15

1/ Naval Missile Center in Naval Technical Evaluation
2/ Targets not available for testing at higher altitudes
3/ OPTEVFOR and AF (TAC) joint Operational Test and Evaluation program
4/ F-15/AIM-7F FOT&E

Technical	Objectives/Threshold	Demonstrated Performance
Weight		
(a) Launch (lbs)	480/510	510
(b) Warhead (lbs)	90	86
Size		
(a) Length/Diameter (in)	144/8	144/8
(b) Wing span (in)	40	40
Guidance	Semi-Active Continuous	
Propulsion Impulse (lb-sec)	31,000	30,800

Budget Activity: Tactical Programs, #4

Program Element: #2761F (AIM-7F/M)

b. AIM-7M, system characteristic consistent with AIM-7F stated values. Primary areas of improvement are look down in clutter and ECCM capability.

	AIM-7F Demonstrated	AIM-7M Threshold
Subclutter visibility (db)		
Electronic Countermeasures (Prob Guidance)		
Barrage Noise	Not Demonstrated	
Spot Noise		
Blinking Noise		
Velocity Gate Stealer		

Budget Activity: Tactical Programs, #4

Program Element: #27161F (AIM-9L/M)

Test and Evaluation Data

1. Development Test and Evaluation: a. AIM-9L. The AIM-9L SIDEWINDER is a joint Navy/Air Force project with the Navy acting as executive Service. The Naval Weapons Center has technical management responsibility for the program. Raytheon is the development contractor. The AIM-9L is being developed to optimize the SIDEWINDER design for the air combat "dogfight" environment.

The Development Test and Evaluation (DT&E) of the prototype AIM-9L was divided into three distinct phases. The first phase, Engineering Test, was designed to allow for optimization of missile parameters. The second phase, Development Test, was used to verify system design before release of the missile to an independent test agency. The third phase of the DT&E was a Joint Technical Evaluation to determine the missile's ability to meet the design objectives. The DT&E was accomplished by assigned Navy and Air Force personnel with contractor assistance. The DT&E AIM-9L prototype underwent only slight design changes during DT&E and was therefore, very similar to the production AIM-9L.

During the period of 7 April 1972 to 26 July 1973, a total of 11 AIM-9L launches were accomplished in the Engineering Test Phase. were successful and failed. failures were attributed to the lead bias circuit which was subsequently removed, attributed to poor quality control, and the caused by insufficient roll stability in the missile. This last problem was corrected by increasing the number of rollerons from two to four. Subsequent testing was successful.

Ten AIM-9L firings were conducted in development tests between 31 October 1973 and 29 May 1974, of which were successful were failures, and one was a no-test.

Following design changes to correct the failures, the shots were successful, including direct hits. was the first shot of an AIM-9L against a QF-4 drone operating in full afterburner. This test demonstrated the capability of the missile

The AIM-9L completed the Joint Technical Evaluation (JTE) in March 1975. Twenty firings were conducted between 17 August 1974 and 1 March 1975. of the firings were successful of which were contact hits, and one was a no test. of the launches were failures.

The remaining failures exhibited no guidance after launch. Following changes to correct these failures subsequent firings were successfully accomplished.

Budget Activity: Tactical Programs, #4

Program Element: #27161F (AIM-9L/M)

AIM-9L firings were conducted from Air Force F-4, and Navy F-4, F-14 and A-7 aircraft. During limited captive flight carry reliability testing (664 hours with five failures) the missile demonstrated 132 mean flight hours before failures.

b. AIM-9M. The AIM-9M SIDEWINDER is a joint Navy/Air Force project with the Navy acting as executive service and the NAVWPNCEN, China Lake as the design activity. The AIM-9M program was initiated in April 1976 as the AIM-9L Product Improvement (PI) to improve counter-countermeasures (CCM), clutter rejection and add closed cycle cryogenic cooling. In march 1978 the AIM-9L was redesignated AIM-9M. The AIM-9M Improvements will increased the electronics complexity, but baseline costs will be maintained by using hybrids and repackaging by the Raytheon Company for modern manufacturing technologies. A Reduced Smoke Rocket Motor for AIM-9L/M is under development by Thiokol Corp., to reduce primary smoke from the motor to decrease identification of the launch aircraft.

During the period 17 February 1978 to 16 May 1979 ten free-flight launches were accomplished in the engineering test phase. All of these launches were scored as successful. Of these launches from F-4, F-14, and F-15 aircraft

The AIM-9M Technical Evaluation was initiated in April 1979 and to date six free-flight launches have been completed. Of these launches from F-14, F-4 and F-15 aircraft were successful, been tentatively designated as a no-test and been tentatively designated as a failure. Of the six launches

2. Operational Test and Evaluation:

a. Initial operational testing of the AIM-9L SIDEWINDER missile was a joint Navy/Air Force evaluation. The effort, conducted from January 1975 to March 1976 by the Air Force Test and Evaluation Center (AFTEC) and the Navy's Operational Test and Evaluation Force (OPTEVFOR), used refurbished prototype test articles because preproduction hardware funding had not been approved. This joint test program was primarily conducted at Nellis AFB, Nevada, and Point Mugu NAS, California, with firing deployments to Naval Weapons Center (NWC), China Lake, California, and White Sands Missile Range (WSMR), New Mexico. Navy and Air Force operational aircrews evaluated the AIM-9L in their respective operational environments. Test data was not combined with data obtained during previous testing. The refurbished prototype AIM-9L's demonstrated superior missile free flight performance when compared with inventory Sidewinders, but suitability, specifically captive-carry reliability, was found to be unsatisfactory (97 mean flight hours before failure (MFHBF), falling well short of the stated program threshold (200 MFHBF). Defense Systems Acquisition Review Council (DSARC III) decision memorandum authorized AIM-9L production but limited the rate until such time as satifactory reliability could be demonstrated with the production missile in follow-on testing.

Budget Activity: Tactical Programs, #4

Program Element: #27161F (AIM-9L/M)

b. Follow-on testing of the production AIM-9L missile was conducted in two phases. Phase I, a short-duration, high-intensity test program conducted by the Air Force Test and Evaluation Center (AFTEC) and the Navy Operational Test and Evaluation Force (OPTEVFOR), was designed to evaluate the operational reliability and performance of the early production AIM-9L missile to support the required recommendation for full-rate production. This phase of testing permitted each service to evaluate the missile in their respective operational environments and also provided for a common data base which allowed the Navy and Air Force to combine captive-carry reliability and free-flight (8 firings) performance data. After satisfactory reliability was demonstrated and full-rate production was authorized, phase II was conducted by TAC to evaluate the high rate production missile with emphasis on tactics development, free-flight performance, and extended captive-carry of the mature production weapon.

(1) Air Force follow-on test and evaluation (FOT&E) (phase I) was conducted between August 1977 and January 1978. The majority of testing was conducted at Nellis AFB with firing deployments to White Sands Missile Range. Operational aircrews and logistics personnel were used. During this test, early production missile reliability was determined, free-flight performance was confirmed, adequacy of changes incorporated since initial operational test and evaluation (IOT&E) was verified, and operational missile interface with the F-15 aircraft and support equipment was confirmed. Test data obtained with these production units was compared to, but not combined with, test data obtained during IOT&E. The early production AIM-9L missile demonstrated excellent factory to squadron incoming reliability, satisfactory captive-carry relaibility, excellent free flight performance, and excellent compatibility with the F-15 aircraft. Twenty-three missiles were evaluated during the Air Force program. Incoming reliability was 100%; captive carry reliability was computed to be 206 mean flying hours before failure (MFHBF) at the lower 80% confidence limit based upon 2283.5 actual flight hours and seven relevant failures. Combined Navy and Air Force firing data AIM-9L seeker performance studies conducted on the Nellis Air Combat Maneuvering Instrumentation (ACMI) range against threat representative targets demonstrated the missile to be operationally effective throughout the employment envelope of the F-15 These two deficiencies are presently being corrected under the AIM-9L Product Improvement Program, now called AIM-9M program. Based upon phase I results, AFTEC concluded that the production AIM-9L missile was both effective and suitable for use by USAF tactical fighter units and recommended approval for full-rate production which was granted 14 April 1978.

(2) Follow-on operational test and evaluation (FOT&E) (phase II) has been completed by the Tactical Air Command. Test results and conclusions are anticipated during 1980.

Budget Activity: Tactical Programs, #4

Program Element: #27161F (AIM-9L/M)

3. System Characteristics

a. AIM-9L

Performance	Objectives/Thresholds	Demonstrated
Speed, Max Mach		
Missile Flight		
Launch		
Altitude, ft, (Max)		
Minimum		
Range (Co-Alt 10K ft.)		
Co-speed Mach 0.9		
Tail on (Max., ft.)		
Minimum, ft.		
Beam (Max., ft.)		
Minimum, ft.		
Head On (Maximum, ft)		
Accuracy, CEP		
Kill Probability, %		
Reliability		
Captive Flight (MFHBF)	**Objective/Threshold**	**Demonstrated**
Prototype	-	97 3/
First Production	350/200	216 2/
Mature Production	575/330	425 2/ 5
Missile Description		
Launch Weight (lbs)	187 (Navy)/191 (USAF)	

Budget Activity: Tactical Programs, #4

Program Element: #27161F (AIM-9L/M)

Captive Flight (MFHBF)	Objective/Threshold	Demonstrated
Warhead Weight (lbs)	20	
Length/diameter (ins)	113/5	
Guidance Type	passive, cooled infrared seeker	
Warhead Type	annular blast fragmentation	
Fuze Type	active optical	

NOTES:

1/ Joint Technical Evaluation
2/ FOT&E
3/ IOT&E
4/ Range performance results based on simulations validated by IOT&E firings.
5/ FOT&E and Fleet Unit results with first production contract missiles. This is not mature production, but is indicative of the reliability growth of the AIM-9L.

b. AIM-9M

Performance	Objectives/Thresholds	Demonstrated
Speed, Max. Mach		
Missile Flight		
Launch		
Altitude, ft. (Max)		
Minimum		
Range (Co-Alt 10K ft)		
Co-speed Mach 0.9)		
Tail-on (Max ft)		
Beam (Max, ft)		
Minimum ft.		
Head On (Max. ft) (0°)		
Minimum ft.		

Budget Activity: Tactical Programs, #4

Program Element: #27161F (AIM-9L/M)

Performance	Objectives/Thresholds	Demonstrated
Probability of Guidance %		
Probability of Fuzing (%)		
Lethality		
Accuracy, Average Miss Dis		
Probability of Kill (%)		
Motor Smoke Reduction		

1/ This number represents initial firing results and will be adjusted as future test data is accumulated.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27162F
DoD Mission Area: Defense Suppression, #224

Title: Tactical Air-to-Ground Missiles
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,644	800	8,100	1,700	300	18,200
2330	High Speed Anti-Radiation Missile (HARM), AGM-88	2,644	800	8,100	1,700	300	18,200

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The increased sophistication, concentration, and lethality of enemy ground-based, radar guided, missile and anti-aircraft artillery systems threaten the ability of tactical aviation to accomplish its mission and survive. Anti-radiation missiles provide a lethal counter to this threat. The High Speed Anti-Radiation Missile (AGM-88, HARM) is being developed by the Navy to provide a significant upgraded capability against the threat. The F-4G Wild Weasel represents the only lethal defense suppression weapon system in the Air Force inventory. When deployed, HARM will be its primary weapon. This element will fund the Air Force unique portions of the joint Navy/Air Force HARM development program.

BASIS FOR FY 1981 RDT&E REQUEST: These funds will provide a continuation of the efforts to integrate the HARM with the F-4G Wild Weasel and to assure that the HARM will satisfy the requirement for an advanced anti-radiation weapon system. Development of Air Force unique support equipment, LAU-118 launchers, and technical data will be completed. Development Test and Evaluation will be completed, and joint Air Force Initial Operational Test and Evaluation (IOT&E) with Navy Operational Evaluation will begin.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimate Costs
Procurement (P-3020)				*145,800	1,663,800	1,809,600
Quantities				(300)		

* Includes initial spares

Project: #2330
Program Element: #27162F
DoD Mission Area: Defense Suppression, #224

Title: AGM-88, HARM
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: The HARM is an air-to-surface anti-radiation missile which has been in development by the Navy since 1971. It is an evolution of current Anti-radiation Missile (ARM) weapons designed to damage or suppress radar-directed air defense systems. The requirement for an advanced anti-radiation missile was identified by the Tactical Air Forces in March 1975. The Air Force has identified HARM as the solution for the near-term portion of this requirement. Missile design goals are: Moderate missile size and weight, high speed feet per second), high accuracy ft Circular Error Probable), high sensitivity wideband frequency coverage in a single seeker , long standoff range (up to nautical miles), and the ability (to The HARM, when integrated with the F-4G Wild Weasel, will give the Tactical Air Force a dedicated and highly capable anti-radiation weapons system.

The Air Force, as participating service in the joint Navy/Air Force HARM Program, will fund only those development efforts that are unique to the Air Force. The main thrust of this program will be to integrate the HARM with the F-4G. This integration will require the development and testing of computer software, tests necessary to certify the missile for carriage and launch from the aircraft, and ground and flight tests of the avionics/missile interface. Additionally, peculiar Air Force ground support equipment and technical manuals will be developed.

RELATED ACTIVITIES: The HARM has been designated as the primary Anti-Radiation Missile for the F-4G Wild Weasel. A Memorandum of Agreement of July 1975, between the Air Force and Navy Assistant secretaries for Research and Development, names the Navy as the Executive Service and the Air Force as the Participating Service in the Joint Service HARM Development Program.

WORKED PERFORMED BY: The HARM Development Program is managed by the Navy HARM Program Office, at Naval Air Systems Command (PMA 242), with an Air Force Deputy Program Manager and staff. Management of Air Force unique requirements is provided by the Armament Division Eglin AFB, FL. Principal contractors are: Texas Instruments, Dallas, TX, McDonnell Douglas Aircraft Corporation, St Louis, MO; Thiokol, Brigham City, UT; and Motorola, Scottsdale, AZ. Government facilities such as the Aeronautical Systems Division, Wright-Patterson, AFB, OH; Naval Weapons Center, China Lake, CA; and the Air Force Flight Test Center, Edwards AFB, CA are also utilized.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Studies and flight testing leading to certification for carriage of the HARM and LAU-118 launcher on the F-4G Wild Weasel began in June 1977. Development of computer software to integrate the HARM with the F-4G APR-38 avionics began in 1978. A Defense System Acquisition Review Council II was held on 14 Feb 1978. On 23 March the Secretary of Defense approved HARM's entry into engineering development. Modifications to the F-4G to integrate the HARM have been developed, bench tested, as flown in a series of captive flight missions. Computer software, developed to integrate HARM with the APR-38 have been bench/ground tested; and evaluated in captive flight tests and HARM firings from the F-4G. A total of prototype HARM missiles have been successfully

fired as of Aug 79 from the Navy A 7E and Air Force F-4G to demonstrate improved against a variety of radar targets. All tests have been successful and all test objectives have been met to date. The development effort has recently revealed technical problems at the problem. Recovery programs are underway; but these problems will slip the Defense System Acquisition Review Council (DSARC) III about six months.

2. FY 1980 Program: The HARM Air Force Preliminary Evaluation (AFPE) has been extended to with additional captive carry and live firings planned for completion of test objectives for this phase. Air Force development of peculiar support equipment and technical data will continue. Air Force development and flight qualifications of the LAU-118 launcher will be completed. Qualification testing of a HARM/APR-38 software threat update will be initiated. A Navy Secretarial Acquisition Review Council IIB is planned for which will review suitability of test results to date for a decision on Navy pilot production missiles.

3. FY 1981 Planned Program: Qualification testing of a HARM/APR-38 software threat update will be completed. Integration of HARM into the F-4G will continue, to include development and testing of Air Force peculiar ground support equipemnt and technical data. A Navy/Air Force Initial Operational Test and Evaluation (IOT&E) will begin in This test effort includes 16 captive carry missiles (8 Navy and 8 Air Force); and 24 missile firings (12 for Navy and 12 Air Force).

4. FY 1982 Planned Program: The Navy/Air Force IOT&E and development and testing of Air Force peculiar ground support equipment and technical data will be completed. A production decision will be made at DSARC III in March 1982.

5. Program to Completion: Initial Air Force deliveries to inventory will begin in May 1983. Any additional tests required as a result of IOT&E will be performed.

6. Milestones:

			Date
a.	DSARC I		Oct 72
b.	DSARC II A		Jan 77
c.	DSARC II A (additionally)		Feb 78
d.	DSARC II B	*Sep 79	Jul 80
e.	Begin IOT&E	*Dec 80	Jul 81
f.	DSARC III	*Sep 81	Mar 82
g.	Air Force deliveries begin	* Jun 82	May 83

Explanation of Milestone Changes: The technical problems revealed during 1979 DT&E have caused schedule slips and necessitated a program restructure.

Project: #2330
Program Element: #27162F
DoD Mission Area: Defense Suppression, #224

Title: AGM-88, HARM
Budget Activity: Tactical Programs, #4

7. Resources: Not Applicable

8. Comparision with FY 1980 Budget Data: ($ in thousands) The Air Force budget for HARM RDT&E has increased by 1,800 thousand dollars. This increase is due to the schedule slip discussed in paragraph 6 above, as well as the requirements to fund the LAU-118 launcher development in this PE rather than with the F-4G class V mod.

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimate Costs
TOTAL FOR PROJECT	4,300	1,300	800	7,600	1,900	16,400

Budget Activity: Tactical Program, #4

Program Element: #27162F Tactical Air-to-Ground Missiles

Test and Evaluation Data

1. Development Test and Evaluation (DT&E) (S): The AGM-88 HARM is a joint Navy/Air Force project with the Navy as Exective Service. The Navy is conducting Engineering Development under PE 64360N. Naval Weapons Center, China Lake is the lead organization. Texas Instruments has been chosen as the Weapons System Integration Contractor (WSIC). The Air Force will monitor the Navy DT&E and will also conduct seven of the fourteen live firings. Air Force DT&E addresses the integration of the HARM with the F-4G Wild Weasel, which contains the APR-38 avionics suite. Since 1977, modifications to the F-4G to integrate the HARM have been developed, bench tested, and flown in a series of captive flight missions. Computer software, developed to integrate HARM with the APR-38 have been bench/ground tested; and evaluated in captive flight tests and HARM firings from the F-4G.

Prototype missile and pilot production missiles are being procured during DT&E. Prototype and pilot production hardware will contain extended HARM frequency coverage and improved maneuverability capabilities which were developed during the extended phase of advanced development. Test results are shown in Navy PE 64360N Descriptive Summary.

Prototype Missiles - These missiles are being tested to evaluate performance of the contractor prototype design against a variety of radar targets in five operational scenarios. Prototype hardware will be subjected to ground tests, captive flight tests and firing tests. Objectives include: acquisition and tracking of characteristic target signatures in various operational scenarios, and verification of hazard free performance to aircraft and handling personnel. An indication of operational effectiveness and suitability will be obtained. A total of prototype missiles have been fired as of Aug 79 from the Navy A-TE and Air Force F-4F to demonstrate improved maneuverability and capability against a variety of radar targets. All tests have been successful and all test objectives have been met to date. The development effort has recently revealed technical problems at the problem. Recovery programs are underway; but these problems will slip DSARC III about six months. During this phase, reliability will be evaluated through a Test Analyze and Fix program. A preliminary maintainability demonstration will be held using operational personnel. A DNSARC IIB will be held to evaluate test results of remaining prototype missiles before proceeding to pilot production.

Pilot Production Missile - Pilot production missiles will be utilized to conduct and complete DT&E and to conduct the Joint IOT&E. Pilot production and related equipment will be evaluated against full specification, operational suitability requirements to certify readiness of the system to enter operational evaluation. Missile reliability will be demonstrated and a first article configuration inspection will be accomplished to validate the contractor's competitive production data package.

2. Operational Test and Evaluation (C): Operational testing on the Highspeed Anti-radiation Missile (HARM) will be conducted as a joint Navy Operational Evaluation (OPEVAL)Air Force Initial Operational Test and Evaluation (IOT&E) program with each service separately evaluating the missile with its own aircraft and avionics but with coordinated planning and sharing of test results to eliminate duplication of effort. The purpose of the IOT&E is to evaluate the operational effectiveness and operational suitability of the HARM to provide a basis for the first major production decision.

The IOT&E which will be managed by the Air Force Test and Evaluation Center (AFTEC), will be conducted in two phases, a preliminary phase and a dedicated phase. An Air Force Preliminary Evaluation (AFPE) will be conducted in combination with Development Test and Evaluation (DT&E), using prototype missiles to obtain an early indication of operational effectiveness and suitability. The seven missiles launched by the Air Force during DT&E will be fired from the F-4G Wild Weasel aircraft by operational aircrews from the Tactical Air Command (TAC), and will provide data for the AFPE. Navy and Air Force maintenance personnel are to monitor missile buildup, test, repair and maintenance actions by the contractor. The AFPE results will be input to the DNSARC IIB, which is the decision point for approval of pilot production. The DNSARC IIB reviews will consider pilot production for 125 missiles; of which the initial 5 pilot production missiles will be utilized to conduct Navy TECHEVAL, and 40 production missiles which will be allocated for Navy and Air Force OPEVAL/IOT&E (OT-LLLB). These initial 45 pilot production missiles will be procured with RDT&E funding. The remaining

The dedicated phase of Air Force IOT&E will be conducted separate from development testing, and will use pilot production missiles integrated with production F-4G aircraft. In addition to a captive flight program to evaluate captive flight reliability of the missile, a minimum of 12 pilot production missiles will be fired from the F-4G. Testing will be conducted on test ranges at Nellis AFB, NV; Point Mugu Missile Test Center, CA; China Lake CA; and White Sands Missile Range, N.M. This phase of testing will be flown by TAC operational aircrews and missile maintenance checkout and loading will be performed by Air Force personnel. COMOPTEVFOR and FTEC will provide independent assessments of the operational effectiveness and operational suitability of HARM for the DSARC III production decision.

Type Missiles	Number of Missiles
Prototype (Navy OT-IIIA or Air Force AFPE)	Data from DT&E will be ultilized where possible during IOT&E.
Pilot Production (Navy OT-IIIB or Air Force IOT&E)	TECHEVAL: Navy Firings OPEVAL/IOT&E: 16 captive carry missiles (8 Navy and 8 Air Force); 24 missile firings (12 for Navy OPEVAL, 12 for Air Force IOT&E.

Type Missiles	Number of Missiles
	Limited Production:
Production (FOT&E)	20 Navy firings.

Follow-on Operational Test and Evaluation (FOT&E) will be conducted by COMOPTEVFOR with the first block of production missiles to verify correction of deficiencies, if necessary.

3. System Characteristics (S):

Operational	Approved Program *	Demonstrated
Velocity (avg over 10NM) fps		
Range (NM) level launch		
5,000 ft alt		
15,000 ft alt		
30,000 ft alt		
Frequency coverage	Wideband	Wideband
CEP (ft)		
Sensitivity (fixed body antenna)		
Single Seeker	High Sensitivity	High Sensitivity
Free flight reliability (probability)		TBD***
Weight (lbs)	780	796

Operational	Approved Program *	Demonstrated
Length (ft)	13	13.7
Diameter (inches)	10	10

* DCP-93 Goals - (Rev A in process)

** Demonstration based on results of Development Test and Evaluation of contractor missiles extrapolated to specific performance parameters. Approved program operational and technical characteristics will be demonstrated during operational evaluation (Navy OPEVAL/Air Force IOT&E).

*** Results to date continue to support the approved program goals, but sufficient test time has not, as of this writing enabled accumulation of a statistically significant sample size.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27247F
DoD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Tactical Surveillance System
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
PE27247F	TOTAL FOR PROGRAM ELEMENT	200	300	300	300	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program has as its main objective the development of procedures, tactics, and interface equipment/software to facilitate tactical use of systems within an operational framework.

BASIS FOR FY 1981 RDT&E REQUEST: In 1977 Congress directed each service to establish a Service Tactical Surveillance office to direct related studies and exercises. The FY 1981 funding and outyear programming provide continuing funding for this effort. Efforts will include evaluation and development of interfaces with programs and enhancement of our tactically deployed forces through tactical exercises and improved interfaces with the Intelligence Community. This will include necessary software development, equipment evaluation, and related developmental studies.

OTHER APPROPRIATION FUNDS: NOT APPLICABLE

Program Element: #27247F
DoD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Tactical Surveillance Systems
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: This program was established by Congress to explore the tactical utility of assets. Efforts accomplished under this program will provide for development, evaluation, and testing of tactics utilizing resources. Efforts will include participation in tactical exercises, system interface software/hardware development, and related developmental studies.

RELATED ACTIVITIES: Will require interface with systems.

WORK PERFORMED BY: Air Force management of this effort will be under the Air Force Deputy Chief of Staff for Plans and Operations. The principal contractors are the Aerospace Corporation, El Segundo, CA, and Geodynamics Corp., Springfield, VA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In FY 1978 efforts were continued with Exercise COLD FIRE 79, POST OAK I, and Special Exercise COPE PACE and BLUE FLAG.

2. FY 1980 Program: This effort will continue exercise evaluation, software development programs and equipment and procedure evaluation.

3. FY 1981 Planned Program: On-going FY 1980 efforts will be continued. Efforts will be initiated for interface with various Air Force, other service and programs to include studies, software modification and equipment evaluation. A continued involvement in tactical exercises will be pursued.

4. FY 1982 Planned Program: On-going efforts will be planned.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: Not Applicable

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27252F
DOD Mission Area: Electronic Warfare/Counter C^3, #257

Title: EF-111A
Budget Activity: Tactical Programs, #4

RESOURCES: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,800	7,000	10,500	5,100	8,000	178,000

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED : This program provides for the Research, Development, Test and Evaluation (RDT&E) and integration of the ALQ-99E jamming subsystem into two F-111A aircraft. These aircraft are designated as EF-111A's and are equipped to perform dedicated tactical support jamming missions against surveillance, acquisition and ground control intercept radars. A phased production program tied to a suitability demonstration assessment was approved at Defense System Acquisition Review Council (DSARC) III. Satisfactory completion of the suitability demonstration will provide the basis for a full production go-ahead and procurement of a force of EF-111A aircraft to fill the current requirement for an Air Force tactical support jamming capability.

BASIS FOR FY 1981 RDT&E REQUEST : Funding is required to continue development and qualificaiton of peculiar support equipment and to initiate enhancements to improve the EF-111A capability against Postulated Soviet Radar capabilities. Other tasks to be initiated include development of a for the EF-111A, development of flight simulation and the enhancement and expansion of existing ALQ-99E equipment capabilities.

OTHER APPROPRIATION FUNDS:

*Aircraft Procurement (3010)	177,500	102,800	266,400	244,300	178,800		993,900
(Quantities)	(6)	(3)	(12)	(12)	(9)		

*Includes Initial Spares

Program Element: #27252F
DOD Mission Area: Electronic Warfare/Counter C^3, #257

Title: EF-111A
Budget Activity: Tactical Programs #4

DETAILED BACKROUND AND DESCRIPTION: Aircraft of the tactical forces are unable to counter the entire radar threat spectrum with on-board electronic countermeasures (ECM) subsystems due to space, weight, and power limitations. On-board tactical ECM subsystems are primarily directed against the enemy's terminal weapon control radars. The mission of degrading surveillance, acquisition, and ground control intercept radars must be accomplished by tactical support jamming forces. Studies by the Department of Defense and United States Air Force concluded that the most effective means of providing the required jamming would be through integration of the ALQ-99 jamming subsystem with the F-111A aircraft. This combination meets the requirements without recourse to expensive and time consuming development of a new weapon system. This program also takes full advantage of experience gained with the existing Navy EA-6B system, incorporating improvements where they will be most effective.

The purpose of this program is to develop, test and evaluate the EF-111A Tactical Jamming System to demonstrate the system's operational performance prior to a production decision. One inventory F-111A aircraft has been modified to incorporate updated ALQ-99E ECM subsystems including receivers, computers and ten high-power transmitters with directional/steerable antennas. Modified ALR-62 Terminal Threat Warning and ALQ-137 Self Protection Subsystems have been incorporated. Receiver antennas have been isolated from the transmitter antennas by locating them in a new vertical fin which incorporates an integral fairing for the equipment installation. The right-hand crew station is modified to incorporate necessary controls and displays. The existing F-111A Environmental Control System was replaced by the larger version from the F-111D to handle increased cooling requirements. Larger capacity F-14 electrical generators have also been added. A second inventory F-111A has been modified to the EF-111A form factor and used for the airworthiness certification and to certify the tail fin design. The SECDEF Defense Systems Acquisition Review Council (DSARC) III Memorandum directed a phased production program tied to demonstraion of operational suitability with deficiency corrections incorporated. A full production decision will occur at the final review scheduled on March 12,1980. Efforts continue to complete development of automatic test equipment although aircrew simulator development and some enhancement efforts have been deferred pending a full production approval.

RELATED ACTIVITY: The United States Navy developed the ALQ-99 Electronic Counter Measures (ECM) subsystem under Program Element (PE) 25674N EA-6B for installation in the EA-6B aircraft. Warning and Self Protection Equipment from PE 64738F, Protective Systems, are being used.

WORK PERFORMED BY: Aeronautical Systems Divisions, Wright Patterson AFB, OH, is responsible for management of the EF-111A program. The program was competitive. The winning bidder, as prime contractor, is Grumman Aerospace Corporation, Bethpage, NY (airframe and electronics). Prime subcontractors are: Airborne Instruments Laboratory, Deer Park, Long Island, NY (ALQ-99 receiver); Raytheon Company, Goleta, CA (ALQ-99 Band transmitters and exciters for all bands); Astronautics Corporation of America, Milwaukee, WI (displays); American Electronics Laboratories, Colmar, PA (ALQ-99 Band transmitters); International Business Machines, Oswego, NY (Computer); Sanders Associates Inc, Nashua, NH (Self-Protection Subsystems); and Daimo Victor, Belmont, CA (Threat Warning Subsystems).

Program Element: #27252F
DOD Mission Area: Electronic Warfare/Counter C^3, #257

Title: EF-111A
Budget Activity: Tactical Programs, #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The EF-111A program was first funded in late FY 1973. Procurement of long-lead electronic warfare equipment proposal solicitation, evaluation and award of dual design definition contracts followed the Defense Systems Acquisition Reveiw Council (DSARC) I review. The design definition included 23 risk reduction analysis and brassboard equipment demonstrations. Dual design definition/risk reduction study contracts with the Grumman Aerospace Corporation and General Dynamics were completed in September 1974. Proposals for the two prototype development programs were evaluated and Grumman was selected. A Joint Operational and Technical Review and a DSARC II review were conducted. Prototype phase tasks included electrical system design and modification; radome fabrication and installation; weapons bay reconfiguration; avionics vehicle equipment development; simulator evaluation; software design; and integration testing. Contractor Development, Test and Evaluation/Initial Operational Test and Evaluation was completed in April 1978. DSARC III met in December 1978 and, in February 1979, directed a phased production program for the first six aircraft tied to successful accomplishment of milestones associated with a suitability demostration. Modification of the first F-111A began in May 1979.

2. FY 1980 Program: Verification of deficiency corrections will continue. The suitability demonstration flight effort was completed November 16, 1979. A full production decision is scheduled to occur in March 1980. Development of ground support equipment was initiated although efforts to increase or expand existing EF-111A capabilities and developed aircrew simulators were deferred pending the outcome of the suitability demonstration and production decision. Assuming a favorable production decision as would be indicated by the test results, the production program will continue with the procurement of three modification kits in FY 1980. The efforts previously deferred pending results of the suitability evaluation will be initiated in FY 80. These include initiation of an analysis and evaluation effort to define a efforts for enhancement of ALQ-99E capabilities against Soviet radar capabilities and development of an aircrew simulator. Ground support equipment development and test will be continued. Deficiency correction efforts will be completed.

3. FY 1981 Planned Program: The production program will continue with the procurement of 12 modification kits in FY 1981. Development qualification of a will be continued. Enhancement developments to improve the EF-111A capability against Soviet radar capabilities will continue as will development and test of aircrew simulators. Ground support equipment development and test will be completed.

4. FY 1982 Planned Program: The production program continues with the additional procurement of 12 modification kits in FY 1982. Enhancement developments to improve EF-111A capabilities against Soviet radars will continue as will development of a Development of flight simulators will be continued.

Program Element: #27252F
DOD Mission Area: Electronic Warfare/Counter C^3, #257

Title: EF-111A
Budget Activity: Tactical Programs, #4

5. Program to Completion: The production program will be completed with procurement of 9 additional modification kits in FY 83. The first 18 aircraft are scheduled to complete delivery in December 1983 (Initial Operational Capability) with completion of the delivery of all aircraft by December 1986. Development and test of an Aircrew Flight Simulator will be completed in 1983 with delivery of the development simulator and one procurement simulator to follow. Development and test of a capability will be completed. Level of effort enhancement updates against Soviet radar systems will be continued.

6. Milestones:

A.	Phase IB Contract Award		Jan 75
B.	Preliminary Design Completed		Nov 75
C.	Final Design Completed		Aug 76
D.	Avionics Equipment Development Completed		Oct 76
E.	Aircraft #1 (Less Tactical Jamming Systems avionics) Modification completed		Feb 77
F.	Fabrication of Avionics Set Completed		Feb 77
G.	Aircraft #1 (less TJS avionics) First Flight Completed		Mar 77
H.	Bench Avionics Integration Completed		May 77
I.	Simulator testing Completed		Jun 77
J.	First Full-Up Airborne Avionics Performance Test Completed		Jun 77
K.	Aircraft Ground Test (less TJS avionics) Completed		Feb 78
L.	Flight Test Evaluation Completed		Apr 78
M.	Defense System Acquisition Review Cycle III completed		Dec 78
N.	Defense System Acquisition Review Council (DSARC III) Memorandum	(added)	Feb 79
O.	Initiation of Phased Production/Suitability Evaluation	(added)	Mar 79
P.	Final Milestone/Full Production Decision	(added)	Mar 80
Q.	Completion of Support Equipment Development		Sep 80
R.	Complete Development and Test of	*(Sep 82)	Sep 83
S.	Level of Effort to Update Capability against threat changes		Continuing

* Date presented in FY 80 Descriptive Summary

Explanation of Milestone Changes: DSARC III milestones show scheduled assessment of deficieny corrections and analysis of military worth. development was deferred pending full production release of the EF-111A and as an off-set for the increased funding needed to complete the deficiency correction demonstration.

7. Resources: Not Applicable

Program Element: #27252 Title: EF-111A
DOD Mission Area: Electronic Warfare/Counter C3, #257 Budget Activity: Tactical Programs, #4

8. Comparison of the 1980 Budget Data: Development cost increases from $172.2 to $178.0 to include additional updates necessary to align ALR-62 software with F/FB-111 fleet systems and for continuing level of effort enhancement updates against threat changes.

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimate Costs
RDT&E (3600)	21,100	8,800	7,000	7,900	9,900	172,200
Procurement (3010)*	24,100	177,500	55,000	441,800	187,700	886,100

* Current Procurement Program accelerated from that shown in FY 1979 Descriptive Summary to reduce total program cost, smooth procurement profiles and accelerate delivery schedules.

Program Element: #27252F
DOD Mission Area: Electronic Warfare/Counter C^3, #257

Title: EF-111A
Budget Activity: Tactical Programs, #4

Test and Evaluation Data

1. Development-Test and Evaluation: The ground testing portion of the Development, Test and Evaluation (DT&E) was initiated by the development contractor, Grumman Aerospace Corporation, Bethpage, NY, in March 1975 to ensure subsystem and system integration performance for those development efforts directed by DSARC III. This was accomplished prior to flight test to insure that new or modified subsystems met contractural specifications. Tests conducted at contractor/subcofacilities under laboratory/mockup conditions included the environmental control system, modified electrical power system, new antenna/radomes associated with new equipment, reliability, vibration, software support, support equipment and retained F-111A avionics systems. Air Force software support and fully developed support equipment was not available for this phase due to DSARC II direction based on the cost associate with support equipment development and the need to verify EF-111A effectiveness prior to expenditure of funds associated with these areas. Peculiar ALQ-99E intermediate level and software support was provided by contractor personnel during DT&E. This was a factor recognized as limiting the quality of information availabile for a later decision and resulted in continued testing after DSARC III. Specific test and evaluation capabilities built exclusively for the support of EF-111A Development, Test and Evaluation includes a System Integration Test Station for software testing and total system integration and a crew station mockup for human factors evaluations of cockpit control and display adequacy and to evaluate opeator procedure sequences. Government owned facilities that were used include the NASA wind tunnels (for aerodynamic loads and flutter tests), the DOD Full Scale Anechoic Chamber(for electromagnetic interference and compatibility investigations), the Electronic Warfare Ground Simulators(for subsystem evaluation/optomization) the Rome Air Development. Center EF-111A antenna pedestal(for antenna pattern testing/optomization), the Air Force Eglin Test Range and the Western Test range(to evaluate ALQ-99E receiver and transmitter performance with previously establish baselines). The Grumman Electronic Warfare Test Range was used to obtain broad based engineering data. Government test facilities/ranges used during DT&E did not differ signifigantly from those used during Initial Operational Test and Evaluation (IOT&E) although they did differ for later testing due to constant upgrade/modification of facility equipment. Airborne testing utilized two EF-111A prototype aircraft. Overall DT&E air vehicle testing was performed from 10 March 1977 to 22 Jun 1977 using a prototype modified to the proposed structural configuration but without peculiar EF-111A avionics. Testing concluded that a tail fin redesign was necessary. This was accomplished later and resulted in a satisfactory evaluation. The second EF-111A prototype vehicle was used for contractor DT&E system and subsystem tests between 17 May and 30 September 1977. This vehicle differed from the airworhtiness vehicle in that all avionics subsystems were installed. System and subsystem components were identical to those intended for use in the production EF-111A except for the ALR-23 Infrared Warning Receiver which was present for testing but deleted in the production configuration. The configuration of other systems evaluated during DT&E have been altered slightly from the original DT&E configuration as a result of corrections deficiency identified during this and other phases of the flight test. Specific components added to the modified F-111A airframe included the ALQ-99E Jammer Sub System, the ALR-62 Terminal Threat Warning System, the ALQ-137 Self Protection System, a new Environmental Cooling System, revised aircrew station and updated generators from the F-14.

Budget Activity: #4 Tactical Program

Program Element: 64220F - Tactical Jamming System, EF-111A

2. Operational Test and Evaluation:

a. The Initital Operational Test and Evaluation (IOT&E) of the EF-111A tactical jamming system (TJS) was conducted October 1977-April 1978 by the Air Force Test and Evaluation Center (AFTEC). The aircraft was flight tested in the barrier/standoff and penetration/escort mission roles. The close air support (CAS) and battlefield interdiction (BFI) mission roles were evaluated at the Air Force Electronic Warfare Simulator (AFEWES). The following is a summary of the IOT&E results and conclusion.

(1) While flying in standoff/barrier orbit, the EF-111A prevented EW/GCI radar tracking of an percent of the time when the was in orbit in friendly airspace NM from the FEBA. It also prevented tracking of F-4s flying at along a route from a point nm on the friendly side of the FEBA to the FEBA. The EF-111A's performance in the standoff/barrier role was determined to be

(2) The EF-111A's performance in the penetration/escort role supporting deep strikes was evaluated during low and medium altitude missions. The low altitude support effectiveness was undetermined the EF-111A was evaluated in three areas. They were:

a) Prevention of radar tracking. At ranges greater than NM from the radar site, the EF-111A prevented EW/GCI radar tracking of the strike force for periods greater than The EF-111A's performance in this area was

b) Reduction of AI engagements. Without the EF-111A percent of the F-4 strike flights were engaged. With EF-111A support, engagements by simulated MIG-21s (F-5s) were The EF-111A's performance in this area was

c) Reduction in SAM engagements. The EF-111A's performance in reducing SAM engagements was undetermined however, the reduction in successful target acquisitions by SAM radars was measured. EF-111A jamming reduced the number of successful acquisition attempts by simulated SAM radars by percent. The number of successful acquisition attempts by simulated SA-3 radars increased percent. The overall performance of the EF-111A in reducing SAM radar acquisitions was rated

(3) When supporting close air support (CAS) missions the EF-111A's performance in reducing in the Air Force Electronic Warfare Evaluation Simulator (AFEWES) radar simulations.

(4) When supporting battlefield interdiction (BFI) missions at the AFEWES, the EF-111A reduced the number of strike formations which were engaged by respectively. The EF111A's performance in this role was percent for the

(5) In addition to the EF-111A's jamming effectiveness, the IOT&E included evaluation of the ALR-62, ALQ-137, human factors, aircraft performance, internal EMI/EMC, external EMI/EMC, and software. Results in each of these areas are:

a) The ALR-62 and the ALQ-137 are the key elements of the self protection system. The ALR-62 and therefore the performance of the ALR-62 was undetermined. The ALQ-137 performance was

b) The single EWO concept was validated. The displays, controls, and cockpit configuration were determined to be satisfactory; however, some man-machine interface software improvements were recommended.

c) Aircraft performance was satisfactory.

d) Internal EMI/EMC was undetermined due to the ALR-62 not being in a configuration for testing.

e) External EMI/EMC was minimal and determined to be satisfactory.

f) The ALQ-99E and ALQ-137 software was satisfactory.

(6) Reliability was evaluated in two areas: missions completion success probability (MCSP) and hardware reliability. The EF-111A's MCSP was .67 and was satisfactory. Peculiar subsystem reliability, measured in mean time between maintenance actions (MTBMA) was 2.6 hours for the ALQ-137, 30.3 hours for the Electrical Power System and 17.3 hours for the Environmental Control System.

(7) Although the reliability of the ALQ-137 was below the threshold criteria, the reliability improvements identified during testing should improve its MTBMA to an acceptable level. Due to software problems, the ALR-62 had a low use rate which precluded a reliability evaluation. The ALQ-99E and the EPS were satisfactory and the ECS reliability was excellent. No significant degradation occurred in the system common to the F-111A.

(8) Maintainability was evaluated in terms of maintenance manhours per flying hour (MMH/FH). MMH/FH values were determined using an analytical approach resulting in a value of 70.9 hours which was deficient. The correction of deficiencies identified during the test should result in a satisfactory level for an operational system.

(9) The logistics composite model (LCOM) was used to estimate maintenance manpower requirements for the current and a mature system. For an 18 UE squadron, the LCOM showed 77 additional aircraft maintenance personnel were required to support the current EF-111A when compared to the F-111A. The removal of the fire control and weapons delivery system for the EF-111A eliminated 106 munitions maintenance personnel. As a result, there were 538 total authorizations for a reduction of 29 personnel. As the avionics support for the ECM system matures, the total reduction could reach 68. A computer model was also used to estimate the annual operating support cost for an 18 UE squadron. The results estimate the O&S cost to be $34.97 million in 1978 dollars. This cost is sensitive to initial spares procurement because an inadequate initial buy will escalate the cost of replenishment spares.

(10) Software supportability was determined to be

b. Because the EF-111A was maintained by contractor personnel during IOT&E, and due to the number and possible impact of identified deficiencies, OSD directed the Air Force to complete a suitability demonstration to provide e addtional decision data. The additional operational testing of the EF-111A TJS was conducted as an FOT&E managed by AFTEC. The primary purpose of the FOT&E, as directed in a 10 February 1979 OSD memo to Sec AF, was to evaluate system reliability and maintainability (R&M) using Air Force maintenance personnel. Flight testing was initiated at Mt Home ABF during April 1979 and was planned to end in October 1979. Reliability data was collected during the entire test. Maintainability data was gathered from 1 June 1979 through 31 October 1979, as the period 18 April through 31 May 1979 was used for training Air Force maintenance personnel. Although the test was primarily designed as a suitability assessment some effectiveness testing was conducted. Laboratory testing to compare the effectiveness of the ALQ-99E and the ALQ-137 in performing the self-protection role was conducted at the AFEWES. Similar testing with the ALQ-99E and ALQ-137 installed in the prototype EF-111A test aircraft was also conducted against radar simulators on the Nellis ranges. Flight testing was also conducted to evaluate the performance of the ALR-62 in an internal (ALQ-99E/ ALQ-137) and external (F-4 aircraft with ALQ-119 self-protection ECM pods) ECM environment. Flight testing was completed on 14 November 1979. The AFEWES tests have incurred delays due to test system problems and is scheduled to be completed on 4 February 1980.

(1) The DSARC III memorandum established a flight test goal of 150 flight test hours for the collection of R&M data. Final flight test results were:

a) 85 missions flown out of 89 scheduled.

b) 261.4 flight test hours accumulated for reliability data.

c) 197.6 flight test hours accumulated for maintainability data.

d) A 5.0 hour Mean Flying Hours Between Failure (MFHBF) was demonstrated for the ALQ-99E (FOT&E threshold was 3.0 hours).

e) Mean Time To Repair (MTTR) for the ALQ-99E was measured at 3.1 hours. However, due to the high skill level of the test team maintenance personnel a projection for a normal operational unit with some personnel in a training status was made. This projection indicated the ALQ-99E MTTR could be 4.4 hours. The FOT&E threshold was 6.0 hours.

f) The ALQ-137 experienced two failures in 121 flying hours for an MFHBF of 60.5 hours.

g) False Removal Rate of Line Replaceable Units resulting from built in test/built in test equipment was 19.2 percent. The FOT&E threshold was 25 percent.

h) The measured MMH/FH was 22.6. Since these results were obtained in a sterile test environment with a highly skilled and motivated test team a projection was made to estimate the MMH/FH for a mature EF-111A system in an operational unit. This estimate indicated the MMH/FH would be close to the current 58.1 MMH/FH of the F-111A. However due to cooling and wiring improvements to be made during modification the EF-111A, MMH/FH should be somewhat lower than that for the F-111A.

i) Improvements to correct ALQ-99E software deficiences discovered during IOT&E were evaluated and determined to be satisfactory.

j) Corrections to the deficiencies discovered during IOT&E, such as ALQ-99E internal EMI, ALQ-99E Band 4 transmitter reliability and ALQ-99E power interrupts, were evaluated and determined to be satisfactory.

k) ALR-62 flight testing showed system operation to be considerably improved when compared to the system's performance during IOT&E. The system experienced

Budget Activity: #4 Tactical Program

Program Element: 64220F - Tactical Jamming System, EF-111A

c. The final test report is scheduled to be published by 1 February 1980. Because all of the data from the AFEWES testing will not be available until mid February 1980, some of the AFEWES test results will be published as an addendum to the final report in late February/early March 1980.

d. Though the effectiveness of the EF-111A in its mission roles of Close Air-Support and Battlefield Interdiction could not be assessed in IOT&E and FOT&E due to test facility limitations, a study and analysis was conducted in these areas by the Air Force. This analysis, titled Sabre Challenge Bravo, was published in July 1979. Conclusion from the analysis are summarized below:

(1) STAND-OFF FOR BARRIER OPERATIONS:

(2) STAND-OFF FOR CLOSE AIR SUPPORT (CAS) MISSIONS:

(3) MEDIUM ALTITUDE BFI ESCORT ROLE:

a)

b)

Budget Activity: #4 Tactical Program

Program Element: 64220F - Tactical Jamming System, EF-111A

5.

6.

7.

(4) EF-111A THEATER ARMY AIR DEFENSE SYSTEM EFFECTIVENESS. (Does not include the EF-111A contribution to the defense against airborne interceptors):

a)

b)

(5) KEY FINDINGS:

3. System Characteristics: Signifigant EF-111A performance parameters with Decision Coordinating Paper threshold values shown below.

A. Aircraft	DCP Threshold	Achieved Values		Testing During	Accomplished By
Maximum sustained air speed at Sea Level (Mach)	.91	1.07		IOT&E	AFTEC
				IOT&E	AFTEC
				IOT&E	AFTEC
B. ALQ-99E Jammer Subsystem					
				IOT&E	AFTEC
				IOT&E	AFTEC
				IOT&E	AFTEC
				IOT&E	AFTEC
Reliability Mean Flying Hour Between Failure (hr)	3.0	4.5	1/	FOT&E	AFTEC
Maintainability Mean Time To Repair, organizational level (hr)	6.0	3.0	1/	FOT&E	AFTEC

1/ Interim results from Defense Systems Resources Acquisition Council directed FOT&E Phase I assessment

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 27411
DOD Mission Area: Tactical Command and Control #254

Title: Overseas Air Weapons Control Systems
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	(300)[1]	0	200	200	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This effort, the EIFEL/DISTEL (E/D) Program, will provide an automated command and control system for the United States Air Force-operated Allied Tactical Operations Center (ATOC) at Sembach, Germany. When the E/D Program is completed, the ATOC at Sembach will be interoperable with other ATOCs in the Central Region.

BASIS FOR FY 1981 RDT&E REQUEST: Air Force Systems Command is tasked to provide technical assistance to United States Air Forces Europe to acquire the basic E/D System.

OTHER APPROPRIATION FUNDS:	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Procurement (3080)	0	0	12,229	325	Continuing	Not Applicable
Quantity			1			

1 Funds programmed in Program Element (PE) 27415, United States Air Forces Europe (USAFE) Command and Control Systems, for early work in developing specifications, documentation, and a Memorandum of Understanding.

Program Element: #27411 Title: Overseas Air Weapons Control System

DOD Mission Area: Tactical Command and Control #254 Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: EIFEL/DISTEL (E/D) is a German-developed data management and command and control system which automates selected command and control functions. The system has been installed in the two North Atlantic Treaty Organization (NATO) Central Region Allied Tactical Operations Centers (ATOC) operated by the Federal Republic of Germany. The United States Air Force (USAF) plans to adapt and procure the present version of E/D for installation in the US-operated Central Region ATOC at Sembach, Germany. Further, the USAF plans to participate in a cooperative effort with the German Air Force to develop a follow-on version of E/D. By procuring the E/D system, three of the four ATOCs in the NATO Central Region will have common equipment. Not only will this procurement significantly enhance interoperability, but it may also provide the impetus for acquiring the same system for the fourth ATOC. This program, then, is a prime example of NATO-stated objectives for commonality/interoperability and furthers the administration's "two-way street" policy regarding NATO procurements.

RELATED ACTIVITIES: A Memorandum of Understanding has been written and is being staffed by country representatives.

WORK PERFORMED BY: United States Air Forces Europe (USAFE), Ramstein Air Base, Germany will manage the acquisition of the current E/D System with technical assistance provided by Air Force Systems Command (AFSC), Andrews Air Force Base, MD. The follow-on version of E/D will be a cooperative effort with the Federal Republic of Germany. AFSC will manage the USAF portion of that effort.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Preliminary work on E/D began under Program Element 27415, USAFE Command and Control Systems. The work included developing specifications, documentation, and a Memorandum of Understanding between the US and the Federal Republic of Germany.

2. FY 1980 Program: The initial feasibility studies and the Memorandum of Understanding will be completed. In addition, plans are being developed to adapt the E/D System to meet the unique requirements of the ATOC at Sembach, Germany. Negotiations to procure the German-developed hardware and software will begin. Participation with the Federal Republic of Germany in developing the follow-on version of E/D will begin.

3. FY 1981 Planned Program: Procure and install the current version of E/D. Continue working with the Federal Republic of Germany on the follow-on version of E/D.

4. FY 1982 Planned Program: Complete installation and testing of the current E/D System. Continue working on the follow-on version of E/D.

5. Program to Completion: This is a continuing program.

Program Element: #27411 Title: Overseas Air Weapons Control System
DoD Mission Area: Tactical Command and Control #254 Budget Activity: Tactical Programs #4

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: Not applicable. No funds requested in the FY 1980 Budget.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 27412F
DOD Mission Area: Tactical Command and Control #254

Title: Tactical Air Control System (TACS)
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	9,969	10,951	12,500	6,800	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The tactical air forces require a highly developed, reliable, positive control system to fully exploit the inherent capabilities of tactical air power. The Tactical Air Control System (TACS) provides the means through which the Air Force Component Commander exercises control of his forces to accomplish his assigned mission. This program provides for major improvement to the existing manual TACS. Efforts in progress are designed to automate command, control, and communications processing functions; to develop electronic counter-countermeasures; and to develop the System Trainer and Exercise Module (STEM) for Control and Reporting Center/Control and Reporting Post (CRC/CRP) personnel.

BASIS FOR FY 1981 RDT&E REQUEST: The request provides for continued development and procurement of STEM and the Ultra Low Sidelobe Antenna; continued development of the Anti Radiation Missile (ARM) Alarm System; and initiation of full scale engineering developement of ARM Decoys. Efforts to improve Forward Air Control Posts and to package equipment procured to support the Computer Assisted Force Management System are planned. Systems engineering will be obtained to support the above efforts.

OTHER APPROPRIATION FUNDS:	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Estimated Costs
Procurement (3080)	592	792	17,900	34,951	Continuing	Not Applicable
Quantities CRC/CRP Improvements (STEM)			17			

Program Element: # 27412F
DOD Mission Area: Tactical Command and Control #254

Title: Tactical Air Control System (TACS)
Budget Activity: Tactical Program #4

DETAILED BACKGROUND AND DESCRIPTION: The 485L development and acquisition program is established to manage and provide effective improvements to the Tactical Air Control System (TACS). The Air Force's TACS consists of the men, materiel and procedures established to control tactical air operations. The tactical air forces require a highly developed, reliable, and systemized positive control system to fully exploit the inherent flexibility of tactical air power.

Improvements to the TACS are evolutionary and are implemented through a series of procurements designed to increase system effectiveness incrementally while responding to the increasing enemy threat. The first of three phases, approximately 1965-1968, was an expedited buy of "off-the-shelf" equipment to provide a first-level capability for urgent, near-term contingency requirements. The second phase, approximately 1969-1972, was to provide improved equipment by exploiting current technology. Phase I and II were accomplished under the 407L Program. The third phase, planned for approximately 1973-1984, provides automated and miniaturized equipments adapted to the requirements of that period. Equipment to satisfy the capabilities desired in Phase III is being developed and acquired under the 485L Program.

Those improvements presently authorized for development and acquisition are listed below:

(1) Tactical Air Control System/Tactical Air Defense System Hardware
Netted Telephone Radio Interface Device
Frequency Shift Keyer

(2) Control and Reporting Center/Control and Reporting Post Improvements
System Trainer and Exercise Module

(3) Lightweight Manpack Radio; HF/SSB, AN/PRC-104

(4) Dual Band Radar Beacon, AN/TPN-28

(5) Microwave Relay, AN/GSQ-120

(6) Electrical Equipment Shelter, S-530 A/G

(7) Ultra Low Sidelobe Antenna

(8) Anti Radiation Missile Alarm Sensor

(9) Forward Air Control Post Improvements

Program Element: #27412F
DoD Mission Area: Tactical Command and Control #254

Title: Tactical Air Control System (TACS)
Budget Activity: Tactical Program #4

RELATED ACTIVITIES: This program interfaces with the Tactical Information Processing Interpretation Program, the Joint Interoperability of Tactical Command and Control Systems Program, and with efforts to improve European and Korean Command and Control Systems.

WORK PERFORMED BY: Electronics Systems Division, Hanscom Air Force Base, MA, is responsible for this program. Rome Air Development Center, Griffis AFB, NY, and the Tactical Air Command, Langley Air Force Base, VA, provide engineering and operational support. Major contractors include GTE Sylvania, Needham Heights, MA (System Trainer and Exercise Module) (STEM); Applied Devices Corp, Long Island, NY (Dual Band Beacon); ITT Defense Communication Division, Nutley, NJ (GSQ-120); MITRE Corp., Bedford, MA, (Systems Engineering); Goodyear Aerospace Corp., Litchfield, AZ, (S-530 Shelter).

1. FY 1979 and Prior Accomplishments: In FY 1979, the Air Force accepted full delivery of all 22 AN/GSQ-120, Microwave Relay Sets; and began receiving production models of the AN/PRC-104, Lightweight Manpack Radios, and the S-530, Electrical Equipment Shelters. In October 1978, a contract for development of the STEM was awarded. Initial Operational Test and Evaluation of the Dual Band Beacon was conducted. The discrepancies noted will be fixed and re-tested before a production decision is made.

2. FY 1980 Program: All 20 Frequency Shift Keyers will be delivered. Development and in-plant testing of STEM are planned. Engineering development of the Anti Radiation Missile (ARM) Alarm and Ultra Low Sidelobe Antenna (ULSA) systems will continue. Work to develop an improved Forward Air Control Post (FACP) is programmed. Studies leading to a Computer Assisted Force Management System (CAFMS) are planned. Systems engineering to support these tasks is also planned.

3. FY 1981 Planned Program: Continued development leading to production decisions is planned for STEM and ULSA. Engineering development for ARM Alarm will continue. Full scale engineering development for ARM Decoys will begin. Efforts to improve FACPs and define packaging requirements and support for CAFMS are planned. Continue systems engineering support for the above efforts.

4. FY 1982 Planned Program: Complete procurement of STEM and ULSA. If a favorable production decision is reached, begin procuring ARM Alarm. Continue development of ARM Decoys. Obtain systems engineering support as required.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable

7. Resources: Not applicable

Program Element: #27412F
DoD Mission Area: Tactical Command and Control #254

Title: Tactical Air Control System (TACS)
Budget Activity: Tactical Program #4

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
TOTAL FOR PROGRAM ELEMENT	8,408	14,000[1]	10,000	8,200	Continuing	Not Applicable

The $951,000 difference in the FY 1980 estimates stems from the Congress' decision to realign $2.051 million for systems engineering from the 3080 to the 3600 appropriation and the Air Force's subsequent reduction of the requirement by $1.1 million.

The $4.3 million increase in the FY 1981 estimate is due to the anticipated packaging effort for the Computer Assisted Force Management System, a fact-of-life increase for Anti Radiation Missile (ARM) Alarm costs, and inflation.

1 Estimate included $4 million requested in the FY 1979 Supplemental Appropriation. The request was disallowed.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27415F
DoD Mission Area: Tactical Command and Control, #254

Title: USAFE Command and Control System
Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5,900	5,900	6,200	8,800	6,500	38,800

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Tactical Fusion Center (TFC) was established in the Federal Republic of Germany to provide for the receipt and integration of information from intelligence and reconnaissance systems, and tactical air operations systems to support the United States Air Forces in Europe. This program will develop software and procure the necessary hardware to enhance the currently limited and primarily manual capabilities in the TFC. The improvements to be provided are of paramount importance in assuring the effective employment and security of United States Air Force units in Europe.

BASIS FOR FY 1981 RDT&E REQUEST: The funds requested would provide for the continuation of software development to receive, integrate, distribute and display intelligence and operational data in a useable format. Also, an upgrade of the TFC hardware will continue.

OTHER APPROPRIATION FUNDS

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Other Procurement (3080)	703	998	76			4,990

Program Element: #27415F
DoD Mission Area: Tactical Command and Control, #254

Title: USAFE Command and Control System
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: An integrated and responsive command and control system is of paramount importance in assuring the security, effective control, and economical employment of United States Air Force (USAF) forces identified for, or assigned to, the North Atlantic Treaty Organization (NATO).

In this wartime role, CINCUSAFE will exercise command of the Allied Air Forces Central Europe (AAFCE) from the In this capacity, CINCUSAFE requires processed, correlated, and integrated information from selected intelligence and operational sources to: (1) assess the status of friendly forces, enemy forces, and the battle situation; (2) support decisions concerning allotment of air resources in the European Central Region; and (3) provide specific guidance for the employment of critical resources. The Tactical Fusion Center (TFC), that was established in the to provide information required to meet CINCUSAFE's needs, as installed, provides only a partial solution. The existing computer system provides limited intelligence data to the TFC and supports only certain tasks, although it has the capacity to perform more TFC functions. Current interfaces with and theater information and collection systems are basically manual. Software will be developed and equipment procured under this program to enable the computer system to receive and process more of the required data, perform the necessary functions, and provide the information required by CINCUSAFE and his staff for effective command and control of air operations.

RELATED ACTIVITIES: The TFC was established in a hardened bunker Federal Republic of Germany, under the Constant Keystone program. The baseline computer system in the TFC is a Digital Equipment Corporation Dual System 10, provided by the in FY 1977 under the KALEIDOSCOPE program. Other related Air Force activities include Program Element (PE) 64750F, Project 1955 DoD Indications and Warning; PE 31025F, Intelligence Data Handling Systems; PE 31056F Intelligence Communications; PE27431F, Project 2517 Battlefield Exploitation and Target Acquisition; and Project 2576 Tactical Fusion Division. These programs are coordinated through a Headquarters United States Air Forces Europe (HQ USAFE) Management Office. The Project will facilitate receipt and processing of data from TEREC, GUARDRAIL, COMPASS EARS.

WORK PERFORMED BY: Air Force management for the OASIS project is provided by a Program Management Office established at the Electronic Systems Division, Hanscom AFB, MA, supported by the MITRE Corporation, Bedford, MA. A Development contract, to baseline existing systems and identify incremented improvements to meet user requirements, is being accomplished by Martin Marietta (Prime) and System Development Corporation (Subcontractor). Preliminary information studies were performed by TRW, Redondo Beach, CA, and Radio Corporation of America (RCA), Burlington, MA.

Program Element: #27415F
DoD Mission Area: Tactical Command and Control, #254

Title: USAFE Command and Control System
Budget Activity: Tactical Programs #4

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A Program Office was established and two preliminary studies completed in early 1977. One study addressed the information flow and system sizing requirements, and the other air and missile order of battle requirements. The Program Office completed a comprehensive Program Management Plan that was released in March 1977. The software development facility at the National Security Agency (NSA) was established to effect changes to the baseline computer system. The Request for Proposal was released for the engineering development efforts in this program. In 1978, the development contract was let 26 Jan with Martin Marietta. A software development facility was established at Electronic Systems Division (ESD) to develop and test modifications for the operational unit. The Tactical Fusion Center (TFC) baseline was evaluated. The operational procedures were refined and performance data for TFC communication and automated data processing (ADP) equipment baselined. Baseline functional and product specifications for the KALEIDOSCOPE software were prepared. A graphics generating and disseminating terminal and a Combat Operations Intelligence Center (COIC) Network processor were acquired, installed, and tested. Development of software for the COIC network processor was begun. In 1979, development of software for the TFC/User interactive terminal and display continued. Software development efforts to expand the TFC computer system functions and the internetting of this computer with supporting data base systems continued. Developments relating to air track correlation were completed. Development of technical data, testing and training continued.

2. FY 1980 Program: Software development for the incoming reports, COIC network processor and the TFC/User interactive terminal and displays will continue. Upgrading of the baseline computer system will continue. Development associated with the receipt and processing of data from several collection systems TEREC, GUARDRAIL, COMPASS EARS will be completed.

3. FY 1981 Planned Program: Software development for the COIC network processor will continue. Upgrade of incoming reports will continue. Software development for the TFC/User interactive terminal and displays will continue.

4. FY 1982 Planned Program: Development of software for the Order of Battle data base will begin. TFC hardware upgrade will continue. Message processing capability will be expanded to accommodate intelligence inputs. Software development for the COIC network processor and TFC/User interactive terminal and displays

5. Program to Completion: Software developments related to system improvements and input interfaces will continue. The interface with the various collection systems will be accomplished as the systems are introduced into the theater. The program will be completed in FY 1983.

6. Milestones Not Applicable.

Program Element: #27415F
DoD Mission Area: Tactical Command and Control #254

Title: USAFE Command and Control System
Budget Activity: Tactical Program #4

7. Resources: N/A, single project program.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,100	4,400	5,900	9,500	14,400	39,700

The differences between the FY 1980 and FY 1981 Descriptive Summaries reflect a net decrease in funding of 900 thousand dollars. FY 1979 funds were increased 1,500 thousand dollars to cover an unfunded urgent requirement to initiate an interface between the Tactical Fusion Center (TFC) and the operational users, to initiate incoming report processing software upgrade and to support the Eifel/Distel project. FY 1981 funds were cut 3,400 thousand dollars by OSD because of low expenditure rates. FY 1982 and 1983 funds were increased to accommodate sensor input efforts moved back due to OSD cut in the budget in FY 1980.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27417F(64744F) Title: Tactical Airborne Command and Control System
DoD Mission Area: Tactical Command and Control #254 Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT (PE)	37,900*	52,100	65,600	64,100	112,900	1,631,300

NOTE: RDT&E funds for FY 1978 and prior were included in PE 64744F, Airborne Warning and Control System (AWACS)

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program has as its main purpose the development and acquisition of an effective survivable airborne surveillance system for command and control of tactical forces and strategic defense of the United States (US). The E-3A (AWACS) will overcome ground based surveillance system deficiencies through its unique ability to provide extended all altitude surveillance and for the first time, the means to manage an air battle situation in real time. It will contribute significantly to a more effective integration of the capabilities of US forces supporting US, North Atlantic Treaty Organization (NATO) or other worldwide requirements.

BASIS FOR FY 1981 RDT&E REQUEST: This request will support flight testing of US/NATO standard configuration with Maritime radar, Hughes Improved Joint Tactical Information Distribution System terminal, and a larger computer. It will also support continued development of display remoting enhancement plus additional radios/consoles as well as initiation of development for Electronic Counter-counter Measures improvements.

OTHER APPROPRIATION FUNDS:						
Aircraft Procurement (3010)	245,100	326,800	260,600	241,800	183,700	2,736,100
(Quantity)	(3)	(3)	(2)	(2)	(2)	(31)

* FY 78 and FY 79 efforts reported under PE 64752F. Large aircraft terminal development for the Joint Tactical Information Distribution System (PE 64754F) is funded in PE 27417F.

Program Element: #27417F
DoD Mission Area: Tactical Command and Control #254

Title: Tactical Airborne Command and Control System
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: The E-3A Airborne Warning and Control System (AWACS) will support a variety of tactical air operations and the air defense of the Continental United States (CONUS). It will overcome current deficiencies of present ground based systems (range, vulnerability, limited effectiveness against low altitude targets and susceptibility to electronic countermeasures). The capability to detect and track targets against ground clutter makes AWACS effective against low-altitude targets. Since the radar is mounted on a high flying jet aircraft, increased surveillance volume and detection range are realized. Mobility, the capability to maintain awareness of the developing air situation, and the ability to command weapons in its own defense make the E-3A highly survivable.

The airborne platform is a Boeing 707 aircraft. Equipment includes the radar, communications, identification sensors, navigation units and data processor to provide an integrated presentation of the air situation on operator display consoles. Interchangeability in missions will be accommodated with a change of central processor software. The Core E-3A is capable of detecting and tracking low flying aircraft targets in the presence of ground clutter, detecting bomber aircraft at a distance of nautical miles, detecting tactical aircraft up to nautical miles, computer tracking of targets, 6.2 hours on station time at 1000 nautical miles from base, and active interrogation of aircraft using a cooperative beacon in cryptological secure or standard modes. Increased Command and Control improvements as well as Electronic Counter-Counter Measures improvements are planned for the E-3A to exploit its inherent capabilities and to keep pace with the evolving threat.

The E-3A significantly enhances the combat effectiveness of air, ground and naval forces. Strategic defensive forces will utilize AWACS, in conjunction with interceptor forces, for the wartime defense of the CONUS and as an integral element of the mobile air defense force for contingencies requiring air defense outside the United States. Tactical forces will use AWACS for command and control during the deployment of tactical air forces; and in accomplishing interdiction, rescue and airlift missions. Its flexibility and versatility will enable it to be deployed at any level of military action ranging from a show of force through general war. During these deployments, the means will exist, for the first time, to manage the air and sea battle.

RELATED ACTIVITIES: The Overland Radar Technology Program (Program Element (PE) 63701F) proved the feasibility of overland radar in support of AWACS. The conceptual portion of the AWACS program was funded under PE 63402F (AWACS) prior to December 1967. North Atlantic Treaty Organization (NATO) Airborne Early Warning and Control System (PE 64752F) established in FY 1978 to fund United States share of NATO development effort (subsequently changed to PE 01012F).

Program Element: #27417F
DoD Mission Area: Tactical Command and Control #254

Title: Tactical Airborne Command and Control System
Budget Activity: Tactical Programs #4

WORK PERFORMED BY: The Air Force management is provided by the Electronic Systems Division, Hanscom AFB, Bedford, Massachusetts. The integration contractor is Boeing Aerospace Company, Seattle, Washington. The major subcontractors are: (1) Radar - Westinghouse Electric Corporation, Baltimore, Maryland; (2) Data Processor - International Business Machines, Owego, New York; (3) Displays - Hazeltine Corporation, Long Island, New York; (4) Ultra High Frequency radios (Less Transceivers) - Electronics Communications Incorporated, St. Petersburg, Florida; (5) Identification Friend or Foe - Airborne Instruments Laboratory, Long Island, New York; (6) Navigation - Northrop, Los Angeles, California; (7) Very High Frequency radios - Collins Communications Systems, Cedar Rapids, Iowa; and (8) Audio Distribution System - Hughes Aircraft Company, El Segundo, California; (9) Joint Tactical Information Distribution System Digital Data Link - Hughes Aircraft Company, Fullerton, California. Government Furnished Equipment vendors are: (1) Engines - Pratt and Whitney Aircraft Division of United Aircraft Corporation, Hartford, Connecticut; (2) Ultra High Frequency Transceivers - Collins Communications Systems, Cedar Rapids, Iowa.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior accomplishments: Feasibility studies by Boeing, McDonnell Douglas, and Lockheed (each study using a different radar and airframe) led to the Air Force conclusion that an Airborne Warning & Control System (AWACS) was feasible and could be delivered in the 1970s. In FY 1967, contracts were awarded to Boeing and McDonnell Douglas for studies to examine the aerodynamics of the radar rotodome configuration, to determine the optimum configuration and to integrate the results of all the other studies into a system study to establish a baseline design including results of the Overland Radar Technology Program. The Contract Definition Phase of the program was initiated during CY 1969 and was completed with the selection of the Boeing Company as the system acquisition contractor in July 1970. The AWACS program and the contract with Boeing was arranged in three phases (Brassboard Radar Demonstration; Development, Test and Evaluation (DT&E); and Production) with established performance milestones within each phase that were demonstrated with test results before the decision was made to proceed to the next phase.

The Brassboard Radar Demonstration phase, initiated with Hughes and Westinghouse as competing radar subcontractors, was designed to verify the performance of the radars. The two radars (Hughes and Westinghouse) were installed in modified Boeing 707 aircraft and the competitive radar fly-off began in March 1972. AWACS long lead avionics subsystem development to support the DT&E phase was initiated following successful ground testing of the radars.

The competitive radar flight test programs was successfully completed in October 1972 with the selection of Westinghouse as the radar vendor. The Airborne Tracking Demonstration was initiated and accomplished early due to the early announcement of the winning radar vendor. After the successful completion of the Brassboard Radar demonstration phase in December 1972, the DT&E phase which included the System Integration Demonstration (SID) was initiated with utilization of the selected radar and other mission avionics to demonstrate the total AWACS function. The SID avionics configuration, originally a single-thread system to resolve technical problems prior to a production request,

was enhanced by the inclusion of additional equipment to permit the using commands, Tactical Air Command and Aerospace Defense Command, to conduct a parallel Initial Operational Test and Evaluation (IOT&E). This permitted the production decision to be supported by both technical feasibility and operational suitability data. Reconfiguration of the brassboard aircraft, used to test the non-selected radar, to the Development Test and Evaluation (DT&E) prototype configuration for use as the first DT&E aircraft and fabrication of two new DT&E aircraft was started in FY 1973.

In FY 1974 the installation and checkout of the hardware and software in the System Integration Demonstration (SID) aircraft was completed and first flight was accomplished in March 1974. The remainder of the FY 1974 SID effort was devoted to performance verification of subsystems as well as the full SID configuration including both air vehicle and mission electronics. All critical design reviews for the full configured Airborne Warning and Control System (AWACS) were completed. Initial equipment deliveries for the DT&E Avionics Integration Laboratory were received and installation was begun. Work continued on the three DT&E aircraft initially funded in FY 1973.

The SID flight test program, with active participation by the operating commands, was completed in November 1974. This, and other test flights during FY 1975, demonstrated the operational suitability of AWACS while evaluating electronic compatibility/interference with other systems, survivability, interoperability/mutual enhancement with other Army, Air Force and Navy command/control and weapons systems and performance in electronic countermeasure environments. The results provided high visibility into the potential of the AWACS and confidence for the production release in March 1975.

In addition to the SID tests, fabrication continued on the three operationally configured pre-production aircraft with research and developments funds. Development of Time Division Multiple Access communications terminals and installation design were also started. A maritime surface surveillance modification to the radar was accomplished in support of demonstration goals for the April 1975 Deployment. Flight crew training of Air Force personnel was initiated. Full scale production of the six E-3As authorized in FY 1975 began in March 1975. First operational delivery occurred in March 1977.

By December 1975, all of the mission avionics had been installed, checked out and integrated in the Avionics Integration Laboratory. Airworthiness flight tests to determine air vehicle flight loads, flutter characteristics and performance/handling qualities began in August 1975 with the first DT&E pre-production aircraft and were completed in October 1976. The second DT&E pre-production aircraft with mission avionics equipment began flight tests in October 1975. The third DT&E aircraft began flight tests in May 1976. These three aircraft and production system #1, which began flight tests in July 1976, were utilized to accomplish the DT&E objectives of the Core, or basic, configuration test program. Separate DT&E/IOT&E test programs will be accomplished on enhancements to this Core configuration. These aircraft will be delivered to the operational force.

Program Element: #27417F
DoD Mission Area: Tactical Command and Control #254

Title: Tactical Airborne Command and Control System
Budget Activity: Tactical Programs #4

The development, Test and Evaluation on the Core configuration was completed in January 1977. This reflected a seven month compression over the previously planned test program made possible through utilization of data previously obtained, principally during the extensive testing conducted during FY 1975. Emphasis continued to be placed on using Air Force personnel to man the operating positions to validate the human factors aspects. Concurrent testing of navigation and communication subsystems, software and flight essential avionics qualification were conducted during radar performance/total system evaluation.

Three operational evaluations of the E-3A were conducted. Two E-3As participated in each of three exercises; a joint Army-Air Force readiness exercise, a tactical exercise representative of the threat and magnitude of a European conflict, and a Continental United States air defense exercise. The E-3A underwent all-weather testing in the climatic hangar, and reliability/maintainability demonstration.

Development effort continued on Time Division Multiple Access (TDMA) communications and Maritime Surface Surveillance enhancements with their associated software. These enhancements will increase the capability and flexibility of the Airborne Warning and Control System in its worldwide surveillance and control functions. TDMA communications, embodied in the Joint Tactical Information Distribution System (JTIDS), provides for jam-resistant high capacity information flow. The Maritime enhancement permits improved surveillance of ocean areas. The Avionics Integration Laboratory which has the same configuration as the production aircraft, continued to be used to evaluate complex operational and engineering situations that cannot be easily generated in flight testing.

In FY 1979, development continued on the JTIDS and Maritime enhancements in support of planned production line incorporation in FY 1980. Enhancements and related efforts accounted for approximately 90 percent of the funding. Other enhancement activity was deferred to FY 1980. Development of corrections to deficiencies identified during test and operational experience began with effort on Identification Friend or Foe Mode IV fixes to improve the secure identification function.

2. FY 1980 Program: Maritime and JTIDS development will be completed. United States/North Atlantic Treaty Organization standard developments were merged into an integrated development program. Full development efforts will begin on Display Remoting and Expanded Command, Control and Communications (C^3) improvements. Display Remoting will provide the total picture of activity seen by the E-3A to high level ground based command authorities. Expanded C^3 provides additional radios and display consoles to increase operational flexibility and capability. Electronic counter-countermeasures improvement studies will continue to evaluate new technologies and improvements to the E-3A radar needed to insure its resistivity to the evolving electronic countermeasures threat. Approximately one percent of the requested funding is for correction of additional deficiencies found in testing and operational experience.

Program Element: #27417F
DoD Mission Area: Tactical Command and Control #254

Title: Tactical Airborne Command and Control System
Budget Activity: Tactical Programs #4

3. FY 1981 Planned Program: Flight testing of the United States/North Atlantic Treaty Organization (US/NATO) standard configuration with maritime radar and Hughes Improved Joint Tactical Information Distribution System terminal and a larger computer will be conducted. Development of display remoting enhancement, and additional radios of consoles will continue. Electronic Counter-Countermeasures (ECCM) improvements development will be initiated.

4. FY 1982 Planned Program: US/NATO standard configuration Initial Operational Test & Evaluation testing will be completed. Development will continue for display remoting enhancement, additional radios/consoles, and ECCM improvements.

5. Program to Completion: Development of enhancements continues with completion in FY 1984.

6. Milestones:

A.	Engineering Development Contract Award	Jul 70
B.	First Flight (Brassboard)	Mar 72
C.	End of Flight Test of Brassboard	Aug 72
D.	Start of Development Test and Evaluation	Jan 73
E.	System Demo Flight Tests Begin	Mar 74
F.	System Demo Test and Evaluation Completed	Dec 74
G.	Start of Production	Mar 75
H.	First Test Flight of First DT&E Aircraft	Aug 75
I.	Development Flight Test Complete (Core)	Jan 77
J.	Interim Operational Capability (Core)	Apr 78
K.	Maritime Radar Flight Test Complete	Jul 80
L.	US/NATO Standard Configuration Flight Test Complete	Sep 81
M.	Display Remoting & Command and Control Improvements Flight Test Complete	Jul 83
N.	ECCM Flight Test Complete	Aug 84

7. Resources: N/A

8. Comparison with FY 1980 Budget Data: ($ in Thousands)

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Costs
Total for Program Element FY 80	99,928	58,600	74,200	63,600	74,900	1,571,366

Program Element: #27417F
DoD Mission Area: Tactical Command and Control #254

Title: Tactical Airborne Command and Control System
Budget Activity: Tactical Programs #4

Electronic Counter-Countermeasures (ECCM) improvements, originally planned to start in FY 79 have been delayed until FY 81. This delay was necessary to evaluate new technology that will insure resistivity of the E-3A radar to electronic countermeasures in the projected threat environment. ECCM studies and brassboard engineering designs are underway to evaluate the most promising technologies. Full scale development is planned for FY 81. In addition to the above change in development, the E-3A production program has been rephased from 3 E-3As in FY 81 and FY 82 to 2 E-3As in FY 81-83. Production schedules remain interleaved with the North Atlantic Treaty Organization (NATO) Airborne Early Warning & Control aircraft to preserve production efficiencies. United States (US) and NATO development schedules have been fully integrated to allow use of shared test assets for the development of the US/NATO standard configuration.

Budget Activity: Tactical Programs #4

Program Element: #27417F

TEST AND EVALUATION DATA:

1. Development Test and Evaluation:

The E-3A DT&E test program was a combined Development Test and Evaluation/Operational Test and Evaluation (DT&E/OT&E) and was conducted in as realistic an operational environment as possible. The development contractor is the Boeing Aerospace Company. The overall objectives of the test effort were to: (a) validate/verify E-3A performance in accordance with design specifications: (b) determine E-3A performance and capability to fulfill operational requirements including interservice interoperability demonstrations; and (c) verify Air Force capability to support the E-3A with standard operational maintenance, logistics and training units using prescribed procedures. The DT&E/IOT&E program was divided into phases. The prerequisites for transition from one phase into another was the successful completion of the preceding phase. The phases and their objectives follow.

Brassboard Airworthiness (Phase I) - The objective was to evaluate the Brassboard aircraft airworthiness with a 30-foot rotodome attached to confirm the best rotodome angle and to assure compatibility of inflight refueling profiles. Tests were joint Air Force - Contractor efforts and were begun in March 1972 and completed in July 1972.

Brassboard Radar Demonstration (Phase I) - The objectives were to (1) demonstrate feasibility of overland radar; and (2) select one of two competing radars (Hughes and Westinghouse). The feasibility of overland radar was established and Westinghouse won the radar competition. These tests were conducted from July 1972 thru October 1972.

Airborne Tracking Demonstration (Phase I) - The objectives were to demonstrate the capability of the system to acquire and track targets while airborne and to demonstrate successful integration of the selected Brassboard radar (Westinghouse) and computer display equipment required to perform the target tracking function while airborne. Successful completion of this and the Brassboard Radar Demonstration was the basis for authorizing Full Scale Development. This phase was conducted from October 1972 thru November 1972.

Systems Integration Demonstration (SID) (Phase II) - The objective was to demonstrate critical Core E-3A functions in a single suit of mission avionics. A secondary objective was to demonstrate E-3A capabilities in an electronic countermeasures environment. During SID all results met or exceeded previously demonstrated brassboard results. Approximately 770 hours were flown on the SID aircraft. Participants included the contractor, the developing command (Air Force Systems Command), the using command(s) (Tactical Air Command and Aerospace Defense Command) and the operacional test center (Air Force Test and Evaluation Center). Successful completion of the SID was the basis for the authorization to commence production. The SID was conducted from March thru October 1974.

Budget Activity: Tactical Programs #4

Program Element: #27417F

Subsystems Tested During Systems Integration Demonstration (SID) - A single suit of all Core E-3A mission avionics underwent development testing during the SID. Differences between the SID and the Core production configuration were largely a matter of scale and packaging. As a result of the SID, the amount of risk remaining in the program was minimal. This assessment was consistent with the program concept of successively reducing risk through positive test results before moving to the next program phase. Of the subsystems tested, the Radar Functional Group was not packaged in the same way as the production system, the Airborne Operational Computer Program did not possess all of the subroutines contained in the production system, the On-Board Test, Monitor and Maintenance functional group was not packaged in the same way as the production system, the On-Board Test, Monitor and Maintenance functional group was different in scale and the air vehicle and engines were different. Testing of these subsystems in the production configuration was considered to be low risk relative to previous testing accomplished. No adverse effect was experienced from conducting tests with the Brassboard/System Integration Demonstration aircraft in lieu of a production prototype.

SID Development Test and Evaluation (DT&E) Results.	Goal	Demonstrated
Track Initiation @ 80% of Initial Detection		
Track Continuity (Minutes)		
Relative Position Accuracy		
Maneuver Response		
Height Accuracy @ 150 Mi		
Average Fighter Detection, NM		
Sea		
Farmland		
Mountains		
Average		

DT&E for Core (Phase III) - The objective was to complete air-vehicle, climatic, and mission avionics qualifications and acceptance testing of the Core configured E-3A. Three development aircraft, the first production aircraft and a ground DT&E Avionics Integration Laboratory (AIL) were used in this phase. The DT&E AIL had the same physical layout as the DT&E aircraft. Flight test activity in this phase, which was conducted in conjunction with Initial Operational Test and Evaluation (IOT&E), began in August 1975 and was completed in January 1977. Additional environmental, reliability and maintainability follow-on testing was then conducted. Three of the four flight test assets were delivered to the operational force during 1978. The third development test aircraft will be utilized in testing of the enhancements to the Core configuration. Test results to date indicate the E-3A will meet all current mission requirements.

Budget Activity: Tactical Programs #4

Program Element: #27417F

Discrepancies/Deficiencies Found During Development Testing:

The System Integration Demonstration (SID) development testing uncovered no deficiencies relative to Brassboard performance and/or the SID requirements. During Initial Operational Test and Evaluation (IOT&E) 21 improvements were suggested by Air Force Test and Evaluation Center and using commands (Tactical Air Command Aerospace Defense Command). These improvements were evaluated and incorporated as appropriate.

An aggressive Deficiency Reporting system during Development Test and Evaluation (DT&E) provided a method for reporting and resolving system problems not being adequately dealt with by the contractor. These deficiencies are being studied monitored and corrected as appropriate.

Likewise, a deficiency reporting effort was accomplished during IOT&E. Six hundred and fifty three deficiencies, with some duplication with DT&E reports, were identified. These 653 reports fell into 43 deficient areas and 142 enhancement or future study areas. Of the 43 deficient areas, fixes have been identified for 30 of them with the remainder under investigation.

All deficiency reports are being studied, monitored and corrected as appropriate.

Maintainability and Reliability Testing of the System

A reliability test and evaluation program was conducted during the DT&E/Operational Test and Evaluation (OT&E) (Phase III). The E-3As reliability and maintainability met or exceeded all major design goals and system level specification requirements as measured against engineering standards. The operational reliability and maintainability performance projected for the system is considered satisfactory for a system of this complexity.

2. Operational Test and Evaluation

The E-3A test program is being conducted as a combined development test and evaluation/initial operational test and evaluation (DT&E/IOT&E). The first phase (brassboard/airborne tracking) was conducted from March 1972 thru May 1973 to identify and assess trade-offs in performance, obtain design data for the second phase of the program, reassess the program risk areas, and obtain data for selection of the E-3A radar subcontractor. The second phase of testing designated the SID phase, was conducted from March 1974 through November 1974 and confirmed that the prototype subsystems could be integrated into an operational system, and demonstrated the potential of a production Airborne Warning and Control System (AWACS) to perform its intended mission. The SID AWACS was also deployed to Europe for operational demonstrations to North Atlantic Treaty Organization defense officials during this phase of IOT&E. Evaluation of system operational effectiveness and suitability of the production E-3A was conducted from August 1975

through December 1976, using three production-configured test aircraft and one production system aircraft. One aircraft was used for airworthiness testing of the air vehicle, and the other three were used for operational system testing.

Brassboard/Airborne Tracking Phase Initial Operational Test and Evaluation (IOT&E) Test Results

During the brassboard radar demonstration and the airborne tracking demonstration, highly qualified, using-command personnel were handpicked and assigned to the contractor's plant to observe all testing. These personnel assisted the E-3A System Program Office (SPO) in the development and approval of test plans and procedures, flew aboard the test bed aircraft, assisted in the collection of test data, and provided independent evaluations of test results. In August 1972, the brassboard Airborne Warning and Control System (AWACS) took part in an Air Defense Command operational exercise, Felix Bravo, that included jamming and non-jamming aircraft (simulating an enemy strike force), and an equal number of friendly fighter aircraft. The AWACS radar detected and maintained tracking of all targets and friendly fighter aircraft at maximum range over a variety of terrain conditions. During December 1972, the AWACS participated in a Tactical Air Command operational exercise, Brave Shield III which involved all the functions of tactical air power, tactical AWACS concepts, and performance. All test objectives were met. An AWACS technology demonstration was conducted 10-30 April 1973 for more than 90 senior civilian and military foreign and United States dignitaries. AWACS demonstrated: The ability to track aircraft deep inside political borders where ground NATO radar systems have no coverage; the ability to detect and track aircraft at low altitude in areas where NATO air defense ground environment ground radars were topographically limited; the ability to provide early warning to a HAWK missile site through an experimental digital data link; the ability to monitor simulated ground forces in the forward edge of the battle area using identification friend or foe transponders; simultaneous tracking of surface vessels and aircraft; resistance to electronic jamming by tracking numerous targets in close proximity to electromagnetic interference (EMI); and interoperability by relaying data for display on ground systems through an experimental digital data communications system AWACS participated in the Amalgam Arrow exercise conducted on 23 May 1973 in the 24th and 25th North American Air Defense (NORAD) Regions. During the exercise, AWACS operated as an extension of the 25th NORAD Region Control Center via an experimental digital data link. Manual intercepts were conducted by weapons controllers on AWACS. Four specific objectives in Amalgam Arrow included: evaluate the operational employment of AWACS in a realistic threat environment; demonstrate AWACS capability to detect and track low altitude targets below ground-based radar coverage; demonstrate AWACS capability to detect and track targets in a multiple jammer environment; and evaluate the operational effectiveness and suitability of the projected AWACS in the strategic defense environment. Additional ECM testing was also conducted as part of this exercise.

System Integration Demonstration/IOT&E Phase Test Results

Two representative tactical scenarios were used to assess AWACS' potential to operate as an extension of the Tactical Air Control System while performing selected functions of a control and reporting center and a control and reporting post.

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The Airborne Warning and Control System (AWACS) effectively controlled interdiction, reconnaissance, counterair, close air support, search and rescue, and airlift missions. AWACS capability to detect and track remotely piloted vehicles was also successfully tested. In two air defense/counterair scenarios, AWACS effectively performed target detection, tracking, identification, and interception in both a clear and electronic countermeasures (ECM) environment. AWACS survivability testing, conducted in four phases, was designed to assess AWACS vulnerability to an active fighter threat in a representative tactical environment. Fighter profiles tested (simulating Fishbed, Flogger, and Foxbat Soviet fighters) ranged from single fighter attack to multiple fighters with ECM escort (simulated Soviet Brewer E aircraft) attacking AWACS simultaneously. Various AWACS tactics to avoid detection and interception were assessed. Results show that the AWACS has a high expectancy for survival. AWACS potential for interoperability with other command and control elements was assessed through joint operations conducted with the 25th North American Air Defense Region, elements of the Tactical Air Control System, the Navy Tactical Data System, and the Army air defense command and control HAWK system. During these tests, a developmental time-division-multiple-access digital data link was used to down-link AWACS surveillance and tracking information to these command and control elements. Test results confirmed that AWACS can extend surveillance limits of surface-based command and control systems and down-link tracking information. These tests demonstrated that AWACS has a high potential to greatly enhance combat effectiveness in joint command and control operations.

Initial Operational Test and Evaluation (IOT&E) Results Following the System Integration Demonstration (SID) Phase

The SID configured AWACS deployed to Europe from 3-25 April 1975 to demonstrate its capabilities to North American Treaty Organization defense officials and allied military personnel. Limited IOT&E data were collected during the scripted demonstration to further evaluate the operational suitability and effectiveness of the AWACS. IOT&E objectives included an assessment of the capability of AWACS to enhance the European command and control systems, an evaluation of the electromagnetic compatibility (EMC) of the AWACS radar and European ground radars, an early assessment of the potential utility of a interface, and an evaluation of a maritime surveillance capability (MSC) radar modification. The capability to detect and downtell the positions of transponder-equipped ground forces was also evaluated. From data collected during this deployment, the following observations were made regarding AWACS effectiveness: the AWACS demonstrated a capability to enhance to a considerable degree present command and control systems

AWACS MSC radar, and the ability to detect and crosstell ground force transponders will add a high degree of flexibility to the effectiveness of the system. The Air Force Test and Evaluation Center conducted special IOT&E tests of the SID configured AWACS from 12-19 May 1975 to respond to a House Armed Services Committee request for additional information on the capabilities of AWACS. Five specific AWACS areas examined in these tests included: (a) Capability against close formation and maneuvering targets; (b) the ability to self-triangulate against concurrently employed ground-based and airborne jammers; (c) capability against self-screening

and escort jammers; (d) the ability to resolve target altitude, and track low flying tactical aircraft over varying terrain; and (e) the effectiveness of the ALT-28 and ALQ-119 jammers against Airborne Warning and Control System (AWACS). These special tests confirmed the results and conclusions documented in the Air Force Test and Evaluation Center (AFTEC) System Integration Demonstration (SID) Initial Operational Test and Evaluation (IOT&E) report dated November 1974. AWACS demonstrated its potential operational effectiveness against tactical formations and low altitude and jamming targets.

At the direction of Office of the Secretary of Defense /Director of Defense Research and Engineering, AFTEC conducted another special test on 22 May 1975 to obtain data on the capability of the SID AWACS to detect, track, and control interceptors while avoiding an aggressor force of radar-equipped interceptors and jammer aircraft in a limited free-play environment. The results showed that the SID AWACS, in conjunction with the F-15, was effective in determining the location of the aggressor raids and engaging them. The results also showed that the

During these first phases of IOT&E, the advanced development models of the E-3A demonstrated the feasibility of overland lookdown radar and confirmed the potential operational effectiveness of pre-production hardware and software. These tests, along with survivability tests and special EMC tests, supported authorization to proceed with E-3A production. Details of these tests were reported in the following AFTEC reports: AWACS IOT&E Final Report, Nov 74, (S); AWACS Free Play Test, Jun 75, (S); and AWACS Special IOT&E, Jul 75, (S).

Production Configured E-3A Phase IOT&E Results

The final 16 month phase of IOT&E evaluated the core production-configured E-3A under a variety of operational conditions to assess its operational effectiveness and operational suitability. Two E-3As, test system number 3 (TS-3) and production system number 1 (P-1), were used during each of the IOT&E tests. TS-3 contained a full set of production equipment (computers, consoles, radios, etc.) plus the complete suite of special test equipment and instrumentation used for engineering and development testing. P-1 was fully production-configured. The tests during this phase simulated the required operational missions prescribed for the E-3A in the Commander, Tactical Air Command (COMTAC) Concept Plan 65 and Commander-in-Chief, North American Air Defense Command/Commander-in-Chief, Air Defense (CINCNORAD/CINCAD) Concept Plan 3111. Scenarios for these tests closely approximated the projected threats in terms of tactics, numbers of aircraft, and electronic countermeasures. Up-to-date intelligence estimates were used to plan/develop realistic hostile force simulations for each scenario. Additional realism was ensured by using a red, white, and blue team concept in staging two-sided battles. Three live tests in the series included Brave Shield XV, a US Readiness Command joint exercise; a specially designed large-scale tactical operations test; and Vigilant Overview 77-1, a large-scale North American Air Defense exercise. The results of this final phase of IOT&E were reported in the AFTEC Phase III IOT&E Final Report, Sep 77, (S) included assessments of operational effectiveness and logistics/operational suitability.

Budget Activity: Tactical Programs #4

Program Element: #27417F

Operational Effectiveness

The initial production E-3A can effectively perform the missions prescribed in the COMTAC Concept Plan 65 and CINCNORAD/CINCAD Concept Plan 3111 in a dense electronic countermeasures (ECM)/threat environment when manned by crews with a high level of proficiency. It will significantly enhance the capability of the Air Force to conduct and manage tactical and strategic defensive air operations. With the addition of the E-3A, these air operations can be conducted with efficiency and effectiveness that far exceed the capability of current, ground-based and airborne command, control, communications, and surveillance systems. It has a high probability of survival when threatened by hostile fighters. The inherent ECM resistivity of its radar enables it to operate effectively in a heavy ECM environment.

Operational Suitability

The E-3A is supportable through a mix of organic and interim contractor support (ICS). ICS at organizational, intermediate, and depot level is an important and necessary element in E-3A supportability and will be required until organic Air Force capability is fully established. ICS is projected to be phased out incrementally as Air Force capability increases. The evaluation of the operational suitability of the E-3A (including ICS) resulted in three logistics elements being rated deficient and needing improvements: (1) maintainability, (2) availability, and (3) support equipment. The major contributors to these deficient ratings were immature reliability, maintainability, and supply consumption data, and late radar design stability. These areas caused logistics support decisions to be based on incomplete information. The maintenance plans and concepts are based on the design capability to automatically detect and isolate faults in the mission avionics subsystems. This capability was not sufficiently developed during Initial Operational Test and Evaluation to assess its effectiveness as a maintenance tool in three specific areas: (1) surveillance radar, (2) data display and control, and (3) identification. These deficiencies did not prevent achievement of an initial operational capability because ICS made up most of the short-fall. However, continued emphasis should be placed on the correction of deficient supportability areas to achieve a high level of organic support at the earliest possible time. Operator/maintenance training courses and hardware/software training equipment are able to support the E-3A mission. Tactical Air Command and Air Training Command have developed technical training courses for E-3A personnel. If E-3A trainers were equipped with a fault insertion capability, the quality of training should improve. The E-3A mission simulator and E-3A flight simulator need improvements, particularly in software. Proposed improvements were identified to the SPO and corrections are programmed. The positive target control program was satisfactory. The computer program ground support capability was deficient due to numerous documentation errors. These documentation errors are being corrected.

Budget Activity: Tactical Programs #4

Program Element: #27417F

Core E-3A Follow-on Operational Test and Evaluation (FOTE)

FOT&E, initiated in January 1977, is being conducted in two phases with operational crews using production aircraft, training equipment, and support equipment. Past FOT&E. FOT&E Phase I, managed by the Air Force Test and Evaluation Center, was completed in February 1978. This Phase was designed primarily to refine the operational suitability (reliability, maintainability, availability and logistics supportability) assessments made during phase III Initial Operational Test and Evaluation (IOT&E). Because IOT&E assessments were constrained by the Development Test and Evaluation contractor-managed environment, phase I Follow-on Operational Test and Evaluation (FOT&E) provided the first opportunity for a detailed assessment of E-3A suitability under Air Force hands-on maintenance management. The operational effectiveness objectives addressed during phase I FOT&E were those not completed in IOT&E, or those where the contractor had made equipment changes after IOT&E and before production delivery. Test data were collected on a noninterference basis during the 552 Airborne Warning and Control Wings (AWACW) primary function of training for attainment of phase I initial operational capability (IOC). No aircraft were dedicated to the test effort. FOT&E flight data were gathered from training missions and during an E-3A deployment to Europe. This deployment, commonly referred to as "EUROTEST 77," provided the first opportunity to assess the logistics supportability of the E-3A in an overseas location. It also provided additional data on the integration of the E-3A into the existing North Atlantic Treaty Organization ground command and control system, and information on the E-3A radar compatibility within the European Central Region electromagnetic environment. The results of this first phase of FOT&E were reported in the Air Force Test and Evaluation Center E-3A FOT&E phase I Final Report, Jul 78 (S). Test results confirmed that the production E-3A can effectively and efficiently perform its prescribed mission and that the E-3A will greatly enhance the capability of the Air Force to conduct tactical air operations. However, several significant reliability and maintainability problems, and deficient logistic support areas must be improved prior to achievement of a full readiness capability. In particular, significant reliability problems were experienced within the air vehicle functional group, surveillance radar functional group and the data display group. The E-3A SPO is actively pursuing a reliability improvement program, and has approved 66 engineering change proposals for inclusion during a planned retrofit. Maintainability, while satisfactory, can be improved. The effectiveness of on-board diagnostics must be determined to evaluate their specific contribution to E-3A maintenance concept in terms of decreased mean-time-to-repair and reduced maintenance man-hours per flying hour. The Air Force supply support posture, while improving, is primarily dependent on the prime contractor for mission-essential avionics item repair under Interim Contractor Support. In many cases, the required contractual repair turnaround times are not being met. Critical spares for main operating base (MOB) and deployment operations must be satisfied through cannibalization and reallocation of mission-essential items from the production line. The requirement in both range and depth for deployment spares kits has not stabilized. The E-3A demonstrated its capability to effectively interoperate with the existing command and control system in Europe. However, continued evaluation of current and planned

digital links must be made to fully assess net effectiveness and refine operational procedures. Present Follow-on Operational Test and Evaluation (FOT&E). FOT&E phase II, managed by the Tactical Air command (TAC), was initiated in March 1978 to refine IOT&E and phase I FOT&E assessments with emphasis on tactics and procedures. The USAF Tactical Fighter Weapons Center is managing the phase II FOT&E for TAC with the test team collocated at the 552d AWACW MOB, Tinker AFB OK. The test team, comprised of representatives from TAC, Air Defense Command, and Air Force Systems Command, is conducting the test in conjunction with normal training and maintenance activities of the 552d AWACW. No dedicated resources, beyond the test team, are being used for the phase II evaluation. Major test objectives include: (1) Evaluate corrective actions for previously identified deficiencies. (2) Refine E-3A tactics and provide information on procedures and doctrine. (3) Verify and refine estimate of the production E-3A operational effectiveness and suitability. During the first 15 months of testing, the 552d AWACW has accumulated over 8,300 flying hours and 1,200 sorties, which included participation in 24 major exercises. The test team has participated in a cross section of these activities in support of FOT&E objectives. Based on data collected to date, the following preliminary results/observations are provided: General - Phase II preliminary findings support the conclusions of Initial Operational Test and Evaluation (IOT&E) and phase I FOT&E that the production E-3A can effectively perform its prescribed mission; Tactics and procedures refinement/development - Physical arrangements for the North American Air Defense battle staff aboard the core E-3A, as previously reported, are insufficient to effectively support E-3A mission crew and command element simultaneously; Based on FOT&E efforts, a new type of control, termed "tactical control," has been developed to enhance counter-air operations by adjusting E-3A support to the capabilities and requirements of various fighter aircraft; Baseline procedures have been formulated to exploit E-3A lookdown capabilities in support of close air support-forward air control and rescue missions; Operational suitability - Hardware reliability has shown a favorable trend throughout the test period; Significant progress has been made in the maintainability area; and Deficiencies in supply support, previously reported in phase I FOT&E, continue to affect the overall availability of mission capable aircraft. FOT&E phase II is scheduled to be completed by 30 June 1980. Test reporting will be accomplished in two parts. Part A of the final report covering the period March 1978 - May 1979 will be published in December 1979. Part B will be published in September 1980. A multi-command radar maintenance evaluation (Air Force Test and Evaluation Center lead) is also being conducted in parallel with the phase II FOT&E to evaluate the E-3A Build-in-Test/Fault-Isolate-Test (BIT/FIT) capability to support daily maintenance activities. This test began in July 1978 and is scheduled for completion in June 1980.

E-3A Enhancements IOT&E

Background. Decision Coordinating Paper 5, Revision 3, 5 March 1976, approved continued production of the E-3A, and the development of a selected set of system enhancements chosen to provide a fully effective worldwide force. The enhancements were to be developed as separate entities and integrated into the E-3A for testing as the enhancement

items became available. In May 1976, the Deputy Secretary of Defense directed the Air Force to plan for an Office of the Secretary of Defense (OSD) review of the Airborne Warning and Control System enhancement program when the respective enhancement development efforts are essentially completed. He further stated that it is contemplated that the Defense Systems Acquisition Review Council (DSARC) would then review development and test status and consider the operational utility of the respective enhancements in light of an updated threat evaluation prior to committing the government to production. The purpose of operational testing of the enhancements is to provide an evaluation of the operational utility of each enhancement for the DSARC review. In December 1978, NATO signed an agreement with the United States (US) Government (as their agent) for the procurement of 18 E-3A aircraft. To support this commitment and the US standard configured E-3A aircraft, the Air Force intends to ask OSD for approval of a low rate production of maritime and joint tactical information distribution system (JTIDS) components when the DCP is updated. Past Enhancement Testing. To date no operational testing, except the Initial Operational Test and Evaluation (IOT&E) of the JTIDS waveform B terminal, has been completed. Testing began during May-June 1978 with a preliminary evaluation of the JTIDS time division multiple access (TDMA) system on board an E-3A. The purpose of this test was to determine JTIDS communications coverage, E-3A system performance in a JTIDS environment, and provide an initial estimate of the operational effectiveness/suitability of the TDMA communication system planned for the E-3A under the OSD-approved enhancement program. This Development Test Evaluation (DT&E/IOT&E) effort provided an opportunity to test the concept of spread spectrum and frequency hopping as a transmission technique in a simulated operational environment. Major emphasis was placed on assessing the electronic counter-countermeasures (ECCM) capability of the system. Operational test results demonstrated electronic countermeasures resistivity and operational effectiveness potential of the JTIDS terminal. However, until corrected,

Results of this test were reported in the December 1978 Air FForce Test and Evaluation Center E-3A JTIDS Terminal IOT&E Final Report.

Planned Enhancement Testing

The Block 10 (US Standard) E-3A configuration is being developed in two steps. During step I, an interim configuration of the E-3A (Block 05) incorporating enhancements sponsored by the US Government, will be developed and qualified by the contractor. Step II will include enhancements sponsored by North Atlantic Treaty Organization (NATO). The US Standard E-3A will be a core E-3A plus maritime surveillance capability (MSC), a JTIDS Hughes improved terminal (HIT), upgraded computer program functional group (CPFG), and modified data analysis processor group (DAPG). Under the current schedule the US standard configured E-3A will not be ready for IOT&E until September 1981. The MSC radar components and software will be installed and checked out by the contractor by 3 July 1980. However, the modified DAPG and upgraded CPFG through which the MSC must be operated will not be qualified until 1 September 1981. The JTIDs HIT will be installed onboard the E-3A in April 1981 and contractor testing will be completed by

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15 September 1981. To lower the risk of going into production and to give OSD some assurance that the maritime radar and the Hughes improved terminal (HIT) will meet the operational requirements, a preliminary operational effectiveness assessment of the maritime radar modification is scheduled to be conducted by Air Force Test and Evaluation Center (AFTEC) from 3 July - 30 August 1980. This assessment will be limited to determining if the E-3A radar with the maritime modification meets specification requirements and operational performance thresholds. The initiation of operational testing of the maritime radar is dependent on the availability of engineering-verified software. Additionally, the Joint Tactical Information Distribution System (JTIDS) adaptable surface interface terminal (ASIT) will undergo Initial Operational Test and Evaluation (IOT&E) by AFTEC in 1980. The JTIDS HIT will not be installed on the E-3A during this timeframe. However, the HIT will be included in the Adaptable Surface Interface Terminal (ASIT) which will permit a preliminary JTIDS HIT hardware assessment during ASIT testing. The Block 20/25 configuration will be a retrofit program of the Block 01 (core) and Block 10 configured E-3As. Block 20 will consist of Block 01 plus JTIDS, larger computer, rapid access teletype, 5 Ultra High Frequency (UHF) radios, 3 situation display consoles (SDCs), display remoting equipment and an austere battle staff. Block 25 will consist of Block 10 plus 5 UHF radios, 3 SDCs, display remoting equipment and an austere battle staff. Testing of these enhancements is expected to begin in Nov 82 and be completed by Aug 83. The Block 30/35 configuration will be a retrofit program of the Block 20 and Block 25-configured E-3As to incorporate ECCM improvements to the E-3A radar. Testing of these enhancements is tentatively planned for September-December 1984.

Program Element: #27417F — Title: Tactical Airborne Command and Control System
DoD Mission Area: Tactical Command and Control #254 — Budget Activity: Tactical Programs #4

3. Operational and Technical Characteristics.

Comparison System Integration Demonstration (SID)(Test System #1)/Production

	SID[1] EC-137D	E-3A[2] CORE
GENERAL		
Crew Size	11	17
Production or Production Prototype Systems		
Radar	NO	YES
Navigation	YES	YES
Data Processor	YES	YES
Display	YES	YES
Identification Friend or Foe	YES	YES
On-Board Test Maintenance and Monitor	YES	YES
Communications	PARTIAL	YES
HARDWARE		
Consoles	4	9
Auxiliary Display Unit	1	2
UHF Transceivers	4	14
HF Radios	1	2
VHF AM Radios	2	3
VHF FM Radios	0	1
CAPABILITY		
Radar Targets/Scan		
IFF Targets/Scan		
Data Processing Track Capacity		
Data Processing Simultaneous Intercepts		

1/ Also called Test System Number 1
2/ Test Systems #3 and #4 are identical to Core Production aircraft in terms of the listed parameters. Test System #2 has been retrofitted to production configuration. All test systems will be delivered to the operational force.

Program Element: #27417F
DoD Mission Area: Tactical Command and Control #254

Title: Tactical Airborne Command and Control System
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Comparison E-3A Requirements to Current Estimates

TECHNICAL CHARACTERISTICS	E-3A CORE/BLOCK II[1/] REQUIREMENTS	DEMONSTRATED PERFORMANCE
Detection Range (0.9 Probability in 1 Min)		
Bomber (NM)		
Fighter		
Crew Size	17	17
System Track Capacity		
Simultaneous Intercepts		
Targets Position Accuracy (NM)		
Time on Station at 1000 NM from Base (hrs)	6.1	6.2

RELIABILITY AND MAINTAINABILITY CHARACTERISTICS

	DESIGN REQUIREMENTS	DEMONSTRATED PERFORMANCE
Probability of Completing 9-hr Mission	0.88	.88
Maintenance Manhour/Flight Hour	28.0	38.0 *
In Commission Rate	80%	95.7%
Probability of Fault Detection	95%	97%
Probability of Fault Isolation	90% to 3 Primary Replaceable Units	95%
Turn Around Time	90% in 5.5 Hours	90% in 4.8 hours
False Alarm (Prob of not detecting failure)	.08	.03

1/ Includes jam-resistant, secure Joint Tactical Information Distribution System capability and Maritime Surveillance enhancements.

* Actual Data; March 79 - Oct 79

Program Element: #27417F
DoD Mission Area: Tactical Command and Control #254

Title: Tactical Airborne Command and Control System
Budget Activity: Tactical Programs #4

Design Requirements for E-3A Improvements

TECHNICAL CHARACTERISTICS	THRESHOLD	GOAL
Maritime Radar		
Maritime Targets Position Accuracy (NM/Degree)		
Maritime Targets Position Accuracy With ECM		
Maritime Targets Detection Range With ECM (NM)		
Maritime Target/Land Resolution (NM)		
JTIDS		
Message Transfer Ratio (0/0)		
E-3A Data Base Transfer (MIN)		
ECCM Margin (DB)		
Terminal Initialization Time		

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27423F
DoD Mission Area: Tactical Command and Control, #254

Title: Advanced Communication Systems
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	12,000	44,600	25,800	Continuing	N/A
2277	SEEK TALK	5,300*	9,900	41,000	24,000	2,000	88,900
2482	HAVE QUICK	4,600**	1,900	0	0	0	8,800
2614	SINCGARS-V Integration		200	3,600	1,800	Continuing	N/A

* Previously in Program Element 63727F, Advanced Communication Technology
** Previously in Program Element 64708F, Other Operational Equipment

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

The objective of this program is to develop and implement air-to-air and air-to-ground UHF and VHF communications which can survive in the jamming environments of the present and in the future. SEEK TALK and HAVE QUICK are Air Force led UHF programs while Single Channel Ground and Airborne Radio System (SINCGARS) is an Army led VHF program. SEEK TALK is an advanced technology, long term program which will provide jam resistance intended for all UHF voice communications. HAVE QUICK is applying demonstrated technology to provide an urgently needed resistance to jammers The Air Force will participate with the Army to plan for the integration of the SINCGARS VHF jam resistant capability in those weapon systems requiring direct communications with Army forces.

BASIS FOR FY81 RDT&E REQUEST: United States tactical forces are required to conduct tactical operations in a complex communications environment which is increasingly subject to electronic countermeasures. Protection of existing tactical communications is required. HAVE QUICK will begin production and deployment of an inexpensive

capability that will protect the most critical and vulnerable tactical communications. Deployment of HAVE QUICK will allow for the time needed to develop the threat independent technologies in the SEEK TALK program. SEEK TALK will begin full scale development and accomplish the necessary integration engineering to enable its deployment in combat aircraft and ground command and control systems. The Air Force will continue to participate in the Army's Single Channel Ground and Airborne Radio System (SINCGARS) program. Planning for the integration into Air Force aircraft and the deployment of Air Force unique equipment will continue. The Air Force will enhance efforts to prepare for the FY 82 SINCGARS system testing.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Total Estimated Cost
2482, HAVE QUICK					
3010		6,700	20,500		27,200
3080		1,573	393		1,966

Procures 1700 units to support the Tactical Air Force most critical needs.

Program Element: #27423F
DoD Mission Area: Tactical Command and Control, #254

Title: Advanced Communication Systems
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION:

This program is an initiative to provide jam resistant ultra high frequency (UHF) and very high frequency (VHF) communications. Tactical Air Forces use voice communications to coordinate and control the air-to-air and air-to-ground battle. The Air Force has an urgent requirement to protect those UHF communications from hostile jamming. The HAVE QUICK project is applying current demonstrated technology to modify a limited number of Air Force UHF voice radio. HAVE QUICK will start production in FY 1980. This modification will allow

This approach will protect the most critical aircraft communications during the time required to develop a more advanced technology to counter rapidly evolving jamming technology. SEEK TALK is developing this advanced capability for broad use in UHF communication systems. SEEK TALK will combine psuedo-random noise modulation and adaptive antenna techniques to provide this protection. SEEK TALK will start Full Scale Engineering Development in FY 1981 and will accomplish the preliminary modification enginering efforts necessary to deploy SEEK TALK in aircraft and ground command and control systems. The Army Single Channel Ground and Airborne Radio (SINCGARS) program will modernize all the tactical single channel voice VHF radios used by the Army. The Army is providing a module which will provide a secure jam resistant capability. The Air Force is participating with the Army to build an airborne version of this jam resistant radio. The integration of this radio into Air Force aircraft will insure interoperability with Army ground forces in a jamming environment. The SINCGARS Integration project will allow Air Force planning for SINCGARS integration and development of Air Force unique equipment.

RELATED ACTIVITIES: The Air Force is participating in the Army SINCGARS program PE 63746A as part of the Joint Chiefs of Staff validated Joint Operational requirement. The Air Force is responding to the requirement to protect UHF voice communications from jamming. Extensive activities are continuing with both the Army and the Navy so that interservice operations will be possible.

WORK PERFORMED BY: The HAVE QUICK and SEEK TALK programs are managed by the Air Force Systems Command (AFSC) Electronic Systems Division Hanscom AFB, MA. The advanced development phase of SEEK TALK has been contracted for and tested by the Rome Air Development Center, Griffis AFB, NY. The MITRE Corporation, Bedford, MA supports the Air Force as general systems engineer. Contractors include: Hazeltime Corporation, Greenlawn NY; General Electric

Program Element: #27423F
DoD Mission Area: Tactical Command and Control, #254

Title: Advanced Communication Systems
Budget Activity: Tactical Programs, #4

Company, Utica NY; E-Systems, St Petersburg, FL; Sanders Associates Inc, Nashua NH; TRACOR, Los Angeles, CA; Magnovox, Fort Wayne, IN and Collins Radio, Cedar Rapids, IO.

Program Accomplishments & Future Programs:

1. FY79 and Prior Accomplishments: HAVE QUICK completed several supporting activities and began full scale development and flight qualifications of modified ARC-164 UHF radios. Development tests and Initial Operational Tests and Evaluation (IOT&E) were started. SEEK TALK completed four competing design studies, and selected three contractors to build competing advanced development models.

2. FY 1980 Program: HAVE QUICK will complete modification testing and begin production leading to initial deployment in late FY80. SEEK TALK will complete fabrication of the competing advanced development models and will begin testing of this equipment. Studies to consolidate operational, compatibility and integration requirements for SINCGARS will be started.

3. FY81 Planned Program: HAVE QUICK production and deployment will continue. SEEK TALK will begin Full Scale Enginering Development. Electromagnetic compatibility analysis of SINCGARS integration into aircraft and the development of Air Force unique equipment will be started. The Air Force will prepare to support Army testing in FY82.

4. FY82 Planned Program: HAVE QUICK production and deployment will be completed. SEEK TALK will complete full scale development and start developmental and operatonal testing. Coordinated development activities with the SINCGARS program will continue. The Air Force will support the Army in testing the SINCGARS system to insure interoperability between the services and the North Atlantic Treaty Organization.

5. Program to Completion: Having completed Initial Operational Test and Evaluation (IOT&E), SEEK TALK expects its production decision in FY 1983. Aircraft modification efforts will be proceeding in parallel during the production period. SINCGARS integration efforts will continue with airborne radio production starting in the mid 1980's.

6. Milestones: Not Applicable

7. Resources: Not Applicable

Program Element: #27423F
DoD Mission Area: Tactical Command and Control, #254

Title: Advanced Communication Systems
Budget Activity: Tactical Programs, #4

8. Comparison with FY80 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Complete	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT			12,000	21,400	Cont	N/A
2277	SEEK TALK	3,900*	5,300*	8,300	21,200	17,700	58,200
2482	HAVE QUICK	970*	4,600**	3,500			11,970
2614	SINCCARS-V Integration			200	200	Cont	N/A

*Previously in Program Element 63727F, Advanced Communication Technology
**Previously in Program Element 64708F, Other Operational Equipment

During FY 1979 the SEEK TALK program was restructured to reflect actual expected Full Scale Engineering Development cost and to accelerate the production decision to FY 1983 and to preparation for expedited production and installation of SEEK TALK equipment. The program restructure increased the estimated FY 1981 program $14,800 thousand and added $30,700 thousand to the total program. During FY 1979 the Army identified their intention to select the SINCGARS production contractor during the FY 1982 Design Test and Evaluation (DT&E). The Air Force has added $3,000 thousand to the estimated FY 1981 program to prepare to support these FY 1982 DT&E efforts.

Project: #2277
Program Element: #27423F
DoD Mission Area: Tactical Command and Control, #254

Title: SEEK TALK
Title: Advanced Communication Systems
Budget Activity: Tactical Programs, #4

DETAILED BACKGROUND AND DESCRIPTION: As a result of United States (US) experience in Southeast Asia and
t is apparent that the Air Force is facing a rapidly increasing electronic counter-measures (ECM) threat. This threat
This project will provide jam resistance for ultra high frequency (UHF) voice communication. The Air Force SEEK TALK program will develop and implement an air-air and air-ground-air UHF voice communications capability that will permit the Tactical Air Forces (TAF) to fulfill their mission despite hostile enemy communications jamming. SEEK TALK is being developed in response to TAF Required Operational Capability (ROC) 321-75 and the CORONET CLEAR study. SEEK TALK will use pseudo-random noise conferencing modulation and adaptive antenna nulling to provide resistance to hostile jamming.

The pseudo-random noise conferencing modulation will be provided by the development of a spread spectrum modem that retain the desirable features of the present amptlitude modulated (AM) radio. The specific features desired include: voice input and output, reasonable intelligibility, a minimum of knobs and switches, unlimited simultaneous transmissions, conferencing capability, and simultenous reception of multiple signals. Several of these requirements are unique to the TAF voice air-ground-air communications systems and have not been addressed in previous jam resistant communications research and development programs. The modem will be capable of providing these requirements in an ECM environment.

The adaptive antenna array task will be pursued concurrent with the spread spectrum modem development. The adaptive null steering antenna processor development will exploit technology which uses the adaptive loops to either equalize the power of all jamming and communication signals received (power equalization) or improve the antenna pattern in the direction of desired signals and places nulls in the direction of interfering signals. The adaptive antenna processor will be designed to operate in a power equalization mode with the conventional AM radio signal (providing interoperability with conventional UHF communications) and with the spread spectrum modem to place a null in the direction of the interfering signals.

The SEEK TALK program structure contains four phases emphasizing competiton. These phases, Concept Design, Concept Validation, Full Scale Engineering Development and Production, will emphasize system life cycle cost and maintain competition by systematically reducing the number of contractors at the end of each phase. We will continue to address joint Service and NATO interoperability as a high priority issue.

Project: #2277
Program Element: #27423F
DoD Mission Area: Tactical Command and Control, #254

Title: SEEK TALK
Title: Advanced Communication Systems
Budget Activity: Tactical Programs, #4

RELATED ACTIVITIES: Requirements and technical approach are presently being explored with the Navy and Army for the purpose of insuring interoperability. Formal interoperability tasks are part of this program and techniques which are developed by the Air Force will be coordinated with similar techniques being developed by the other Services until such time as formal lead service responsibility or preferred technical approach is selected. Prior to FY 1980, this project was funded under PE 63727F, Advanced Communication Technology.

WORK PERFORMED BY: The SEEK TALK program is managed by the Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA with technical phases of the programs being contrated and tested by the Rome Air Development Center, Griffis AFB, NY. The MITRE Corporation, Bedford, MA supports the Air Force as systems engineer. Contractors include: Hazeltine Corporation, Greenlawn, NY; General Electric Company, Utica, NY; E-Systems, St Petersburg, FL; Sanders Associates Inc., Nashua, NH; ARINC Research Inc., Annapolis, MD; Calspan Inc., Buffalo, NY; Motorola Inc., Scottsdale, AZ; and TRACOR, Los Angelas, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAM:

1. FY 1979 and Prior Accomplishments: SEEK TALK design studies which involve the pilot communication system interface, electro-magnetic compatibility and communication security (COMSEC) were accomplished. Four competing Concept Design studies were completed leading to Concept Validation in FY 1979. Efforts in communication jamming vulnerabilities, aircraft integration and electromagnetic compatibility were initiated. SEEK TALK hardware development began in FY 1979. This hardware will validate and demonstrate system performance and obtain sufficient data to assess the program technical, cost and schedule risk through development and testing of Advanced Development Models (ADM). Vulnerability analysis, electro-magnetic compatibilty and aircraft integration efforts will continue.

2. FY 1980 Program: SEEK TALK ADM system fabrication will be completed. ADM systems will be flight and ground tested by the Air Force and SEEK TALK contractors. Tests will validate system performance and investigate the interplay between the modem, antennas and security devices to confirm integration feasibility. These tests will allow the Operating Commands inspection of SEEK TALK capabilities.

3. FY 1981 Planned Program: SEEK TALK Full Scale Engineering Developent (FSED) will be initiated to insure the engineering design is completed, that all major problems have been resolved, and contractual requirements have been demonstrated by actual performance testing.

Project: #2277
Program Element: #27423F
DoD Mission Area: Tactical Command and Control, #254

Title: SEEK TALK
Title: Advanced Communication Systems
Budget Activity: Tactical Programs, #4

4. FY 1982 Planned Program: SEEK TALK will complete Full Scale Engineering Development and extensive Design Test and Evaluation and Initial Operational Test and Evaluation.

5. Program to Completion: Upon successful completion of testing the SEEK TALK production decision is expected in early FY 1983. Production and aircraft installation will continue in parallel with initial implementation in FY 1984 and an Initial Operational Capability in FY 1985.

6. Milestones: Not Applicable

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Complete	Total Estimated Costs
2277	SEEK TALK	5,300	9,900	41,000	24,000	2,000	88,900

8. Comparision with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Complete	Total Estimated Costs
2277	SEEK TALK	3,900	5,300	8,300*	21,200	17,700	58,200

*Previously in Program Element 63727F, Advanced Communication Technology

During FY 1979 the SEEK TALK program was restructured and baselined to reflect actual expected Full Scale Engineering Development cost and the accelerated production decision to early FY 1983 and preparation for expedited production and installation of SEEK TALK equipment. The program restructuring increased the estimated FY 1981 program $14,800 thousand and added $30,700 thousand to the total program.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27431F (64701F) Title: Tactical Air Intelligence System (TAIS) Activities
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255 Budget Activity: Tactical Programs #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,564	9,090	8,400	9,200	Continuing	Not Applicable
2390	WS-430B Enhancement	450	200				3,000
2514	Imagery Interpretation (II)	257	400	200			9,757
2516	Display Control/Storage and Retrieval (DC/SR)	443		100			43,043
2517	Battlefield Exploitation and Target Acquisition (BETA)	6,150	4,490	1,900			17,340
2539	System Integration and Program Support	1,264	1,100	200	300		19,858
2576	Tactical Fusion Division (TFD)			3,600	7,500	17,200	28,500
2596	Compass Quasar		2,000				2,000
2604	USAFE Tactical Air Intelligence System (UTAIS) Architecture		900	2,400	1,400	9,500	14,200

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The tactical forces are faced with a critical deficiency in their capability to rapidly and accurately process, interpret, and disseminate information from various intelligence collection systems. The purpose of this program is to develop and acquire mobile, land based processing, interpretation and exploitation systems for use by tactically deployed general purpose forces. TAIS Activities is an intelligence system program element that includes eight functional development projects: Enhanced WS-430B (formerly Image Processing), Imagery Interpretation, Display Control/Storage and Retrieval, System Integration and Program Support, Compass Quasar, Battlefield Exploitation and Target Acquisition, Tactical Fusion Division, and United States Air Forces in Europe Tactical Air Intelligence System Architecture (Compass Quasar will be transferred in FY 81 to Program Element 28019, Tactical Cryptologic Program as a result of Budget Exercise 81 C1, change control numbers 81C1D957 and 50BT8890).

Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

BASIS FOR FY 1981 RDT&E REQUEST: This request is for the Tactical Information Processing and Interpretation (TIPI) program to complete development and test of the Enhanced WS-430B prototype, to complete software development for the Imagery Interpretation Segment, correct Program Management Responsibility Transfer deficiencies for the Display Control/ Storage and Retrieval Segment, and to perform integration tasks for the various TIPI segments. This request also includes the Air Force share for continuation of Battlefield Exploitation and Target Acquisition (BETA) development; the engineering development for Tactical Fusion Division; the Office of the Secretary of Defense (OSD) directed development of the Compass Quasar project; and development of the United States Air Forces in Europe Tactical Air Intelligence System (UTAIS) Architecture.

OTHER APPROPRIATION FUNDS:

Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Other Procurement (3080)	2,269	35,900	0	4,330	27,680	160,000
(Quantities)	Not Applicable					

Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: The tactical forces in the field have continually been faced with a critical deficiency in their capability to rapidly and accurately interpret information collected by reconnaissance aircraft and their timely handling and distribution of all intelligence products. Methods of collection have kept pace with technological advances, but the capability to rapidly exploit the information remains constrained by slow, inaccurate manual methods. To overcome these deficiencies, Program Element (PE) 64701F, Tactical Information Processing and Interpretation (TIPI) System development, was initiated as a joint Air Force, Army, Marine Corps program with the Air Force as Executive Agent. TIPI Research Development Test and Evaluation funds were transferred to PE 27431F as of 1 October 1978. The TIPI system will apply automatic data processing techniques to enhance exploitation and collation. This automation will assist in providing finished intelligence to a deployed commander in a useable time frame. The TIPI program objective is to develop air transportable facilities that provide for processing, reproducing and interpreting aerial reconnaissance and surveillance products; collating with intelligence from all other sources; reporting on enemy force activities; preparing and distributing target materials; and supporting mission planning. The equipment will be shelterized and will be modularized so that appropriate numbers and types can be used at any location depending upon the size and nature of the job. The system will be composed of functionally independent segments that will be interoperable and capable of interfacing with other systems. In recognition of the requirement for a multi-source correlation facility, the joint Battlefield Exploitation and Target Acquisition (BETA) demonstration was initiated. BETA is a test bed to provide near-real time targeting data and battlefield status information to tactical field commanders. The Tactical Fusion Division (TFD) project is the Air Force follow-on project for BETA to develop, produce, and field multi-source correlation facilities based upon BETA technologies. The Compass Quasar project is to develop and field equipment interfacing with the Tactical Air Control System and a classified source. Additional details on Compass Quasar are available to properly cleared personnel. United States Air Forces in Europe Tactical Air Intelligence System (UTAIS) Architecture will start a systematic improvement of the United States Air Forces in Europe Tactical Air Intelligence System.

RELATED ACTIVITIES: The TIPI program will provide mobile land based facilities only and is complementary to Navy programs which provide similar capabilities aboard ships. The program is managed by a jointly manned Program Office (PO). Certain related but peculiar Marine Corps and Army requirements are funded and managed by the Marine Corps and Army. Each Service will budget separately for production, but the procurements will be jointly managed by the PO. The Photo Interpreter Report and Edit Station, to be used in Air National Guard Enhanced WS-430B, was developed in PE 64750F, Intelligence Equipment, Project 2716. The Air Force Tactical Fusion Division, Project 2576, will be based upon the jointly developed technologies in the BETA program, Project 2517.

Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

WORK PERFORMED BY: Air Force management is provided by Electronic Systems Division, Hanscom AFB, MA, supported by Rome Air Development Center, Griffiss AFB, NY, and Aeronautical Systems Division, Wright-Patterson AFB, OH. Contractors are: Texas Instruments Incorporated, Dallas, TX - Imagery Interpretation (II); Fairchild-Hiller Corporation, Germantown, MD II subassemblies; Raytheon Corporation, Alexandria VA - II subassemblies; General Electric Corporation, Daytona Beach, FL - system integration service; Radio Corporation of America, Burlington, MA - Display Control/Storage and Retrieval (DC/SR) Segment; Mead Laboratories, Dayton, OH - Enhanced WS-430B; E Systems, Melpar Div, Falls Church, VA - Compass Quasar; and TRW, Redondo Beach, CA - Battlefield Exploitation and Target Acquisition. Contractors for Tactical Fusion Division and the United States Air Forces in Europe Tactical Air Intelligence System (UTAIS) Architecture have not been selected.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments:

Project 2390 - WS-430B Enhancement. The Imagery Processing (Enhanced WS-430B) segment contains the equipment to develop and reproduce reconnaissance film. This segment will not be a new development, but will be a modified and updated version of the existing WS-430B Photo Processing and Interpretation Facility. Engineering development of WS-430B shelters selected for prototyping was initiated in FY 1977. Tests were initiated on an automatic photographic chemical mix module and a packaged waste water treatment system. This type of commercial equipment is planned for use in the Enhanced WS-430B. Shelterization of one Advanced Tactical Processor (ATP) to provide a large roll film processing capability for Pacific Air Forces (PACAF) was completed in FY 1977 and delivered to PACAF in January 1978. In August 1978, the WS-430B Enhancement contract for prototype development was awarded to Mead Laboratories of Dayton, OH. The contract for shelterization of the second ATP for Tactical Air Forces was awarded to Houston Fearless 76, Carson, CA in September 1978. Development of the Enhanced WS-430B and the ATP continued throughout the year.

Project 2514 - Imagery Interpretation (II). The II segment is comprised of three shelters containing automated equipment and communications to enable the photo interpreter to rapidly and accurately extract and disseminate information from tactical reconnaissance imagery. The segment completed development and testing in December 1974. The production decision was made in January 1975. On 28 February 1975, an II prototype was deployed to Zweibrucken Air Base, Federal Republic of Germany, for formal demonstrations and training. In May 1977, the production contract was awarded to Texas Instruments. A software update was initiated to comply with new Defense Intelligence Agency Manual 57-5 report formats; to accept data in the Navy Intelligence Processing System Phase III Extract 3 format; to utilize switched AUTODIN and AUTODIN Protocol; to manually override code matrix block data; and to search data files based on map cursor inputs. The follow-on contract to complete production of the II segments was awarded to Texas Instruments in September 1978 to complete Air Force requirements

and satisfy initial Army requirements. In December 1978, a decision was made that the II also provide Tactical Electronic Reconnaissance (TEREC) processing and TEREC data link capability. The production efforts continued.

Project 2516 - Display Control/Storage and Retrieval (DC/SR). The DC/SR is a six shelter segment containing the automated equipment and analysts' consoles necessary to enable intelligence personnel in a Tactical Air Control Center (TACC) to correlate intelligence data from all sources and to perform intelligence analysis, threat assessment, collection management and target planning in a timely manner. Development and testing was completed in October 1975. During the testing, the computer response time was too slow to satisfy the Tactical Air Command requirement and a complete software and hardware analysis was performed. The software was simplified and hardware improvements were initiated to decrease the response time. The DC/SR was deployed to the Brave Shield XV Exercise in October 1976 and software/hardware improvements accomplished in FY 1976 were satisfactorily demonstrated. During October 1977, the DC/SR participated in the Bold Eagle Exercise at Hurlburt Field, FL. Eight DC/SR displays were successfully integrated into the TACC during the exercise. During FY 1978, the second DC/SR procurement package was released to RCA of Burlington, MA. Production of second DC/SR continued during FY 1979.

Project 2517 - Battlefield Exploitation and Target Acquisition. See following pages.

Project 2539 - System Integration & Program Support. For the Tactical Information Processing and Interpretation (TIPI) system to operate as an efficient integrated intelligence processing system, management attention was directed to inter-system interoperability; commonality of support equipment, data bases, development/production requirements; and interoperability with other tactical and strategic systems required by the using command and higher headquarters direction. To aid the TIPI Program Office in these efforts, the services of an industrial system integration and checkout contractor were obtained. For the past nine years, system integration and checkout tasks have been performed by General Electric Corporation, Daytona Beach, FL, to ensure an integrated approach, to conduct appropriate technical analysis, to support program reviews, and to provide test support.

Project 2576 - Tactical Fusion Division (TFD). A Tactical Fusion Division Study was initiated and completed in FY 1977. In FY 1978, planned engineering development was deferred to fully support the Battlefield Exploitation and Target Acquisition (BETA) project.

Project 2596 - Compass Quasar. System development was conducted in Program Element 31011G(F), Consolidated Cryptologic Program, Project 1001.

Project 2604 - United States Air Forces in Europe Tactical Air Intelligence System (UTAIS) Architecture. Not applicable.

Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

2. FY 1980 Program:

Project 2390 - WS-430B Enhancement. An engineering development contract, awarded in August 1978, will provide for the installation of commercial equipment in a prototype Enhanced WS-430B. The prototype contract will be completed; Development Test and Evaluation/Initial Operational Test and Evaluation will begin September, 1980. Shelterization of a second Advanced Tactical Processor (ATP) will be accomplished. This ATP will be used by the Strategic Air Command to evaluate ATP capability to process large roll film.

Project 2514 - Imagery Interpretation (II). Software and communications updates will continue. These updates to the computer memory circuits, common chassis design, power supply, and input-output devices will provide state-of-the-art computer circuits and maintenance functions for faster and easier fault identification. Production IIs will begin delivery to using commands in May, 1980. Tactical Electronic Reconnaissance (TEREC) processing will be incorporated into production IIs.

Project 2516 - Display Control/Storage and Retrieval (DC/SR). A second DC/SR will be assembled using six shelters and equipment which were residual assets from the DC/SR and United States Marine Corps Intelligence Analysis/Storage and Retrieval prototypes. This DC/SR will be delivered to Tactical Air Command in January, 1980. Program Management Responsibility Transfer will occur in September, 1980.

Project 2517 - Battlefield Exploitation and Target Acquisition. See following pages.

Project 2539 - System Integration & Program Support. A three year contract, awarded in October 1977, will continue the Tactical Information Processing and Interpretation system development and production integration tasks.

Project 2576 - Tactical Fusion Division. Deferred.

Project 2596 - Compass Quasar. This project is to be transitioned to this Program Element in FY 1980. Compass Quasar will develop and produce the hardware and software necessary to provide information to the Tactical Air Control System from a classified source. Additional information is available to properly cleared personnel.

Project 2604 - United States Air Forces in Europe Tactical Air Intelligence System (UTAIS) Architecture. The project will start a systematic layout of the UTAIS to determine the proper architecture and overall improvements necessary to the major segments and driving functions in the European command and control environment. This effort will concentrate on the Combat Operations Intelligence Center as the central segment and will prepare a Request for Proposal to start improvements on the other segments in the architecture.

Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

3. FY 1981 Planned Program:

Project 2514 - Imagery Interpretation (II). Delivery of production IIs to using commands will continue.

Project 2516 - Display Control/Storage and Retrieval (DC/SR). Program Management Responsibility Transfer discrepancies will be corrected by AFSC.

Project 2517 - Battlefield Exploitation and Target Acquisition (BETA). See following pages.

Project 2539 - System Integration and Program Support. Tactical Information Processing and Interpretation (TIPI) System interoperability testing and integration tasks will be completed.

Project 2576 - Tactical Fusion Division (TFD). As the BETA Project begins its phasedown, the TFD Project will be re-initiated with the development of a prototype operator terminal which meets the Tactical Air Command's ruggedized mobility requirements.

Project 2604 - United States Air Forces in Europe Tactical Air Intelligence System (UTAIS) Architecture. Combat Operations Intelligence Center enhancements and improvements to UTAIS architecture will continue to keep pace with the evolving command and control and threat environment.

Other Procurement- WS-430B Enhancement. The enhanced WS-430B prototype will be completed in September 1980 and will be delivered to Tactical Air Command (TAC) at Bergstrom AFB, TX, for Operational Test and Evaluation. The OT&E will require approximately 60 days. The transfer of program management responsibility from Air Force Systems Command (AFSC) to Air Force Logistics Command (AFLC) is planned for January 1981. AFLC will begin the production contract preparation and review cycle.

Compass Quasar. Will be transferred in FY 81 to Program Element 28019, Tactical Cryptologic Program as a result of Budget Exercise 81 C1, change control numbers 81C1D957 and 50 BT 8890.

4. FY 1982 Planned Program:

Project 2514 - Imagery Interpretation (II). Delivery of production IIs will be complete.

Project 2517 - Battlefield Exploitation and Target Acquisition. See following pages.

Project 2539 - System Integration and Program Support. No tasks planned.

Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

Project 2576 - Tactical Fusion Division (TFD). Technologies, specifications, and requirements determined during the BETA test bed demonstration will be used to prepare a Request for Proposal for the engineering development that follows BETA. This effort will provide the Air Force with its required unique hardware and software developed by BETA.

Project 2604 - United States Air Forces in Europe (USAFE) Tactical Air Intelligence System (UTAIS) Architecture. Engineering development will be continued to enhance the COIC and other segments in the architecture.

Other Procurement- WS-430B Enhancement. The enhanced production of WS-430B segments will be initiated.

5. Program to Completion:

Project 2514 - Imagery Interpretation (II). Project completed.

Project 2516 - Display Control/Storage and Retrieval (DC/SR). Project completed.

Project 2517 - Battlefield Exploitation and Target Acquisition. See following pages.

Project 2539 - System Integration and Program Support. Project completed.

Project 2576 - Tactical Fusion Division (TFD). Engineering development and testing of prototype will be complete in FY 1983. Production will be started in FY 1983 and be completed in FY 1987.

Project 2604 - United States Air Forces in Europe (USAFE) Tactical Air Intelligence System (UTAIS) Architecture. COIC enhancements and improvements to UTAIS architecture will continue to keep pace with the evolving and control and threat environment.

Other Procurement- WS-430B Enhancement. Installation of enhancement equipment in selected existing WS-430Bs will be completed in FY 1984.

Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Deconnaissance and Target Acquisition, #255

Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

6. Milestones:

		Date
A.	Display Control/Storage and Retrieval (DC/SR) Initial Operational Test and Evaluation	31 Oct 75
B.	Imagery Interpretation (II) Production Contract Award	29 May 77
C.	DC/SR Improvements Complete	30 Sep 78
D.	Enhanced WS-430B Prototyping Complete	*(Mar 80) Sep 80
E.	Tactical Fusion Division (TFD) Development (Displays) Contract Award	Oct 80
F.	Delivery of Second DC/SR	Jan 80
G.	Compass Quasar Interface Contract Award	*(Oct 79) Mar 80
H.	United States Air Forces in Europe Tactical Air Intelligence System (UTAIS) Architecture Contract Award	Jun 80
I.	Tactical Fusion Division (TFD) System Integration Contract Award	Oct 81

* Dates presented in FY 1980 Descriptive Summary.

EXPLANATION OF MILESTONE CHANGES: D: Six month slip due to late Government Furnished Equipment delivery (3 months) and Preliminary Design Review changes (3 months). G: Delayed to take advantage of operational tests in Europe during the first quarter of FY 80.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,450	8,600	9,600	7,600	19,900	122,900
2390	WS-430B Enhancement	800	900	200			3,400
2514	Imagery Interpretation (II)	400	200	300			9,500
2515	Manual Radar Reconnaissance Exploitation Segment (MARRES)						1,600
2516	Display Control/Storage and Retrieval (DC/SR)	1,450	500				43,000

Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
2517	Battlefield Exploitation and Target Acquisition (BETA)	4,800	5,700	5,000	1,900		17,400
2539	System Integration and Program Support	1,000	1,300	1,200	3,300	13,200	19,300
2576	Tactical Fusion Division (TFD)			2,000			17,000
2596	Compass Quasar						2,000
2604	Combat Operations Intelligence Center (COIC) Enhancement			900	2,400	6,700	9,700

The estimate of $8,400 thousand for FY 1981 is $800 thousand more than the $7,600 thousand estimated in the FY 1980 submittal. $200 thousand is provided for the II segment to correct Program Management Responsibility Transfer deficiencies. $100 thousand is provided for the Display Control/Storage and Retrieval segment to correct Program Management Responsibility $200 thousand is provided for program support to the Tactical Information Processing and Interpretation Program Office. $300 thousand is provided to TFD for prototype operator terminal.

Budget Activity: Tactical Programs #4
Program Element: #27431F Tactical Air Intelligence System Activities

TEST AND EVALUATION DATA:

1. Development Test and Evaluation: The Tactical Information Processing and Interpretation (TIPI) System contains functionally independent segments. Each segment is developed, tested, and produced according to the segment schedule. WS-430B Enhancement, Project 2390, the Imagery Processing Segment, is the only Development Test and Evaluation (DT&E) scheduled for FY 1980. The WS-430B Enhancement development contbact award was awarded to Mead Laboratories, Dayton, OH in August 1978. In FY 1976 the Imagery Processing (IP) segment development was cancelled to reduce system cost. In place of the IP segment, the existing WS-430B, Photo Processing and Interpretation Facility (PPIF) will be enhanced. The enhancement will not involve extensive developmental costs because state-of-the-art processing, printing quality control, and pollution abatement equipment will be integrated into the required PPIFs. The enhancement will extend the WS-430B's service life and provide modernized equipment to meet the Tactical Air Forces' (TAF) requirements for an IP. A prototype Enhanced WS-430B will be assembled and tested in a DT&E scheduled at Bergstrom AFB, TX in FY 1980. The test will last for approximately 60 days.

The Display Control/Storage and Retrieval (DC/SR) segment, Project 2516, contains automated equipment and analyst's stations to provide the Combat Intelligence Center with a capability to rapidly correlate, analyze, and assess intelligence inputs. The prime contractor was System Development Corporation of Santa Monica, CA, and the subcontractor was Radio Corporation of America, Burlington, MA. DT&E was accomplished from June 1975 through September 1975 at Langley AFB, VA.

The Imagery Interpretation (II) segment, Project 2514, contains automated equipment and communications which enable the photo interpreter to rapidly and accurately extract and disseminate information from tactical reconnaissance imagery. The prime contractor is Texas Instruments, Dallas, TX. An extended DT&E was conducted on 12 August 1974 through 31 December 1974 at Langley AFB, VA. The purpose of this test was to train user personnel, resolve problems identified during the Initial Operational Test and Evaluation evaluate the rigid auxiliary shelter, evaluate the II segment and Intelligence Data Handling System interface, and determine the capabilities of the II segment to perform additional photo interpretation. Test results were satisfactory on all items. Numerous software changes were necessary to more fully automate the exploitation of imagery without coded data blocks. Also, some software and hardware modifications were required to increase target location accuracy. The testing was completed prior to production decision and the II segment production contract was awarded in May 1977.

The Tactical Fusion Division (TFD), Project 2576, is the planned Air Force follow-on engineering development of the Battlefield Evaluation and Target Acquisition (BETA) Test Bed. Lessons learned from the BETA Demonstration in 1980 will be used in the development of a prototype system to satisfy the Tactical Air Forces' operational requirement for a mobile, air transportable correlation capability for security sensitive and time perishable data. No contractor has been selected. Request for Proposal initiation is planned for FY 1981. Procurement and initial installation of ruggedized/militarized equipment will begin in FY 1982. In FY 1983, installation and checkout of equipment will be completed. DT&E will be initiated in FY 1983 and will be completed in FY 1984.

Budget Activity: Tactical Programs #4
Program Element: #27431F Tactical Air Intelligence System Activities

The Compass Quasar, Project 2596, contains equipment and software to extract information from a classified FY 1980 effort. Development Test and Evaluation (DT&E) requirements are to evaluate the proper interface with the Tactical Air Control System and will be conducted in FY 1982.

The United States Air Forces in Europe (USAFE) Tactical Air Intelligence Systems (UTAIS) Architecture, Project 2604, is an effort to improve the overall United States Air Forces in Europe Tactical Air Intelligence Systems (UTAIS) architecture and will be accomplished in phases. Each phase will test the information processing and handling functions and determine system shortfalls that can be overcome with improved hardware and updated/revised software. There is no DT&E or IOT&E associated with this project.

2. Operational Test and Evaluation: The WS-430B Enhancement program is managed by the AF Systems Commands Aeronautical Systems Division (ASD). The prototype development contract was awarded to Mead Technology Laboratories, Dayton, Ohio, in August 1978.

Initial Operational Test and Evaluation (IOT&E) will take place 1 through 31 October 1980 at Bergstrom AFB under the management of USAF Tactical Air Warfare Center (TAWC). The month long test will be conducted using normal training film flown by the 67th Tactical Reconnaissance Wing to simulate wartime tasking.

The purpose of the IOT&E is to determine the operational effectiveness and suitability (including reliability/maintainability) of the Enhanced WS-430B prototype prior to modification/enhancement of the existing WS-430B facilities. Specific areas to be investigated include: pollution control improvements, a requirement for non-conventional film processing speed capability, improved design of selected shelters, a Photo Interpreter's (PI) Report and Edit Station for ANG systems, and best means for implementing the production (modification) phase (i.e., combination of user performed TCTOs; depot modifications; contractor modifications). The test team will be composed of representatives from Tactical Air Command (TAWC and 67TRW), Air Force Logistics Command, and the Air Training Command.

Upon completion of the IOT&E the results will be evaluated, a production (modification) decision will be made, and the production (modification) phase of the program will begin. There are no future OT&E plans.

The Display and Control/Storage and Retrieval (DC/SR) IOT&E was completed at Langley AFB, VA in September 1975. The purpose of the IOT&E was to evaluate the operational effectiveness, logistics supportability, and maintainability of the DC/SR. The test concluded that the DC/SR did not provide adequate automated support to tactical intelligence functions because of excessive computer response time, an overly large and inefficiently structured data base, and inadequate software utility. Deficiencies were corrected by software and hardware improvements. In logistics supportability and maintainability this test concluded that ample spares should be procured to provide adequate replacement parts during the the life of the DC/SR. The supportability and maintainability deficiencies are being resolved by Air Force Logistics Command. The DC/SR will not go to production; however, a second DC/SR is being assembled from residual Marine Corps and Air Force prototype equipment. Delivery is scheduled for late January 1980.

The DC/SR IOT&E revealed major deficiencies in the DC/SR, generally attributable to unacceptable response time of the automated data processing. The objectives of the IOT&E were not, in general, quantified but were qualifiable objectives to determine suitability of automated data processing in the area of intelligence data handling. The IOT&E results justified this automation with the provision that response time be improved. This was accomplished through improvement of the software and the doubling of the computer memory from 128K words to 256K words. As a result of this change, internal system responsiveness improved by a factor of 23:1. There are no future OT&E plans.

The Operational Test and Evaluation of the Imagery Interpretation (II) segment was conducted at Bergstrom AFB, TX, from 3 January 1973 through 3 May 1973. The DT&E/IOT&E was a joint Air Force/Marine Corps effort directed by the Air Force Systems Command's Electronic Systems Division (ESD), and USAF Tactical Air Warfare Center (TAWC). The purpose of this test was to determine the effectiveness of the II segment in a simulated operational environment. Guidance relative to operational conditions was obtained from Pacific Air Forces (PACAF), Tactical Air Command (TAC), and United States Air Forces in Europe (USAFE). USAFTAWC conducted the testing. A test schedule was drawn up to simulate the task loadings resulting from a tactical reconnaissance squadron flying at a rate of 1.2 sorties per assigned aircraft. Test personnel were drawn from operational units and received contractor operator training. The OT&E results showed that the II segment had more capability than was envisioned when the concept was originated. The test also indicated that a three-shelter II segment could support all missions flown by a tactical reconnaissance squadron in a 24-hour period. The test results show that some deletion and modifications to hardware, software, and operating procedures were necessary. Some of these included adding an additional supervisor's station in the Auxiliary (A) shelter, including the computer maintenance console with each segment and making some modifications to the system software. Upon completion of initial OT&E, recommended engineering changes were made and the II system underwent an Extended DT&E/OT&E, at Langley AFB, VA from 12 August 1974 to 31 December 1974. The DT&E was conducted by ESD while the IOT&E was conducted by USAFTAWC. The purpose of this test was to train user personnel, resolve problems identified during IOT&E and evaluate changes made since initial testing at Bergstrom. In addition, the II segment's ability to do third-phase interpretation was tested. The II segment hardware was relatively trouble free and experienced no failures that delayed meeting scheduled test objectives. The II segment was found to be fully capable of third-phase imagery exploitation. After successful completion of the extended DT&E/OT&E, the II segment prototype was deployed to USAFE and integrated into the operations of the 26th Tactical Reconnaissance Wing at Zweibrucken AB, Germany. Production contracts were subsequently awarded to Texas Instruments, Inc. There are no future OT&E plans.

Initial Operational Test and Evaluation (IOT&E) of the prototype Tactical Fusion Division (TFD) is scheduled to start in October 83 and finish in July 84. The purpose of the IOT&E will be to evaluate, in an operationally realistic environment, the operational effectiveness and operational suitability of the prototype TFD. The IOT&E will include evaluations of TFD system/equipments: performance, interoperability, compatibility, information processing/correlation capability, human factors and training requirements, maintainability/reliability, mobility, transportability, security, survivability/vulnerability, electronic countermeasures susceptibility, and electronic counter-countermeasures capabilities. Plans for the conduct of this IOT&E are presently being initiated by the Tactical Air Command, in conjunction with the Air Force Test and Evaluation Center, the Air Force System Command, Air Force Logistics Command and the Air Training Command.

Budget Activity: Tactical Programs #4
Program Element: #27431F Tactical Air Intelligence System Activities

3. System Characteristics:

a. The WS-430B Enhancement performance and objectives are:

Performance	Objective	Demonstrated
Image Processing	20-40 feet per minute	To be tested in FY 1980
Pollution Abatement	Reduce quantity; Reduce residual chemical levels	
Quality Control	Improve chemical management of development solutions	
Dry Printing	Provide quick and effective reproduction capability	
Photo Interpreter Report and Edit Station	Provide effective and rapid means to transmit intelligence reports	
Shelter Update	Provide efficient use of available space	

b. Tactical Fusion Division currently planned performance and objectives are:

Performance	Objective	Demonstrated
Number of Sensors Inputing	15	To be tested in FY 1983
Sensor Report Rates	250 reports per hour/sensor	
Full Situation Display Generation	10 seconds	
Cross Correlation Display	3 seconds	
Self Correlation of Reports	3 seconds	
Graphics Portrayal Transmission Between Centers	± 15 seconds	

c. The Display Control/Storage and Retrieval (DC/SR) Initial Operational Test and Evaluation (IOT&E) revealed major deficiencies in the DC/SR, generally attributable to unacceptable response time of the automated data processing. The objectives of the IOT&E were not, in general, quantified but were qualifiable objectives to determine suitability of automated data processing in the area of intelligence data handling. The IOT&E test results justified this automation with the provision that response time be improved. This was accomplished through improvement of the software and the doubling of the computer density memory from 128K to 256K words. No OT&E is planned for the future.

Performance	Demonstrated Capabaility
Simple query	1 minute
Simple update	1 minute
Input messages per 24 hours	1000
Output messages per 24 hours	646
Plots per 24 hours	20
Digital data base (character capacity)	62 million
Reliability (Mean Time Between Failure)	379 hours
Maintainability (Mean Time To Return)	22 minutes
Availability	.999

Project: #2517
Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Battlefield Exploitation and Target Acquisition
Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: In May 1976, Tactical Air Command submitted a requirement for a fusion (information correlation) capability that would receive and process all source inputs on time critical items for immediate action. To properly size, cost, and recommend alternate approaches for this capability, a Tactical Fusion Division Study was initiated and completed in FY 1977. In mid-FY 1977, an Army and Air Force effort, with Defense Advanced Research Projects Agency technical assistance was initiated to develop and demonstrate a computer assisted information correlation capability to support deployed tactical commanders. The project, entitled Battlefield Exploitation and Target Acquisition (BETA), will provide the Services with a test-bed to validate operational concepts involving the rapid integration and correlation of sensor derived, near-real time data and to determine requirements for future acquisition of similar battle management systems. The test-bed will consist of two correlation centers (one to be employed at the Allied Tactical Air Force, and one at the Army Corps), to include sensor systems interfaces, internal communications, and remote displays. The overall objectives of the project are to design, implement and test the correlation centers in field demonstrations in the United States and Europe in FY 1980. Demonstration results will be used to define requirements for follow-on engineering developments that will field operational capabilities for the Services.

RELATED ACTIVITIES: Efforts on the Tactical Fusion Division engineering development have been deferred until FY 1981 when the technology and methodology from BETA can be applied to develop prototype fusion equipment that will fulfill the Tactical Air Forces' requirement for a mobile, transportable, near-real time, all source information correlation capability.

WORK PERFORMED BY: The Executive Agent for this joint project is the Army with the Joint Project Office (JPO) located at Harry Diamond Laboratories, MD. The JPO is manned by Army, Air Force, Navy, Marine Corps and National Security Agency management personnel. The Air Force peculiar development and management will be accomplished by Electronic Systems Division, Hanscom AFB, MA. TRW, Redondo Beach, CA, is the prime contractor.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A Tactical Fusion Division Study was initiated and completed in FY 1977. A BETA Project Request for Proposal was released to industry in November 1977. Prime contract was awarded to TRW for the BETA test-bed design and fabrication. Modifications required on interfacing sensor subsystems were determined. Communications support plans were prepared and a Critical Design Review was conducted. Plans for the modification to sensor subsystems and communications support equipment were accomplished.

Project: #2517
Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Battlefield Exploitation and Target Acquisition
Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

2. FY 1980 Program: In early FY 1980, the Battlefield Exploitation and Target Acquisition (BETA) test bed will be delivered. It will be tested during an exercise in California in mid-FY 1980; the BETA test bed will then be deployed overseas for field test and demonstration in late FY 1980.

3. FY 1981 Planned Program: The BETA test bed will return to the United States for Service use in the engineering development of the follow-on pre-production Air Force correlation centers, the Tactical Fusion Division (TFD).

4. FY 1982 Planned Program: Congressional direction of February, 1979 states that the BETA program continue beyond its currently programmed termination date of FY 1981. The BETA test bed will assist in the early fielding of Service systems through integration and Service evaluation of the utility of sensor and communications technologies, and the evolution of software. A Post 80 Addendum to the BETA Project Plan of April 1979 is in its final stages of coordination within OSD. When signed, the addendum will show a shortfall of $10,850 thousand FY 1980-1984.

5. Program to Completion: Upon receipt of FY 1980-1984 funds, this will be a continuing program.

6. Milestones:

		Date
A.	Award Prime Contract	Feb 78
B.	Critical Design Review	Feb 79
C.	Tri-center Demonstration	Sep 79
D.	Simulation Test	Mar 80
E.	Camp Pendleton, CA Field Training Exercise	May 80
F.	Overseas Field Test	Jun-Aug 80
G.	Overseas Demonstration	Sep-Oct 80
H.	Return to United States	Feb 81

7. Resources: ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,564	9,090	8,400	9,200	Continuing	Not Applicable
2517	Battlefield Exploitation and Target Acquisition (BETA)	6,150	4,490	1,900			17,340

Project: #2517
Program Element: #27431F
DOD Mission Area: Tactical Surveillance, Reconnaissance and Target Acquisition, #255

Title: Battlefield Exploitation and Target Acquisition
Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: Tactical Programs #4

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,450	8,600	9,600	7,600	19,900	122,900
2517	Battlefield Exploitation and Target Acquisition (BETA)	4,800	5,700	5,000	1,900		17,400

The estimate of $17,340 thousand is $60 thousand less than the $17,400 thousand total estimated costs in the FY 1980 submittal. $450 thousand was provided in FY 79 to acquire a BETA Interface Module ($100 thousand) and to fund a Coherent Emitter Location Testbed unfunded requirement ($350 thousand). However, $510 thousand was taken in FY 80 to meet a House Appropriations Committee reduction in Tactical Fusion Center development.

Budget Activity: Tactical Programs #4
Program Element: #27431F Tactical Air Intelligence System Activities
Project: Battlefield Exploitation and Target Acquisition

TEST AND EVALUATION DATA:

1. Development Test and Evaluation: The Battlefield Exploitation and Target Acquisition (BETA) Project has been established to design and develop a test-bed primarily in support of Army and Air Force tactical command centers. The project will demonstrate and evaluate the feasibility and utility of correlating inputs from multiple tactical battlefield sensors and national sensors to produce ground situation displays and target nominations in near-real time for improved battle management. The BETA test-bed is a joint Army/Air Force project with the Army as lead service; during Congressional review of the project for FY 1978 Air Force dollar reprogramming, it was directed that the Navy, Marine Corps and the National Security Agency be brought on board the project. These agencies are now participating in all BETA test-bed efforts. The systems contractor is responsible for preparing a test plan and conducting engineering and installation tests/demonstrations; these test/demonstrations include Correlation Center Support Demonstration, Multi-Center Demonstration, System Integration Tests, a field training exercise, and the BETA European demonstration. The objective of the Correlation Center Support Demonstration is to verify that the contractor has an operating system, data base management system, and display interface software that is running on a computer configuration like that to be used in the BETA test-bed. This demonstration provides the Joint Program Office with a verification that the contractor has an integrated hardware/software capability to support BETA software development. This test was satisfactorily completed by TRW during Dec 78. The objective of the Multi-Center Demonstration is to demonstrate basic BETA software and interactive display capabilities on a fully integrated correlation center, and verify inter-center communications. This test took place successfully on 20 Dec 79. The Systems Integration Tests will verify that test bed performance meets specified capabilities when it is driven by simulated sensor data. The contractor will plan and conduct the tests with government monitoring. The government will conduct an independent evaluation of the test bed performance in a preliminary evaluation of man-machine interfaces, the utility of applications software to be used in the 1980 European evaluations, and training requirements. This test is scheduled for April/May 1980. Then, following the June 1980 Camp Pendleton, CA, field test, the BETA test-bed will be moved to Europe to fulfill requirements for testing in the North Atlantic Treaty Organization environment. This test/demonstration will take place in September 1980 during the REFORGER 80 time frame with Joint Project Office and Service representatives performing system evaluations. Following the 1980 Demonstration in Europe, BETA components will be moved to Eglin AFB, FL, and Ft Hood, TX for further software developments to support Service unique areas, additional sensor interfaces, and completion of items deleted from the 1980 program (for schedule and cost restraints).

2. Operational Test and Evaluation: Not applicable; BETA is a test-bed.

3. Systems Characteristics: The BETA test-bed is a tool that will be used to develop and validate operational concepts and procedures. Specific products will be the Air Force Tactical Fusion Division and the Army All Source Analysis System that are developed based on BETA's concepts and procedures. The BETA test-bed employs Joint Interoperable Tactical Command and Control System (JINTACCS) data messages and will provide early evaluation of these standards in an automated environment. BETA will provide the Department of Defense with a single, joint test-bed for correlation and

fusion of ground target sensor information. The BETA management structure assures that other programs will not duplicate BETA's efforts. The BETA Joint Program Office (JPO) has membership from all four Services and National Security Agency. The JPO receives direction from an all-Service General/Flag officer executive steering committee.

The BETA correlation centers will use common hardware and software. Through BETA, the Air Force and Army exchange data in JINTACCS formats based on inputs from all Services.

The BETA contract was signed in March 1978 with a very ambitious schedule. The system is presently in development and scheduled for the European demonstration in late 1980. There are no plans for production. The results, concepts, procedures and capabilities developed in the joint evaluation of BETA will support tactical fusion center development by the Services.

Based on Office of Secretary of Defense (OSD) direction in February 1979, a plan to use the BETA test-bed to expedite the early fielding of the Tactical Fusion Division is presently being refined for approval by OSD. The post-1980 effort will support the Service programs until projected Initial Operational Capability of the Service systems in 1984.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 28010F
DOD Mission Area: Tactical Communications #256

Title Joint Tactical Communications (TRI-TAC)
Budget Activity Tactical Program #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	29,065	28,400	16,768	23,749	Continuing	N/A
2260	Tactical Communications Control Facility	15,265	13,900	8,468	16,549		
2264	Digital Nonsecure Voice Terminal	200	3,400	2,000	400		
2266	Digital Troposcatter Terminal	8,800	3,800	500	500		
2267	Test	1,200	1,300	1,400	1,500		
2270	Support	3,600	6,000	4,400	4,800		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is the development of secure anti-jam digital communications equipment for use in a tactical environment. Equipment developments center around trunking and switching equipment, system control facilities, local distribution equipment, terminal devices, and interface equipment The effort seeks to achieve economy through joint participation and centralized acquisition of tactical equipment.

BASIS FOR FY 1981 RDT&E REQUEST: This program will continue the support of the Full Scale Development of the Communication System Control Element (CSCE) and testing of the Communications Nodal Control Element (CNCE). The CSCE and CNCE are elements of the Tactical Communications Control Facility Program. The Digital Troposcatter Terminal and the Digital Non-secure Voice Terminal will continue in Full Scale Development. The Air Force will continue support of the TRI-TAC Joint Test Facility at Ft. Huachuca, AZ.

OTHER APPROPRIATION FUNDS:

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
Other Procurement (3080) (includes spares)	—	5,230 2 ea AN/TYC-39 Message Switches	39,470 16 ea AN/TRC-170 Digital Troposcatter Terminals	120,000 49 ea AN/TRC-170 Digital Troposcatter Terminals	Continuing Replacement Program	N/A

Program Element: #28010F
DOD Mission Area: Tactical Communication #256

TITLE: Joint Tactical Communications (TRI-TAC)
Budget Activity: Tactical Program #4

DETAILED BACKGROUND AND DESCRIPTION: The joint Tactical Communications Program (TRI-TAC) is a Department of Defense directed joint service effort to develop and acquire communications equipment for the tactical forces. The program addresses tactical communications requirements in the areas of trunking and switching; systems control facilities; local distribution equipment; terminal devices; and interfaces. The efforts seeks to achieve economy through joint participation and centralized acquisition of tactical equipments. The program includes certain systems analyses, cost effectiveness studies, and Research and Development to integrate service requirements and TRI-TAC developed concepts and equipments. Improvements are required in communications switching and high speed transmission capabilities to achieve high speed, digital, secure comunications in the 1980's. The Air Force effort is known as the Combat Theater Communications Program (CTCP). The Air Force effort includes Full Scale Development of the Communications Nodal Control Element (CNCE) and the Communications System Control Element (CSCE). The CNCE and CSCE provide technical control and system management functions for the TRI-TAC switching and transmission equipment. The Digital Troposcatter Terminal (TROPO), which is in Full Scale Development, will provide long range wideband communications in a tactical environment. The Short Range Wideband Radio will provide an intra-base and down-the-hill wideband radio capability.

RELATED ACTIVITIES: Program Element 28010F is conducted by all the Services under the overall direction of the office of Assistant Secretary of Defense, Comand, Control, Communications and Intelligence, and the guidance of the TRI-TAC Office, Fort Monmouth, NJ. It is related to programs within the Defense Communications System which are more "strategic communications" oriented and to programs within National Security Agency for communications security resources. The objective is to ensure sufficient coordination to prevent duplication of effort and to permit standardization of interfaces where feasible.

WORK PERFORMED BY: The Air Force Systems Command manages the Air Force portion of this program through the Electronics Systems Division, Hanscom AFB, MA, and Rome Air Development Center, Griffiss AFB, NY. Current contractors include: Martin Marietta Corporation, Orlando, FL; Raytheon, Sudbury, MA; ECI, St. Petersburg FL; Analytical Systems Engineering Corporation, Burlington, MA; and MITRE Corporation, Bedford, MA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Development contract for the Tactical Communications Control Facility was awarded in May 1975, and the contract for the Digital Troposcatter Terminal was awarded in June 1976. Both are now undergoing in-plant Contractor Development Testing (CDT). A validation contract for the Digital Nonsecure Voice Terminal was completed in 1978. The Program Office has participated in the Joint Service formulation of the specifications for the Short Range Wideband Radio. The Air Force has provided support (Project 2267) for the TRI-TAC Joint Test Facility at Ft. Huachuca, AZ. Project 2270 provides engineering support for the Combat Theater Communications Program at Hanscom AFB, MA. One CNCE (one of three) and one digital troposcatter radio were delivered to the Joint Test Facility at Ft. Huachuca, AZ in 1979 to begin Service testing. The contractor delivered the remaining two Digital Troposcatter Terminals in May 1979.

Program Element: #28010F
DOD Mission Area: Tactical Communications #256

Title: Joint Communications (TRI-TAC)
Budget Activity: Tactical Program #4

2. FY 1980 Program: Service testing of the Digital Troposcatter Terminal (TROPO) will be completed by May 1980. The Digital Nonsecure Voice Terminal will begin Full Scale Development during this period. The two remaining Communicatio Nodal Control Elements will be delivered to the test bed for service testing.

3. FY 1981 Planned Program: The CNCE will complete service testing. Evaluation of the testing will be completed by both the developing command and the Air Force Test and Evaluation Center. Pre-production planning will continue and preparations will be completed for the Defense Systems Acquisitions Review Council (DSARC). The TROPO will proceed into low rate initial production. The Digital Nonsecure Voice Terminal will continue in FULl Scale Development. The CSCE Full Scale Engineering Development contract is planned to be warded during this period.

4. FY 1982 Planned Program: The Full Scale Development (FSD) of the Communications System Control Element will continue with emphasis on the development of applications software, and an initial low rate production effort will begin. The Troposcatter Teminal will continue in Low Rate Initial Production. The Digital Nonsecure Voice Terminal will complete FSD and begin testing at the TRI-TAC Test Facility.

5. Program to Completion: The Communications System Control Element will continue FSD into FY 1983. All items currently in this program will complete development in the early 1980's.

6. Milestones:

Communications Nodal Control Element - Full Scale Development and Communications System Control Element-Validation

Contract Award	May 1979
Preliminary Design Review - Hardware	Dec 1975
Preliminary Design Review - Software	Aug 1976
Critical Design Review - Hardware	Apr 1977
Critical Design Review - Software Part I	Aug 1977
Part II	Jan 1978
Contractor Development Testing	Sep 1977 - Dec 1978
Delivery Begins	Jun 1979
Service Testing Begins	Mar 1980
DSARC III	Oct 1981
Production Begins	Nov 1981

Program Element: #28010F
DOD Mission Area: Tactical Communication #256

Title: Joint Tactical Communications (TRI-TAC)
Budget Activity: Tactical Program #4

Digital Troposcatter Terminal

Contract Award	Jun 1976
Preliminary Design Review	Feb 1977
Critical Design Review	Aug 1977
Delivery	May 1979
Service Testing Begins	May 1979
Production Decision	Nov 1981
Production Begins	Jan 1982

Digital Nonsecure Voice Terminal

Validation Phase Contract Award	Jun 1976
Validation Effort Complete	Sep 1977
Developmental [illegible]tability Testing	Sep 1977-Sep 1978
Full Scale D[illegible]oment Contract Award	Feb 1980
Service Tes[illegible]	Apr 1981-Aug 1981
Production Se[illegible]	Nov 1981

7. Resources: [illegible] Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	35,600	29,000	28,400	13,300	Continuing	N/A
2260	Tactical Communications Control Facility	17,700	16,200	13,900	6,300		
2264	Digital Nonsecure Voice Terminal	400	600	2,000	700		
2266	Digital Troposcatter Terminal	10,600	10,900	5,000	900		
2267	Test	1,100	1,200	1,300	1,400		
2270	Support	3,300	4,700	5,200	3,000		

No significant change in total Program Element until FY 1981. Change this year due to $4.7 million of RDT&E funds added by OSD to initiate development of the Communications System Control Element.

Budget Activity #4 Tactical Programs

Program Element #28010F - Joint Tactical Communications (TRI-TAC)

Test and Evaluation

1. Development Test and Evaluation: The Joint Tactical Communications (TRI-TAC) program is a joint Service program with each Service responsible for the development of assigned equipment. The USAF has been assigned four items; the Tactical Communications Control Facility is a major item. This report presents the overview. Each Service and National Security Agency (NSA) is also responsible for the Development, Test and Evaluation (DT&E) of equipments tasked by the Department of Defense (DoD). Individual test plans including interface parameters are coordinated with the TRI-TAC Office. Initial DT&E will be conducted in-plant by the developing contractor. DT&E will include hardware integration testing, Communications Security (COMSEC) integration, reliability and maintainability, and acceptance testing of peripheral equipment. Joint DT&E/IOT&E of Air Force developed TRI-TAC equipments was initiated in June, 1979 by the Joint Test Organization at Fort Huachuca, Arizona. The contractor for the Tactical Communications Control Facility is Martin-Marietta, Orlando, FL. The Raytheon Co., Sudbury, MA is the prime contractor for the Digital Troposcatter Terminal. All other development are not on contract at this time.

2. Operational Test and Evaluation: TRI-TAC test and evaluation is being conducted as a multiservice combined development test and evaluation/initial operational test and evaluation (DT&E/IOT&E) program. The acquisition service/agency has overall responsibility for operational test and evaluation of each of the TRI-TAC equipments. Full-scale engineering development models of each TRI-TAC equipment will be operated and maintained by Army, Navy, Marine Corps, and Air Force personnel during IOT&E. These personnel are selected from the using commands and agencies on the basis of specialty codes expected to be used during operational equipment deployment. Testing will be conducted primarily at Ft Huachuca, Arizona, with some interface testing planned at Hurlburt Field, Florida, and Naval facility in San Diego, California.

a. The Air Force Test and Evaluation Center (AFTEC) has OT&E responsibility for the Short-Range Wideband Radio (SRWBR), Digital Nonsecure Voice Terminal (DNVT), Digital Troposcatter Radio Terminal (AN/TRC-170), and the Tactical Communications Control Facility (TCCF). The TCCF is comprises the Communications Nodal Control Element and the Communications System Control Element (CSCE).

(1) The SRWBR development has not been funded. Therefore SRWBR test planning has been deferred pending further direction.

(2) The DNVT full-scale development contract award is scheduled for the second quarter of FY-80. DT&E/IOT&E is scheduled for the period May-August, 1981. IOT&E test planning will begin in early 1980 in coordination with the US Army Operational Test and Evaluation Agency (USOTEA), US Naval Operational Test and Evaluation Agency (OPTEVFOR), US Marine Corps Operational Test and Evaluation Activity (MCOTEA), National Security Agency (NSA), Defense Communications Agency (DCA), and US Air Force using and supporting commands. Productiion contract is scheduled for November, 1981.

Budget Activity #4 Tactical Programs

Program Element #28010F - Joint Tactical Communications (TRI-TAC)

Test and Evaluation

c. The National Security Agency has test and evaluation responsibility for all communications security (COMSEC) items being procured in the TRI-TAC programs. Separate periods of IOT&E are not planned. The COMSEC equipment items are being tested in conjunction with intraoperability, interoperability, and communications security tests conducted during IOT&E of the parent equipment (e.g., AN/TYC-39, CNCE, ANDVT, etc.).

d. The US Marine Corps Operational Test and Evaluation Activity (MCOTEA) has OT&E responsibility for the Unit Level Switch (ULS) program. The ULS comprises three equipment items: an AN/TTC-42 Unit Level Circuit Switch (ULCS), an SB-3865 switchboard, and an AN/GYC-7 Unit Level Message Switch. There are no Air Force plans to procure the AN/GYC-7. The AN/TTC-42 and SB-3665 will be simultaneously tested at the Ft Huachuca test bed. AFTEC is participating in IOT&E test plan development with MCOTEA. IOT&E is currently scheduled for March 1983. A production decision is scheduled for June, 1983.

e. The TDF IOT&E is scheduled for December, 1980, through April, 1981. AFTEC is participating in test bed development with OPTEVFOR. The test objectives address operational performance, survivability, reliability, availability, maintainability, logistics supportability, mobility, transportability, training, human factors, safety, interoperability/intraoperability, and operational security. Because of a recent slip in the TDF schedule, the new production decision.

(2) The Advanced Narrowband Digital Voice Terminal (ANDVT) is in the validation phase of development. A decision to proceed with full-scale engineering development is scheduled for July, 1980. AFTEC will participate in operational test plan development with OPTEVFOR. IOT&E is scheduled for September, 1982 through March, 1983. A production decision is scheduled for May, 1983. TRI-TAC equipment began May, 1979. (Troposcatter Terminal only - DTE/IOT&E concurrent). TRI-TAC test and evaluation will be conducted as a joint service combined Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) program. The service with acquisition responsibility for the various TRI-TAC equipments also has overall responsibity for test and evaluation. A production decision will follow IOT&E for each of the programs. The Air Force has OT&E responsibility for the Short Range Wideband Radios (SRWBR), Digital Troposcatter Radio Terminals Digital Non-secure Voice Terminal (DNVT), and the Tactical Communications Control Facilities (TCCF). The TCCF includes the Communications Equipment Support Element (CESE), Communications Nodal Control Element (CNCE), Communications System Control Element (CSCE), and the Communications System Planning Element (CSPE). The Air Force Test and Evaluation Center (AFTEC) is currently in coordination with the US Army Operational Test and Evaluation Agency (USAOTEA) on their efforts to develop joint service IOT&E plans for the AN/TTC-39 circuit switch, and the digital group multiplexers. AFTEC is also developing, in coordination with the other services, Defense Communication Agency and National Security Agency, the IOT&E plans for the CNCE and the AN/TRC-170 troposcatter radio.

Budget Activity #4 Tactical Programs

Program Element #28010F - Joint Tactical Communications (TRI-TAC)

Test and Evaluation

(3) The AN/TRC-170 IOT&E objectives address radio performance, error rates, voice intelligibility, intraoperability, communications security, survivability, compatability, safety, human engineering, electronic warfare, reliability, availability, maintainability, logistics supportability, mobility, and transportability. One hundred and thirty five days of separate IOT&E will have been conducted between September, 1979, and July, 1980. In addition, to separate IOT&E periods, the AFTEC test team will actively participate in development tests conducted by Air Force Systems Command (AFSC). The production decision is scheduled in November, 1980.

(4) The CNCE IOT&E plan is currently being developed in coordination with USOTEA, CPTEVFOR, MCOTEA, NSA, DCA, and USAF using and supporting commands. DT&E/IOT&E is scheduled from June, 1980 through June 1981. Defense Systems Acquisition Review Council milestone III (DSARC III) is scheduled in August 1981.

(5) The CSCE program is currently being restructured and redefined. Milestone dates are not available.

b. The US Army Operational Test and Evaluation Agency (USOTEA) has OT&E responsibility for the AN/TYC-39 message switch, AN/TTC-39 circuit switch, digital group multiplexer (DGM), mobile subscriber equipment (MSE), mobile record traffic terminal (MRTT) and net radio interface (NRI). AFTEC is participating in testing and test planning for those TRI-TAC equipment items which are programmed to enter the Air Force Inventory. There is no USAF participation planned for the NRI or MSE IOT&E. A separate DGM IOT&E is not planned. DGM equipment will be tested as an integral part of other TRI-TAC equipments.

(1) Four AN/TYC-39 message switches were tested during the period 15 February, 1979, through 15 June, 1979. Raw data analysis is now being conducted to evaluate the operational effectiveness and suitability of the AN/TYC-39. Based on preliminary data analysis, the AN/TYC-39 has the potential to provide a significant improvement in message throughput, decreased operator workload, and message traffic accounting. However, major deficiencies apparantly exist, principally in the area of safety engineering. As these deficiencies are validated, they will be identified to the program manager for correction. The AN/TYC-39 message switch is a DSARC program with DSARC III scheduled for March, 1980.

(2) Four AN/TTC-39 circuit switches are being operationally tested between November, 1979, and May, 1980. AFTEC has participated in IOT&E test plan development with USAOTEA. Seven scenarios are planned to simulate operational deployment of the switches. Test objectives address the areas of operational performance, operational security, reliability, maintainability, safety, survivability, intraoperability, interoperability, human engineering, logistics supportability, mobility, and transportability. The AN/TTC-39 circuit switch is a DSARC program with DSARC III schedul for March, 1980. Although operational testing will not be completely done by DSARC III, an interim Air Force independent evaluation report will be furnished. A final evaluation will be provided at the completion of IOT&E.

Air Force managed Initial Operational Test and Evaluation (IOT&E) for the Joint Tactical Communications Program (TRI-TAC) will be conducted in the FY 79 - FY 83 timeframe by the Air Force Test and Evaluation Center (AFTEC) TRI-TAC test team located at Ft Huachuca, AZ. During the same timeframe, the AFTEC TRI-TAC test director will manage AFTEC test force participating in other service-managed TRI-TAC IOT&E. Testing will be conducted primarily at Ft. Huachuca, with some interface testing planned at Bergstrom AFB, Texas and naval facility in San Diego, California.

Project: #2260 Title: Tactical Communications Control Facility
Program Element: #28010F Title: Joint Tactical Communications (TRI-TAC
DOD Mission Area: Tactical Communications #256 Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: The Communications System Control Element (CSCE) and Communications Nodal Control Element (CNCE) are elements of the Tactical Communications Control Facility (TCCF). The CSCE is management-oriented and will provide real time monitoring and data base maintenance of communication network status and near real time control over the allocation and use of resources within a portion of a deployed tactical communications network. Resources at the node will be assigned, monitored, controlled and managed for users by the CNCE. The hardware and the software within the CSCE and CNCF provide support to the TTC-39 Family of Switches being developed by US Army.

RELATED ACTIVITIES: The TCCF is an element of an integrated tactical communication system and is related to all other elements of the TRI-TAC system.

WORK PERFORMED BY: The contract for the validation phase of the CSCE and the full scale development of the CNCE was awarded to Martin-Marietta of Orlando, FL.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A contract was awarded in May 1975 to Martin Marietta Corporation, Orlando, FL. for the Full Scale Development of the CNCE and the Validation Phase of the CSCE. Preliminary Design Review for the hardware on the CNCE was completed in December 1975. The Full Scale Development effort has continued with emphasis on the applications software development for the CNCE. Contractor Development Testing (CDT) of the Type III CNCE began in early FY 1978.

2. FY 1980 Program: Applications software will be completed in mid FY 1980.

3. FY 1981 Planned Program: The CNCE will complete joint testing. Evaluation of the test results will be completed by the development command (Air Force Systems Command), Air Force Test and evaluation Center and representatives of the other participating services (Army, Navy, Marine Corps).

4. FY 1982 Planned Program: Full Scale Development of the Communications System Nodal Element will begin.

5. Program to Completion: Full Scale Development of the CSCE should be completed in FY 1984.

6. Milestones: Replace previous milestone chart.

Project: #2260
Program Element: #28010F
DOD Mission Area: Tactical Communications #256

Title: Tactical Communications Control Facility
Title: Joint Tactical Communications (TRI-TAC)
Budget Activity: Tactical Programs #4

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Estimated Costs
2260	Tactical Communications Control Facility	15,265	13,900	8,468	16,549	Continuing	Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
2260	Tactical Communications Control Facility	17,700	16,200	13,900	6,300	Continuing	Not Applicable

Increases in FY 1981 and on are due to the Communications System Control Element Full Scale Engineering Development effort which was not previously planned. This program was directed by OSD in 1979* and cost-approved by OSD in early 1980.

*Funds added to Air Force RDT&E budget (29.7M over a period of 5 years).

Project: #2266
Program Element: #28010F
DOD Mission Area: Tactical Communications #256

Title: Digital Troposcatter Terminal
Title: Joint Tactical Communications (TRI-TAC)
Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: The digital troposcatter terminal will permit the intra-theater transmission of secure voice and data at beyond line-of-sight distances. The family of terminals are designed to be modular in nature so that various modules can be interconnected to form a family of terminals. These terminals will be capable of providing communications over a wide range of transmission distances.

RELATED ACTIVITIES: The digital tropo terminal is being developed under the TRI-TAC system architecture and will inter-operate with all other TRI-TAC equipments.

WORK PERFORMED BY: Raytheon Corporation, Sudbury, MA, and Rome Air Development Center, NY

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Air Force Systems Command (AFSC) has conducted extensive tests on commercial modems to determine their applicablity to the digital tropo terminal. These modems were tested both under laboratory and actual field conditions at the Rome Air Development Center. Specifications for the Digital Tropo Terminal were prepared by AFSC and approved by the TRI-TAC Office, Fort Monmouth, NJ. The contract for full scale development of the Troposcatter Terminals was awarded to Raytheon Corporation, Sudbury, MA., in June 1976. The Preliminary Design Review was conducted in Feb 1977 and Critical Design Review was held in August 1977. Full Scale Development of the Tactical Digital Troposcatter Terminal has continued during FY 1978. Contractor in-plant testing of the TROPO began in Feb 1978. The contractor delivered the development models of the TROPO to the TRI-TAC Joint Test Facility in May 1979. After Initial set-up and contractor checkout, the TROPO terminal began Joint Service testing in May 1979.

2. FY 1980 Program: Joint Service testing will continue through August 1980.

3. FY 1981 Planned Program: The TROPO Terminal will complete evaluation by the Services. Preparation will begin for a low rate initial production.

4. FY 1982 Planned Program: Low rate production effort for the tropo system will continue. Production deliveries are scheduled to begin in July 1982.

5. Program to Completion: Production buy will encompass enough units (approx 100) to equip 16 bases.

6. Milestones: Reference previous milestone chart

Project: #2266 Title: Digital Troposcatter Terminal
Program Element: #28010F Title: Joint Tactical Communications (TRI-TAC
DOD Mission Area: Tactical Communications #256 Budget Activity: Tactical Programs #4

7. Resources: ($ in thousand)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Estimated Costs
2266	Digital Troposcatter	8,800	3,800	500	500	Continuation	N/A

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
2266	Digital Troposcatter	10,600	10,900	5,000	--	Continuing	N/A

The funds for Project 2266 were decreased from $10.9 million to $8.8 million - FY 1979 and from $5 million to $3.8 million in FY 1980 reflecting outstanding program management in the last 1-1/2 years.

Project: #2270 Title: Support
Program Element: #28010F Title: Joint Tactical Communications (TRI-TAC
DOD Mission Area: Tactical Communications #256 Budget Activity: Tactical Programs #4

DETAILED BACKGROUND AND DESCRIPTION: This project provides engineering support for the Combat Theater Communications (TRI-TAC) Program Office. This engineering will support the four developments tasked to the Air Force and the systems integration engineering necessary for integrating TRI-TAC equipment into the present Tactical Command, Control & Communications (C^3) environment. In addition, the project provides travel funds for the program office, support for the TRI-TAC Test Liaision Office at Ft Huachuca, support for personnel assigned temporary duty at Ft Huachuca for Development Test & Evaluation of Air Force developed equipment and funds for the Air Force Test & Evaluation Center.

RELATED ACTIVITIES: Not Applicable

WORK PERFORMED BY: Support Contractors including MITRE Corp., Analytic Services and others not yet on contract.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: *
2. FY 1980 Program: *
3. FY 1981 Planned Program: *
4. FY 1982 Planned Program: *
5. Program to Completion: *
6. Milestones: *
7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Estimated Costs
2270	Support	3,600	6,000	4,400	4,300	Continuing	N/A

* This effort provides engineering support for the program already described in this Descriptive Summary. Additionally, it will support the test efforts delineated in the T&E section of this Descriptive Summary.

Project: #2270
Program Element: #28010F
DOD Mission Area: Tactical Communications #256

Title: Support
Title: Joint Tactical Communications (TRI-TAC)
Budget Activity: Tactical Programs #4

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Estimated Costs
2270	Support	3,300	4,700	5,200	3,000	Continuing	N/A

Changes from FY 1980 to FY 1981 are primarily due to reevaluation of Air Force Technical Evaluation Center support costs.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 41119F
DOD Mission Area: Airlift, #261

Title: C-5 Squadrons
Budget Activity: Tactical Programs, #4

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	36,500	12,700	11,098	15,200	24,537	186,671
410A	C-5A WING MODIFICATION PROGRAM	36,500	12,700	11,098	15,200	24,537	186,671

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The C-5A provides rapid worldwide airlift of personnel and supplies in support of DOD and national missions. It represents the only aircraft in the strategic mobility force capable of airlifting large "outsize" cargo. The Wing Modification will insure the future availability of the C-5 force by providing improved wing life compatible with the remaining life of the non-wing structure of the aircraft.

BASIS FOR FY 1981 RDT&E REQUEST: Cyclic testing of the fatigue test wing beyond the first lifetime of 30,000 cyclic test hours will continue. The limited flight test program will be completed and the aircraft will be prepared for Air Force acceptance to continue follow-on flight testing.

OTHER APPROPRIATION FUNDS:	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Costs
Procurement 3010	85,400	166,700	181,800	398,000	831,900
(Quantity)	4	12	18	42	76

Project: # 410A
Program Element: # 41119F
DOD Mission Area: Airlift, # 261

Title: C-5A Wing Modification
Title: C-5 Squadrons
Budget Activity: Tactical Program, #4

DETAILED BACKGROUND AND DESCRIPTION: The C-5A aircraft cannot achieve its design service life of 30,000 hours with its current wing. The safe life limit of the current wing has been assessed as 7100 Representative Mission Profile hours. Discovery of inherent design and materials deficiencies in the C-5A wing structural components date back to the first failure of the static test article in 1969, and a second failure in 1971. In addition, experience gained from testing of two fatigue test articles indicates that the wing service life is far short of its design goal. In 1972 an Independent review team of highly qualified engineering talent was formed to examine all aspects of the C-5 structure. After a year's study, it concluded that, except for the wing, the C-5 structure should be capable of attaining 30,000 hours. The team provided a range of options to increase the life of the aircraft and, from these options the Air Force selected the current modification program which has evolved to total replacement of the center, inner, and outer wing boxes which are the load carrying structural component of the wing. The approach in the design of the new structure is to reduce stress levels in the wing by the addition of necessary material. The material to be used in the new boxes is a different alloy possessing greater fracture toughness. By installing the longer life wing, the availability of the C-5A to the strategic mobility forces is assured beyond the year 2000 time frame.

RELATED ACTIVITIES: The C-5A force is being managed by the Military Airlift Command and by San Antonio Air Logistics Center to assure that wing life limits will not be reached prior to the scheduled modification program input dates. This effort involves individual aircraft flying time management, payload limitations and mission profile restrictions.

WORK PERFORMED BY: The design and development testing is being managed by the Aeronautical Systems Division of Air Force Systems Command. A contract for the design and testing was awarded to the Lockheed-Georgia Company, Marietta, GA in December 1975. AVCO of Nashville, TN, was a major subcontractor for the fabrication of the two test "kits".

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In December 1975 a contract was awarded to the Lockheed-Georgia Company for the design of the wing modification for the C-5A aircraft. Options for the fabrication and testing of two prototype wing modification kits were exercised in January 1977 with the release of long lead materials for the kits. The wing modification design was completed in June 1978. Fabrication of the two test kits was completed in October 1979. The fatigue article was fully assembled in July 1979 and the strain survey was successfully completed in August 1979. Cyclic testing of the fatigue article started in August 1979. Work began in February 1979 to install the second kit into the flight test aircraft.

2. FY 1980 Program: Installation of the flight test wing will be completed and flight testing will commence in August 1980. The fatigue test will continue throughout the year and the first lifetime of cyclic testing (30,000 hours) should be completed by August 1980. Fabrication of the first increment of production kits will begin once the first lifetime of fatigue testing is successfully completed.

Project: #410A
Program Element: 41119F
DOD Mission Area: Airlift, #261

Title: C-5A Wing Modification
Title: C-5 Squadrons
Budget Activity: Tactical Programs, #4

3. FY 1981 Planned Program: The limited development flight test will be completed in December 1980; the aircraft will be deinstrumented and returned to the Military Airlift Command for follow-on testing. The fatigue article will begin the second lifetime of cyclic testing. Fabrication of the first production kits will begin.

4. FY 1982 Planned Program: Cyclic testing to the second lifetime or to 60,000 cyclic test hours will be completed by June 1982. The fatigue test article will then be inspected and evaluated before durability and damage tolerance testing is initiated. Follow-on Operational Test and Evaluation (FOT&E) of the flight test aircraft will be completed in February 1982. Kit fabrication will continue and production line operation for the installation of the first increment of kits (5) will begin in February 1982.

5. Program to Completion: The remainder of the fatigue test program consists of residual strength testing, teardown inspection and test results report. Fabrication and installation of the 76 production kits will complete the Wing Modification program for all 77 of the inventory C-5 aircraft.

6. Milestones:

			Date
A.	Award Design Contract		Dec 75
B.	Exercise Fabrication and Test Options		Jan 77
C.	Critical Design Review		Nov 77
D.	Complete Wing Modification Design		Jun 78
E.	Strain Survey on Fatigue Article		Aug 79
F.	Production Program Approval (Milestone III and Release of Long Lead Funding)	*(Oct 79)	Dec 79
G.	First Flight and Start of Combined Flight Test Program		Aug 80
H.	One Lifetime of Fatigue Testing Complete; Fabrication Go-Ahead for First Kit Increment	*(Oct 80)	Aug 80
I.	Combined Flight Test Program Complete (less report and deinstrumentation)		Oct 80
J.	Input First Aircraft for Production Program Modification; FOT&E Complete		Feb 82
K.	Two Lifetimes of Fatigue Testing Complete	*(Jul 82)	Jun 82
L.	Output First Modified Production Aircraft		Mar 83
M.	Output Last Modified Production Aircraft		Jul 87

* Date presented in FY 1980 Descriptive Summary

EXPLANATION OF MILESTONE CHANGES:

The date for Milestone III review was delayed due to contract negotiations delays. Date for completion of first 30,000 hours of testing changed due to ahead of schedule condition. The date for fatigue article testing is clarified for accuracy.

7. Resources: Not Applicable

Project: 410A
Program Element: 41119F
DOD Mission Area: Airlift, #261

Title: C-5A Wing Modification
Title: C-5 Squadrons
Budget Activity: Tactical Programs, #4

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	30,800	36,500	12,700	9,400	35,500	179,736

Total RDT&E estimated costs were increased by $6.2 million as a result of inflation adjustments of $4.2 million, an additional $1.0 million for tooling effort and an additional $1.0 million for the flight test program. The increase in the FY 1981 estimate of $1.6 million is attributed to an economic adjustment for inflation of $.6 million and $1.0 million to complete the full 55 hour flight test program which was under funded in the previous summary.

Total procurement costs increased by $249.8 million which is primarily attributed to the transfer of kit subassembly funding from Operations and Maintenance (O&M) to the Procurement Appropriation. This transfer realigns the program costs starting in FY 1981 in consonnance with the full funding policy and amounted to $122 million; it was accompanied by a $125 million decrease in the O&M Appropriation. Of the remaining $127.8 million, $71.7 million was caused by inflation, $39.4 million resulted from the transfer of the fabrication effort for two components of the inner wing box from O&M to Procurement and $16.7 million was added for repricing as a result of the contract proposal submitted by Lockheed-Georgia Company. This repricing impacted the kit quantities resulting in the reduction of one kit in FY 1980 and three kits in FY 1981.

Budget Activity: Tactical Programs, #4

Program Element: 41119F, C-5 Squadrons

Test and Evaluation Data

1. Development Test and Evaluation: A contract was awarded in December 1975 to Lockheed-Georgia Company, Marietta, GA, for the design, fabrication, test and evaluation of a modification to the wings of the C-5A which will provide a 30,000 hour wing life after modification. The design phase included an extensive component test program to develop and verify design concepts, material selection, fastener selection and configuration. These efforts conducted by the contractor with support from the Air Force Materials Laboratory and the Air Force Flight Dynamics Laboratory included component strength tests, fatigue tests and damage tolerance evaluations. Members of the Air Force Scientific Advisory Board met on 12 December 1977 as the Division Advisory Group (DAG) to review the design and component test program results. The DAG concluded that the new design as substantiated by the component test program provided much lower stress levels, improved fastener systems, superior materials selection in the areas of fracture toughness and stress corrosion resistance, and a number of design improvements in known critical areas. The overall DAG assessment indicated a conservative design with low technical risk and that the full scale ground tests were well designed to assure the projected service life. The Airlift Systems Program Office, Aeronautical Systems Division of Air Force Systems Command, is the program manager. The development test and evaluation (DT&E) phase began in January 1977 with the release of long lead materials to fabricate two complete sets of test wings using production tooling. The DT&E of the Wing Mod design is divided into two portions, i.e., structural tests and flight tests.

Contractor conducted and Air Force monitored structural testing was initiated in August 1979 with the completion of a strain survey. This test verified the analysis model predicted stresses by actual stress measurement and provided additional corroboration that the working stresses in the new design are significantly below those of the unmodified wing. This portion of the DT&E will form the basis of a production decision, the release of funding for the first kit increment and the production contract award.

Cyclic tests designed to demonstrate the life improvement characteristics of the redesigned components began immediately upon completion of the strain survey. The spectrum applied to the full fatigue article (X-991) will be a flight-by-flight representation of the design usage. Concurrency addressed by a Dep SECDEF April 1976 Memo has been minimized by restricting production kit fabrication until the first of two lifetimes of fatigue testing has verified the fatigue characteristics of the modified wing. Successful achievement of one lifetime or 30,000 cyclic test hours (CTH) of testing, scheduled to be completed by August 1980, is a prerequisite to the actual fabrication of new hardware. This milestone will provide strong confidence in the utility of the modification to be produced and installed.

During the second lifetime, specific requirements for crack propagation testing will be developed. An extensive inspection will be performed at the completion of the fatigue testing at 60,000 CTH to determine the state of the article. After the 60,000 CTH inspection, the article may be used for further evaluation and crack propagation testing, the extent of which will be dependent upon the article's condition.

Because the wing modification design retained the general aerodynamic and subsystem configuration of the structurally deficient wing, an abbreviated flight test program will be performed as explained in the next paragraph. Although completion of the development test and evaluation (DT&E) portion of the flight test coincides with fabrication go-ahead for the first increment of production kits, C-5 force modification is predicated on successful fatigue testing.

2. Operational Test and Evaluation: Commencing in August 1980, C-5 Wing Modification Operational Test and Evaluation (OT&E) will be accomplished in three phases using one aircraft (680214): Combined DT&E/OT&E called the Combined Phase, Phase I Follow-on Operational Test and Evaluation (FOT&E), and Phase II FOT&E.

In the Combined Phase, a team of Air Force and Lockheed personnel will conduct a month long test of the first operational aircraft modified with the new wing structural components at Dobbins AFB, GA. The program will begin in August 1980 and will consist of ground and flight testing. Ground tests will be directed at verifying operation of disturbed systems and vibration tests. Eleven flight test missions will be devoted to functional check flights, flutter and active lift distribution control system reverification, flying qualities, air refueling qualities and limited flight envelope performance. Following these tests, the Air Force Flight Test Center (AFFTC) will initiate a series of performance and handling quality flight tests totaling about five missions. The DT&E portion of this phase will concentrate on the compatibility of the new structural components. The Air Force Test and Evaluation Center (AFTEC) will participate during the Combined Phase in conjunction with the contractor and AFFTC. The completion of this phase of testing coincides closely with the fabrication go-ahead scheduled for October 1980. Parameters from the Combine Phase, to include reliability, availability and maintainability data gathered by USAF personnel will be available to prepare an AFTEC interim report for use by the Department of Defense.

The following OT&E test objectives have been identified by AFTEC for use in all phases of testing:
(1) Determine performance characteristics of the modified aircraft to accomplish the planned missions.
(2) Determine the response of the aircraft to pilot control inputs during normal and emergency operations of all planned mission segments, to include aerial refueling, crosswind landings, and no flap landings.
(3) Determine if operational crews can safely control the aircraft during all segments of planned missions under normal and emergency conditions while observing operational limits and recommended procedures.
(4) Determine the effect of interrupted or modified subsystems on maintainability, reliability, availability, logistics supportability, and operations and support (O&S) cost elements.

Upon completion of the Combined Phase, the aircraft will be delivered to the Air Force at which time Phase I FOT&E, managed by AFTEC, will begin at Dover AFB DE, a Military Airlift Command (MAC) C-5A beddown location. AFTEC-designed test scenarios will be based on MAC strategic airlift and training missions while employing a high flying hour usage and the "lead the force" concept. Phase I FOT&E will last approximately four months and will focus on the operational environment. A final AFTEC report will cover all OT&E events completed during the Combined Phase and Phase I FOT&E. The report will provide estimates of operational effectiveness and suitability, and identify system deficiencies. This phase of testing will be completed early enough for identified deficiencies to be corrected in the first increment of production articles.

Management responsibility of Phase II Follow-on Operational Test and Evaluation (FOT&E) will belong to the Military Airlift Command (MAC). This phase is planned to start in May 1981 and continue until February 1982 when the first aircraft is delivered to the contractor for production modification. MAC will continue to obtain data to increase the confidence of the effectiveness and suitability evaluation conducted during the earlier two phases. The test aircraft will be subjected to maximum exposure of MAC's varied missions, worldwide route system and "lead the force" procedures. Throughout both Phase I and II FOT&E, Loads Environment Spectra Survey (LESS) data will be collected, reduced and analyzed to assist in refining the Force Management Plan and aircraft availability estimates.

Combined flight test crews representing the contractor, Air Force Flight Test Center, and Air Force Test and Evaluation Center (AFTEC) will accomplish inflight testing during the Combined Phase. Combined AFTEC and MAC flight crews will conduct Phase I FOT&E and MAC aircrew personnel will complete Phase II FOT&E. A small team of MAC line maintainance and support personnel under AFTEC management will conduct suitability evaluations in the Combined Phase and Phase I FOT&E. Line MAC maintenance and support personnel will conduct the Phase II supportabilty evaluation.

3. System Characteristics: The configuration of the modification includes new center, inner and outer wing boxes with internal structural changes. The exterior configuration remains essentially unchanged. The leading edge slats, ailerons, spoilers, trailing edge flaps, wing tips, and pylons from the old wing are to be reused. The design approach is to lower the stress levels in the wing by a redesign which will "upsize" (add material to) the structural members. The new boxes will be fabricated from the aluminum alloy 7175T73511 which offers improved fracture toughness and corrosion resistant characteristics over the original 7075T6511 alloy in the present wing. The following comparison details selected operational and technical characteristics of the C-5 aircraft: (1) operated in accordance with the C-5A flight manual limiting routine operation to 80% of the structural limitations; (2) operations based on 100% of the current wing structural limitations for the C-5A; and (3) operations based on 100% structural limitations for the C-5 aircraft after Wing Modification. Range and payload capabilities will be demonstrated during the flight test program and the fatigue article testing will verify these characteristics. Internal wing subsystems will be evaluated to insure that reliability, availablity and maintainability of these components are not reduced due to the modification using the latest data from the unmodified aircraft as the standard.

CHARACTERISTICS	FLIGHT MANUAL	UNRESTRICTED C-5A*	WING MOD C-5
Cruise Speed (MACH)	.77	.77	.77
Maximum Ramp Weight (Wt)	732,500	769,000	840,000†
Maximum Takeoff Gross Wt (2.5G)	712,500	728,000	769,000
Maximum Takeoff Gross Wt (2.25G)†	728,000	764,500	837,000
Operating Wt Empty (MAC Average)	354,000	354,000	372,500
Maximum Payload (2.5G)	144,000	159,900	197,500
Maximum Payload (2.25G)†	204,900	204,900	242,500
Maximum Zero Fuel Wt (2.5G)	498,000	513,900	570,000
Maximum Zero Fuel Wt (2.25G)†	558,900	558,900	615,000
Fuel Capacity	318,100	318,100	332,500
Wing Service Life (Hours)	7,100	7,100	30,000

* Exceeds 80% Structural Limitations (Non-Routine); † Wartime (restricted) Operation.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63735F
DoD Mission Area: Other Support Programs #325

Title: WWMCCS Architecture
Budget Activity: Intelligence and Communications, #5

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimate Costs
	TOTAL FOR PROGRAM ELEMENT	2,900	7,100	10,000	8,329	Continuing	N/A
2188	AFWWMCCS Systems Engineering Planning and Support	2,900	7,100	10,000	8,329	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force Worldwide Military Command and Control System (WWMCCS) Architecture program is our mechanism for insuring that more than 30 strategic Command, Control, and Comunications (C^3) programs fit together as a cohesive whole. These efforts amount to an overall system engineering activity. Tools employed include analysis, simulation and prototype development. A substantial part of the job is to develop modifications to existing Air Force C^3 systems that will enable them to continue to operate with the WWMCCS as it is improved. The objective is to develop a total WWMCCS configuration which is balanced in terms of capability, survivability, and cost for serving the National needs and the mission of the Air Force.

BASIS FOR FY 1981 RDT&E REQUEST: This request provides funds to continue system engineering and analysis efforts of Air Force strategic systems that contribute to the WWMCCS. Technical analyses and support will concentrate on C^3 integration and survivability for warning information dissemination; communications survivability and electromagnetic pulse (EMP) hardening for Air Force Strategic Systems; improved crisis management support for the theater Commanders-in-Chief; and support to the WWMCCS Architect's initiatives.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #63735F
DoD Mission Area: Other Support Programs #325

Title: WWMCCS Architecture
Budget Activity: Intelligence and Communications, #5

DETAILED BACKGROUND AND DESCRIPTION: The Worldwide Military Command and Control System (WWMCCS) provides the means for the operational direction and the administrative support involved in command and control of U.S. Military Forces. The primary mission is to support the National Command Authorities (NCA), and the secondary mission is to support the command and control systems of the Services and subordinate Commands. Essentially all Air Force strategic command and control and sensor warning systems are part of the WWMCCS. This program element serves two functions - intersystem engineering and architecture implementation. First, this program provides for an adequately integrated and standardized system of communications, command and control centers and sensors for the U.S. Strategic Forces. The second effort of this program concerns the large number of improvements, recommended in the WWMCCS Architecture concept and Selected Architecture programs directed by the Deputy Secretary of Defense in 1976. Systems engineering and other technical analyses are required to support these activities which will impact Air Force Systems. Such tasks as Jam-Resistant Secure Communications (JRSC) , Secure Voice and Graphics Conferencing, Joint Crisis Management Capability (JCMC) and WWMCCS Information System are a few that impact directly upon Air Force systems. Implementation of these tasks will require analyses of Command, Control, and Communications (C^3) integration support from Air Force resources to effectively meet National as well as Air Force requirements. The JCMC initiative combines the funding of Airborne Command Center and the Advanced Element of the Army's Rapid Reaction Deployable Command, Control and Communication programs. This activity includes C^3 integration, aircraft modification, and support to the Army as the cognizant component for accomplishing overall system integration activities. The deployable C^3 capability is designed to satisfy the needs of the theater Commanders-in-Chief for an improved crisis management capability. Some of the JRSC terminals will support the JCMC capability. Additionally, JRSC terminals are programmed and are being acquired for support of the Sensor Warning Systems upgrade as well as other WWMCCS and Air Force WWMCCS elements. AFWWMCCS efforts in support of these two tasks will be directed at the interoperability requirement and interface definition for terminal installation at AFWWMCCS Element locations.

Program Element: #63735F
DoD Mission Area: Other Support Programs #325

Title: WWMCCS Architecture
Budget Activity: Intelligence and Communications, #5

RELATED ACTIVITIES: Air Force Worldwide Military Command and Control System (AFWWMCCS) activities span the strategic C^3 community. System Engineering and analysis are initiated in support of on-going product oriented programs within the Air Force. These efforts are needed to integrate the various product oriented programs/systems into the WWMCCS Warning, Display and Command Systems. Analysis efforts will be conducted in support of Missile Tactical Warning (TW) and Attack Assessment (AA). Some specific program elements that relate to 63735F are Warning Information Correlation (WIC), Program Element (PE) 63429F; SEEK OPTIONSs, PE not applicable; and Command Center Processing and Display System (CCPDS), PE 12431F. AFWWMCCS provides for developing the overall architecture for all command and control functions, from sensor to user (end-to-end to include communications and survivability). WIC provides the Research, Development, Test, and Evaluation (RDT&E) for improved missile TW/AA, including specific TW/AA design for integration into the CCPDS. AFWWMCCS, in support of SEEK OPTIONS, provides for system planning, engineering and analysis, and architectural control documents such as Interoperability Requirement Documents (IRD). The IRDs will describe and recommend solutions for TW/AA system interfaces and system architecture. SEEK OPTIONS only includes those modification programs that directly affect the enhancement of National Command Authorities (NCA) and Commanders-in-Chief missile TW/AA information and its survivability. SEEK OPTIONS' purpose is to oversee/harmonize the overall development of an improved missile TW/AA Network. AFWWMCCS, in support of CCPDS, proposes and assesses alternative technical approaches in system upgrades and participates on the User Executive System Management Group (a forum for obtaining community agreement on analyses efforts and recommendations). CCPDS responsibility begins at the communications processor and continues through display generation and display devices. Analysis efforts also will be conducted in support of the WWMCCS Architecture improvements monitored by the WWMCCS System Engineer and the Selected Architecture tasks managed by the Army, Navy and the Defense Communications Agency. All of these tasks require systems engineering and interface definition for implementation of their programs at Air Force installations. Specifically, the developmental effort for Joint Crisis Management, a Selected Architecture Capability, is being accomplished under this PE; but the procurement for aircraft modification is supported by PE 41118F (C-141).

WORK PERFORMED BY: The AFWWMCCS Program Office, Electronics Systems Division, Hanscom Air Force Base, MA, conducts 90 percent of the work in-house with MITRE-Bedford technical support. A number of small systems engineering contracts, both competitive and sole source, have been used to fill gaps in expertise, time, or facilities. Through FY 1978, the following contracts at less than $175,000 per fiscal year were let: Computer Multi-processor Simulation/Test, Honeywell, Phoenix, AZ; Modem Interoperability Analysis, Magnavox, Torrance, CA; Warning and Nuclear Detonation Communications Systems Analysis, TRW, Los Angeles, CA; AFWWMCCS Performance in an Electronic Warfare Environmet, BDM, McLean, VA: Visually Coupled Displays as Executive Aids in Command Centers, Polhemus Navigation Science Corp., Essex Junction, VT; and Technical Support contract for support of improved Crisis Management Capability, Analytic System Engineering Corp., Burlington, MA.

Program Element: #63735F
DoD Mission Area: Other Support Programs #325

Title: WWMCCS Architecture
Budget Activity: Intelligence and Communications,

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Completed system engineering and analyses efforts for: Integration of Command, Control and Communications (C^3) systems into Intercontinental Ballistic Missile (ICBM) Launch Control Centers; Automated Data Processing (ADP) Communications Fault Isolation Procedures; HQ USAF C^3/Crisis Management within the Air Force Operations Center; COBRA DANE Interface Requirements Documentation (IRD) for program decisions and direction; PAVE PAWS IRD; Joint Surveillance System/E-3A Interface Study; Minimum Essential Emergency Communications Network Analysis (technical issues associated with survivable communications) and current operations concepts and plans; ADP Communications Error Analysis; Strategic/Tactical C^3 Intersystems Engineering, Comparisons of Airborne C^3 Systems and Requirements such as Joint Airborne Communications Center/Command Post; Airborne Command and Control Center (ABCC); Crisis Communications Relay FORWARD TALK Rediness Command replacement); and Military Satellite Communications User Subset Architecture. Preliminary definition for the ABCC was completed in this program element. Efforts to establish an outline for C^3 interface with the M-X Missile and Ground Launched Cruise Missile (GLCM) programs began in FY 78. However, future support provided to these programs will be funded by each specific Program Office. Also, the initial communications overlay input to the overall architecture for Sensor Warning system upgrade was completed in FY 1978. Assisted Ballistic Missile office on MX launch back-up communication from the WWMCCS. Accomplished preliminary design evaluation and checked-out the draft plan for Comman Center Processing and Display (CCPDS) end-to-end test. Participated in the Chairman/Joint Chiefs of Staff (C/JCS) study of strategic C^3 connectivity. Performed preliminary costing and scheduling analysis for Joint Crisis Management Capability (JCMC) aircraft modification Supported Army with development of JCMC system design. Participated in the development of a work plan for Jam-Resistant Secure Communication (JRSC) interface.

2. FY 1980 Planned Program: Intersystem efforts in FY 1980 will continue the development of an overall architecture for the Tactical Warning/Attack Assessment (TW/AA) area. Specific focus will be on identifying deficiencies involving transfer of warning data in the compressed mode and sensor to user communications impact. Additional activities in support of the TW/AA area are to continue overall system engineering support and the development of an Intersystem Requirement Document. CCPDS support and coordination with Space Defense architecture will continue. Support of Military Air Command, Strategic Air Command, and Aerospace Defense Command's Strategic C^3 improvement needs will be accomplished. Emphasis will be achieving timely pre-attack alerting and data handling; providing survivable and enduring C^3 capabilities for trans- and post-attack periods; facilitating reconstitution of C^3 assets during post-attack periods; and accomplishing support of improved crisis management capabilities for the theater Commander-in-Chief.

Program Element: #63735F Title: WWMCCS Architecture
DoD Mission Area: Other Support Programs #325 Budget Activity: Intelligence and Communications, #5

Implementation activity for Selected Architecture initiatives will focus on the Joint Crisis Management Capability (JCMC) and Jam-Resistant Secure Communications (JRSC). Efforts for JCMC will be airborne Command, Control, and Communications (C^3) integration support, aircraft modification, and support of the Army as the cognizant component. Efforts for JRSC will be directed at the interoperability requirement and interface solution for terminal installatio at Air Force World Wide Military Command Control System (AFWWMCCS) element locations. JRSC will also support JCMC and the survivable transfer of tactical warning and attack assessment information to the National Military Command Center and other command centers of the Unified and Specified Commands. Additionally support will be provided to the WWMCCS Architect's initiatives (i.e., WWMCCS survivability Research and Development (R&D) Plan).

3. FY 1981 Planned Program: Efforts will center on: continuing analysis and system engineering for hardening AF C^3 systems against physical and electromagnetic threats; continuing the JCMC (accomplish aircraft modification (R&D work)); working on other WWMCCS Selected Architecture efforts (i.e., Secure Voice and Graphics Conferencing (SVGC)); preparing architectural documentation for a decision and direction on satellite system interface with the warning and assessment function of the WWMCCS; and providing program documentation and evaluation of WWMCCS Information System effort as it relates to modification of Air Force WWMCCS computer facilities.

4. FY 1982 Planned Program: FY82 activities will include continuation of intersystem tasks (tactical warning, crisi management, and strategic forces C^3) and the Selected Architecture tasks (JCMC, JRSC, SVGC and others) that were delayed until FY80 and 81, due to the low FY79 funding level.

5. Program to Completion: The Air Force WWMCCS Architecture is a continuing program. Most of the efforts will be in response to WWMCCS Architecture initiatives directed by the Office of the Secretary of Defense through the WWMCCS System Engineer. Programming for this period will not be by Level-of-Effort but by project.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

RESOURCES (Project Listing): ($ in thousands)

Project Number	Title	FY1978 Actual	FY1979 Estimate	FY1980 Estimate	FY1981 Estimate	Additional To Completion	Total Estimated Costs
2188	AFWWMCCS Systems Engineering Planning and Support	5,400	2,900	9,000	8,800	Continuing	N/A

Program Element: #63735F
Title: WWMCCS Architecture
DoD Mission Area: Other Support Programs #325
Budget Activity: Intelligence and Communications, #5

Budget decrease in FY80 is due to: (a) congressional action reduced program by one million dollars and (b) AF reduced program by $900 thousand dollars as a contribution to offset higher priority program costs. Budget increases in FY81 thru FY 82 are a direct result of addressing an Office of the Secretary of Defense directed effort, Joint Crisis Management Capability (JCMC). JCMC supports an improved Crisis Management Capability for the theater Commanders-in-Chief. The increased funding in FY81 of $3.8 million dollars will provide for initiating the required RDT&E efforts associated with accomplishing the aircraft modification.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64778F
DOD Mission Area: Navigation and Position Fixing, #321

Title: Navstar Global Positioning System (GPS)
Budget Activity: Intelligence and Communications, #5

RESOURCES (PROJECT LISTING): ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
RESTRUCTURED PROGRAM ELEMENT TOTAL(see note)	75,600	142,200	126,800	123,200	215,000	933,200

BRIEF DESCRIPTION OF PROGRAM ELEMENT AND MISSION NEED: This program element (PE) funds Air Force participation in the joint program for Phase II, full-scale engineering development (FSED), of the Navstar Global Positioning System (GPS). PE 64778F Navstar GPS reflects those funds previously reported (FY 1979 and prior) in PE 63421F Navstar GPS, PE 64478F Navstar GPS Space & Control Segments and PE 64778F Navstar GPS User Equipment. Military forces need to know precise location (1) to enhance command and control and to coordinate battle tactics and support; (2) to engage in strategic and tactical warfare; (3) to maneuver efficiently in the battle area; (4) to provide accurate and timely fire support; and (5) to facilitate combat support. A global, common grid positioning and navigation system is required to increase both the accuracy and the availability of current weapon systems, especially at night and in adverse weather, thus increasing their effectiveness.

BASIS FOR FY 1981 RDT&E REQUEST: Continues the FSED of all three system segments (space, control and user equipment), the fabrication of three additional first generation satellites to replenish the five-satellite development constellation and the operation of the system to support development testing of US, UK and Canadian user equipment, and the Navy's Fleet Ballistic Missile Improved Accuracy Program (IAP). Replenishment satellites Navstars 9-11 will be in various stages of build-up and test during FY 1981. Navstars 9 and 10 will be available for launch in FY 1982 and Navstar 11 in FY 1983 to maintain the 4-to 5-satellite constellation into FY 1985 to support testing and special limited operations. Design changes to the first generation Navstar satellite design will be completed. These changes are required to modify the satellite for launch on the Space Shuttle using a tailored upper stage (Payload

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NOTE: Since submittal of the FY 1981 President's Budget, the Air Force has restructured the Navstar GPS Program to more effectively operate within the annual GPS total obligational authority for FY 1981-1985. This restructuring has delayed development efforts, making some funds excess to GPS in FY 1980, and has increased RDT&E funding requirements in the FY 1982-1985 period. These requirements in RDT&E will be offset by decreases in other appropriations in Navstar GPS PE 35164F and PE 35165F. The President's FY 1981 Budget for Navstar GPS, previously provided in the R-1 Report, is shown below: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT (President's FY 1981 Budget)	75,600	159,100	126,800	121,900	59,100	792,800

Program Element: #64778F Title: Navstar Global Positioning System (GPS)
DOD Mission Area: Navigation and Position Fixing, #321 Budget Activity: Intelligence and Communications, #5

Assist Module-Delta Class or PAM-D), to provide additional nuclear hardness, to incorporate the Integrated Operational Nuclear Detonation Detection System (IONDS) payload and to extend the expected lifetime. A satellite production decision will be made at the end of FY 1981. The advanced development (Phase I) control station at Vandenberg AFB, CA, will be minimally upgraded to initially control the 18-satellite Navstar constellation until a prime facility is available. During this upgrade, the Phase I control segment will continue to keep the development satellite constellation operational. Software/hardware design for the prime facility will continue. The dual-contractor competitive user equipment development effort will continue with equipment being fabricated to enter development testing in FY 1982 and initial operational test and evaluation (IOT&E) in FY 1983.

OTHER APPROPRIATION FUNDS: Program Element (PE) 35165F contains $744,000 for Operations and Maintenance in FY 1981.

Program Element: #64778F Title: Navstar Global Positioning System (GPS)
DOD Mission Area: Navigation and Position Fixing, #321 Budget Activity: Intelligence and Communications, #5

DETAILED BACKGROUND AND DESCRIPTION: Fundamental to the successful accomplishment of military functions is the ability to precisely position friendly forces relative to each other and with respect to enemy forces. Over the years, the Services have developed numerous positioning and navigation aids to satisfy specific requirements and to increase the effectiveness of weapon systems. Technologies available at the time these systems were developed tended to limit the design and application of these "pos/nav" aids to specific purposes with only a minimum of integration possible. Further improvement in the military utility of these systems has been constrained by accuracy limits, extent of geographic coverage, dependence on foreign basing rights and other reasons.

Through extensive studies, analyses and tests, the Services confirmed that a single, highly precise, satellite-based positioning system could best satisfy the broad spectrum of the Department of Defense requirements documented in the Joint Chiefs of Staff Master Navigation Plan. Thus, in December, 1973, the need for the system was confirmed through the Defense Systems Acquisition Review Council (DSARC) Milestone I Review. Subsequently, the Defense Navigation Satellite System (DNSS), later named the Navstar Global Positioning System (GPS), entered the Concept Validation Phase (Phase I of the GPS Program). The purpose of Phase I was two-fold: (1) to validate that the technology was sufficiently mature to reasonably develop a system which could provide the required capability and (2) to demonstrate the military utility of this system.

Four advanced development model Navstar satellites were launched in an eleven-month period in 1978 to provide the first satellite constellation. Forty-four advanced development model user sets were built and used in eleven different host vehicles in over 700 separate tests to satisfy Phase I objectives. A thorough system cost estimate was prepared to identify the total acquisition and 15-year operational costs for GPS. Force effectiveness studies were performed by all Services for a number of missions--all indicating positive benefits through extensive military use of GPS. The only technical question remaining at the end of Phase I was the expected lifetime of the satellite-borne atomic frequency standards: a thorough development program was initiated to improve the atomic standard lifetime. Therefore, no major technical or operational issues unduly concerned the DSARC during the Milestone II Review in June, 1979.

Concern about system acquisition cost was the only qualifying comment in the Secretary of Defense's approval to proceed into Phase II, full-scale engineering development (FSED), on August 24, 1979.

This concern over cost was subsequently manifested in a substantial reduction in approved program funding in the FY 1981 President's Budget relative to the funding required to implement the program as directed in August, 1979. Consequently, the Air Force restructured the GPS Program to match the funding available. This restructuring could not be completed prior to submission of the FY 1981 President's Budget; therefore, some changes to the specific funds by appropriation are necessary. However, the total GPS requirement by fiscal year, considering all GPS program elements and appropriations, does not require funds exceeding the FY 1981 President's Budget. The major impacts of the reduced program are to delay deployment of the 18-satellite constellation from 1986 to late 1987 and to build to a

constellation of 18 satellites instead of 24; however, the restructured program does provide a system which can readily accommodate future expansion to the full 24-satellite constellation. This change to 18 satellites slightly decreases system accuracy, but more importantly, reduces the resiliency and survivability of the system: individual satellite failures affect the accuracy and availability of navigation signals more severely with the 18-satellite constellation than with the 24-satellite constellation.

In addition, the restructured program defers incorporation of some capabilities until after the 18-satellite constellation is initially deployed. These deferred capabilities will not seriously impact the initial use of GPS but would adversely impact certain missions (operations in dense foliage, certain jamming scenarios and several naval missions) in the long term if totally omitted. As a result, the first generation satellite developed during Phase I will be minimally modified to increase the resistance of the satellite to nuclear effects, to add the capability to deny precision signals to adversaries and to launch the satellite from the Space Shuttle. The Air Force also approved the use of a tailored upper stage, such as the commercially developed Payload Assist Module-Delta Class (PAM-D) upper stage, instead of the Inertial Upper Stage (IUS) for Shuttle-launched Navstar satellites. This decision was based on a projected DOD net cost avoidance of over $300M through the year 2000, achieved mainly through a reduced number of Shuttle launches resulting from opportunities to share launches with other programs. The initial control segment to keep the system accuracy within specification is restricted to a minor modification of the existing control capability achieved by a combination of the GPS Master Control Station at Vandenberg AFB, CA, and the Satellite Control Facility. This current capability would be expanded to operate the 18-satellite constellation (it is currently sized to operate 9-10 satellites) but would require extensive contractor support because of its complexity. Development effort would proceed toward establishment of a prime facility with greater reliability and some reduced complexity to reduce the manpower/skill levels required. However, construction of this prime facility is deferred. Development of the user equipment is not changed by the restructuring. The program as restructured will provide an unlimited number of users with a combination of accuracy, jamming resistance, survivability, coverage and force interoperability (through the common grid) far exceeding that of any other navigation system. With the 18 satellites, suitably equipped US/Allied military users will be able to determine three-dimensional position (latitude/longitude/altitude) to an accuracy of 16 meters or better spherical error probable (50 percentile) and 55 meters or better on a 95 percentile basis.

RELATED ACTIVITIES: The GPS program manager coordinates the supporting activities of the Army, Navy, Marine Corps, Defense Mapping Agency, Department of Transportation and North Atlantic Treaty Organization (NATO) through his Service deputies in the Joint Program Office (JPO). Department of Commerce, Maritime Administration, is investigating very low cost user equipment through the JPO. The use of GPS for providing guidance corrections for tactical missiles is being separately explored under PE 63601F, Conventional Weapons Technology. Investigation of advanced anti-jamming technology for GPS is being conducted under PE 63203F, Advanced Avionics for Aircraft. Program Element 64773F also supports the Navy's Fleet Ballistic Missile Improved Accuracy Program (FBM/IAP) PE 11221N FBM Systems, and the Minuteman guidance testing under PE 11213F, Minuteman Squadrons.

Full-scale engineering development of user equipment is funded by all services under PE 64778A/N/F Navstar GPS for the Army, Navy, and Air Force, respectively. Acquisition is reflected in PE 35164A/N/F, all titled Navstar GPS User Equipment and PE 35165F Navstar GPS Space & Control Segments.

Program Element: #64778F
DOD Mission Area: Navigation and Position Fixing, #321

Title: Navstar Global Positioning System (GPS)
Budget Activity: Intelligence and Communications, #5

An Integrated Operational Nuclear Detonation Detection System (IONDS) payload will be flown with the refurbished qualification model (Navstar 7) of the first generation satellites, on all replenishment development satellites (Navstars 9-11) and on all subsequent Navstar operational satellites. IONDS funds are shown in PE 63435F - IONDS. Integrated acceptance testing is planned to insure compatibility of the IONDS and navigation payloads on Navstar 7. A more powerful second stage is being acquired to provide the additional launch throw-weight capability required by the addition of the IONDS payload. Expendable launch services (Atlas E/F) are funded under PE 35119F, Space Boosters. Space Shuttle launches are funded under PE 35171F, Space Launch Support.

WORK PERFORMED BY: The JPO is located at the Air Force Systems Command's Space Division, El Segundo, CA. The satellite contractor is Rockwell International/Satellite Systems Division, Seal Beach, CA; International Telephone and Telegraph, Nutley, NJ, is the subcontractor for the navigation subsystem. Contract operator for the Phase I control segment during user equipment development testing is the General Dynamics - Electronics Corp., San Diego, CA. Aerospace Corp., El Segundo, CA, provides technical and engineering support. User equipment full-scale engineering development is being performed competitively by Magnavox Advanced Products Div., Torrence, CA, and Rockwell International/Collins Government Avionics Div., Cedar Rapids, IA; Intermetrics, Cambridge, MA, is the independent user equipment software verification and validation contractor. Three contractors are competing for development/deployment of the operational control segment: General Dynamics/Electronics Corp, San Diego, CA; International Business Machines/Federal Systems Div, Gaithersburg, MD; and Martin-Marietta, Denver, CO. One contractor will be selected in FY 1980 to continue into full-scale engineering development of software and hardware/software integration.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAM:

1. FY 1979 and Prior Accomplishments: The first navigation development satellite (Navstar 1) was launched in January, 1978. Navstars 2, 3 and 4 were also launched during 1978 to form the 4-satellite test constellation used to provide data for the Defense Systems Acquisition Review Council Milestone II (DSARC II) Review on June 5, 1979. User equipment test platforms for Phase I included the C-141, UH-1H, F-4J and P-3 aircraft, wheeled and tracked vehicles, ships and manpacks. Actual testing verified that the positioning accuracy was within the ten meters predicted for the system. Development testing to demonstrate the effects of improved positioning accuracy on bomb delivery yielded significant results. Inert 500-lb bombs (MK-82) dropped from a Navy F-4J at various altitudes impacted the target area with an order of magnitude improvement in accuracy over current methods. Both straight-and-level and toss delivery modes were used during the testing with positioning and navigation data derived from four satellites. Other demonstrations of the military value of precise positioning included passive aircraft rendezvous similar to aerial refueling, simulated precision helicopter rescues, aircraft reconnaissance of a preselected ground point, simulated combined aircraft/ship antisubmarine operations and reduced visibility ship harbor departures. A three-contractor competitive predesign of the control segment was initiated as a prelude to the start of full-scale engineering development (FSED). To insure continuity of development between program phases, PE 63421F funded Air Force participation in four competitive contracts for user equipment pre-design efforts to define modularity and logistics concepts, design-to-cost goals, and general conduct of the FSED effort. Two of the four contractors were selected in FY 1979 to conduct the competitive user equipment FSED. Direction to proceed to system FSED was issued on August 24, 1979, by the Secretary of Defense.

Program Element: #64778F
Title: Navstar Global Positioning System (GPS)
DOD Mission Area: Navigation and Position Fixing, #321
Budget Activity: Intelligence and Communications, #5

2. FY 1980 Program: The development satellite constellation will be maintained to support the Navy's Improved Accuracy Program, testing of a GPS receiver on Minuteman and other related user equipment testing. Fabrication of three additional satellites (Navstars 9-11), modification of associated Atlas E/F boosters and acquisition of the upper stage vehicles have been initiated to maintain the test constellation. These satellites will be ready for launch in 1982-1983. The replenishment buy is based on a predicted satellite average lifetime of about 4.6 years. Full-scale engineering development of the operational satellites will start with a modification to Navstar 12. The development and integration of mission control functions for the control segment will begin with the selection of one of the three pre-design stage contractors. User equipment development will continue with the detailed design of the family of user sets and the interfaces for the Phase II test platforms.

3. FY 1981 Planned Program: Fabrication of the replenishment satellites (Navstars 9-11) will continue as will development of the prototype operational spacecraft (Navstar 12) and the control segment. An initial production decision for the first production increment of the operational spacecraft is planned after Critical Design Review of the Navstar 12 design. Purchase, modification and development of executive and special purpose software for the control segment will be keyed to procurement of hardware planned under PE 35165F, Navstar GPS Space & Control Segments. User equipment development continues with completion of design and purchase of parts for preproduction user sets and integration of preproduction user equipment into Phase II host vehicles.

4. FY 1982 Planned Program: Fabrication of satellites (Navstars 9-12) will continue with Navstar 9 planned for launch in late 1982. The modifications to the first generation satellite design will be fabricated for Navstar 12. Phase I control center upgrade will continue. Development and test of the two families of user equipment will continue with Development Test and Evaluation on aircraft, land vehicles, ships and manpacks.

5. Program to Completion: The Phase I control center upgrade will be phased to support the first operational satellite launch with the shuttle in FY 1985. Development and test of the two user equipment approaches will culminate in 1983 with Initial Operational Test and Evaluation. Production of operational user equipment is planned to begin after Defense System Acquisition Review Council Milestone IIIB (DSARC IIIB) and selection of one of the competing designs. Production is planned to be gradually expanded under a "leader-follower" concept to increase the contractor production base. User equipment production is funded under PE 35164A/N/F Navstar GPS User Equipment for the Army, Navy and Air Force respectively.

Program Element: #64778F
DOD Mission Area: Navigation and Position Fixing, #321

Title: Navstar Positioning System (GPS)
Budget Activity: Intelligence and Communications, #5

6. Milestones

	Previous Date*	Current Date
Defense Systems Acquisition Review Council Milestone II (DSARC II)	May 79	Jun 79
Full-Scale Engineering Development Start	Jun 79	Aug 79
Launch Satellite Navstar 5 (replaces Navstar 1)	Apr 79	Feb 80
Launch Satellite Navstar 6 (to achieve 5-satellite constellation)	(Jul 79)**	Apr 80
Launch Refurbished Qualification Satellite Navstar 7 (replaces Navstar 2)	(May 80)**	Oct 80
Launch Replenishment Satellite Navstar 8 (as required)	(Dec 79)**	(3Q FY 81)**
Spacecraft Production Decision (DSARC IIIA)		3Q CY 81
Begin User Equipment Development Testing	3Q CY 82	2Q CY 82
Begin Initial Operational Test and Evaluation (IOT&E)		4Q CY 82
Launch Replenishment Satellite Navstar 9	(2Q CY 82)**	(3Q CY 82)**
Complete IOT&E		3Q CY 83
User Equipment Production Decision (DSARC IIIB)		3Q CY 83
First Shuttle Launch (Navstar 12)	2Q CY 83	4Q CY 84
Initial Operational Capability (18 satellites)	2Q CY 86	4Q CY 87

*Dates presented in FY 1980 Descriptive Summary are shown if changed in FY 1981 Descriptive Summary.

** Replenishment launches shown in parentheses indicate probable launch dates.

Explanation of Milestone Changes: The Defense Systems Acquisition Review Council Milestone II (DSARC II) was slipped by administrative delays during the preparation cycle. The start of full-scale engineering development slipped with DSARC II. The launch of Navstar 5 was delayed to allow modification and extensive testing of improved atomic frequency standards. The launch of Navstar 6 is now required because of the failure of the last of three atomic frequency standards on Navstar 1 in late January, 1980. The launch of Navstar 7 is now planned because of continuing instability of the final atomic frequency standard on Navstar 2. (The modification to the standards on Navstars 5 and subsequent satellites was made to correct the deficiencies responsible for the failures on Navstars 1 and 2.) User equipment development testing was expanded to provide greater confidence in the readiness of the equipment for IOT&E. The launch of Navstar 9 will be delayed because contract award for acquisition of Navstars 9-11 was delayed pending direction to start Phase II. Reduced program funding resulting in a program restructuring delays availability of satellites for the first Shuttle launch. Reduced funding also forced a decrease in the rate of acquiring operational satellites, thereby postponing availability of the 18-satellite constellation.

7. Resources: Not Applicable

Program Element: #64778F
DOD Mission Area: Navigation and Position Fixing, #321

Title: Navstar Global Positioning System (GPS)
Budget Activity: Intelligence and Communications, #5

8. Comparison with FY 1980 Budget Data: ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
FY 1981 Restructured Program	75,600	142,200	126,800	123,200	215,000	933,200
FY 1980 Descriptive Summary	97,300	182,600	145,700	94,400	85,300	855,700
Difference	-21,700	-40,400	-18,900	28,800	129,700	77,500

FY 1979 funds in the amount of $18,700 thousand from PE 64778F Navstar GPS User Equipment and $3,000 thousand from PE 64478F Navstar GPS Space & Control Segments were excess to FY 1979 requirements because of the delayed start of full-scale engineering development. FY 1980 funds in the amount of $40,400 thousand from PE 64778F Navstar GPS are excess to FY 1980 needs because of the delay in beginning development efforts caused by the program restructuring. The estimates for FY 1981 to completion are based on accomplishing a restructured program with a late CY 1987 world-wide three-dimensional capability with 18 satellites.

Budget Activity: Intelligence and Communications, #5

Program Element: #64778F, Navstar Global Positioning System (GPS)

Test and Evaluation Data

1. Development Test and Evaluation (DT&E): This Program Element covers the development of the Navstar Global Positioning System (GPS). Phase I testing has validated the system concept, identified preferred design parameters and demonstrated military utility. The three system segments (space, control and user equipment) have been in development testing since mid 1977. In the space segment, four of the eight development satellites procured from Rockwell Space Division for the Validation Phase (Phase I) have been launched, checked out and declared operational to support the testing of the user equipment. One of the four remaining satellites will be launched in January 1980 to provide test instrumentation for the Navy's Fleet Ballistic Missile Improved Accuracy Program (FBM/IAP) and to provide additional satellite coverage over the GPS test range at the Army's Yuma Proving Ground for user equipment testing. User equipment testing with four satellites began in January 1979. Because each Navstar satellite launched so far carries three rubidium atomic time standards, "clock" failures on Navstars 1 and 2 have not required the launch of additional satellites to continue four-satellite testing. Activities to improve rubidium clock reliability include electronics fixes, rubidium lamp material and process changes, and qualifying a United States manufacturer as a second lamp source. Navstar 5 scheduled for a February 1980 launch will carry improved lamps. Testing with all platforms (C-141, P-3B, F-4J, UH-1H and Army truck) has demonstrated navigation and positioning accuracies within the ten meters predicted for the system. On the F-4J aircraft, the multichannel GPS receiver developed by Magnavox integrated with an inertial measurement unit has achieved positioning accuracies which have permitted straight and level bombing demonstration with of the bombs landing within meters of the target. These results were obtained from over 37 separate bomb releases from an altitude of 5,000 feet. Toss bombing demonstrated similar accuracies. The single-channel Magnavox receiver, the multichannel Texas Instruments receiver, the Rockwell/Collins general development model receiver, and the Magnavox and Texas Instruments manpacks are also demonstrating positioning/navigation performance within specified values. Testing of the Phase I Validation prototype equipment will continue to increase statistical confidence in the test results and to provide valuable engineering data for the Full Scale Engineering Development Phase (Phase II). The prototype control station built by General Dynamics Electronics and operated at Vandenberg AFB, CA, has been successfully controlling and uploading the daily navigation and synchronized time message to the satellites. Data from this small prototype station are contributing to the engineering base for development of the much more extensive Navstar Control Center (NCC) for the operational constellation. Development Test and Evaluation of the space and ground control segments will be limited to refining further the effects of seasonal variations on satellite ephemeris predictions and determining the long-term reliability of the space segment.

2. Operational Test and Evaluation (OT&E).

a. During the GPS Validation Phase (Phase I) completed in May 1979, tests were conducted by the Space and Missile Systems Organization (SAMSO) to demonstrate some of the system's military applications. Applications included coor-

dinate bombing, passive randezvous, special anti-jam performance, approach to landing, Army land operations, and coordinated sea operations. Four satellites where used in the final Phase I testing stages. Testing was conducted at Yuma Proving Ground, AZ, and San Clemente Island Test Area, CA. The Air Force Test and Evaluation Center (AFTEC) monitored the Phase I activities and provided an independent assessment for use in the Milestone II program review. No operational deficiencies were noted by AFTEC that would preclude transitioning to the full scale engineering development phase. Phase I contractors were Magnavox, Texas Instruments, Rockwell International, Collins Government Avionics Division, Rockwell International Satellite Systems Division, and General Dynamics Electronics Division.

b. In the Full-scale Enginering Development Phase (Phase II) of the program, AFTEC will be the executive test agency for all GPS operational test and evaluation (OT&E). Multi-service OT&E will be conducted on user equipment and the control segment (CS), while the space segment (SS) testing will be primarily an Air Force effort.

(1) The user equipment OT&E is scheduled from mid-December 1982 through early July 1983. The Army, Navy, Marine Corps and Defense Mapping Agency will participate in the operational testing of the user equipment in a broad range of military applications. User equipment IOT&E will include several months of combined DT&E/OT&E testing and nine months of separate OT&E prior to the Defense Systems Acquisition Review Council (DSARC) Milestone III review. This testing is intended to provide the independent OT&E input for a user equipment production decision in September 1983. Primary test vehicles will be: B-52D (with Digital Bomb Nav System), F-16, and A-6 aircraft, Aircraft Carrier, Attack Submarine, Army Tank, UH-60 helicopter and a manpack. Operator and maintainance personnel will be drawn from operational units. Primary test locations will be Yuma Proving Ground, AZ; Nellis AFB, NV; Eglin AFB, FL, Ft Carson, CO; and the San Clemente Island Test Area, CA. Phase II user equipment contractors are Magnavox and Rockwell International Collins Government Avionics Division.

(2) Control Segment testing will be conducted as the CS is acquired, using combined DT&E and OT&E, followed by dedicated OT&E. Preliminary planning is to perform OT&E during a series of 60-day periods as the CS expands to accommodate increasing numbers of satellites. Following each 60-day testing period, a report will be submitted to CSAF, since there is no DSARC III for the CS. The first testing period is currently planned to begin in May 1983. Testing periods will occur yearly thereafter until CS operational responsibility is transferred to Strategic Air Command (SAC). A small contingent of OT&E personnel will permanently reside at the Navstar Control Center and will be augmented during each 60-day period of increased OT&E activity. Satellite command and control personnel from the operational unit will be used in OT&E.

(3) For the space segment AFTEC currently plans to assess the phase II satellite constellation and submit a report for DSARC III A (SS only), currently scheduled in September 1981. Sole SS contractor is Rockwell International. Further SS testing will occur with CS testing and be reported accordingly. Current space and control segment testing is subject to change, based on the DSARC II implementing decision, establishment of when SAC will assume operational responsibility for the CS, and selection of a CS contractor. Specific areas which will be addressed during satellite and control segment testing include survivability, operability, and the effects of satellite outages on system accuracies.

c. Overall Navstar GPS OT&E objectives are to:

(1) Evaluate GPS performance in a spectrum of missions in representative vehicles for Army, Navy, Air Force, Marine Corps, and Defense Mapping Agency application. These include air, land, and water navigation; ordnance delivery; rendezvous; and landing approaches in both passive and hostile environments.

(2) Evaluate GPS performance when operated and maintained by Air Force, Army, Navy, and Marine Corps operational and maintenance personnel.

(3) Identify and track deficiencies and improvements.

3. System Characteristics:	Objectives	Demonstrated (Combined DT&E/OT&E)
Three-Dimensional Position Accuracy	10 meters	11.1 meters (Note 1)
Three-Dimensional Velocity Accuracy	.03 meters/sec	0.12 meters/sec
Time Transfer	10×10^{-9} sec	25×10^{-9} sec (Note 2)
Satellites on Orbit	24	4
Satellite Coverage	24 hrs/day world-wide	4 hrs/day over test area
Clock Stability	10^{-13}	2×10^{-13}
Satellite Mean Mission Duration (MMD)	6 years	3 years (not valid for projections) (Note 3)

NOTES:

1. Accuracy is within 11.1 meters 50% of the time and 22 meters 90% of the time.

2. The standard deviation of the synchronization error is 25 nanoseconds.

3. Phase I prototype spacecraft have a design MMD of 4.6 years. The four prototype spacecraft in orbit (Navstars 1-4) are supporting testing in spite of several rubidium clock failures. Fixes implemented on Navstars 3-5 and additional fixes to be installed on all remaining prototype spacecraft are expected to permit achieving the 4.6 year MMD.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65708F
Title: Aircraft Navigation System Verification
DoD Mission Area: Navigation and Position Fixing # 321
Budget Activity: Intelligence & Communications, #5

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,700	1,300	1,600	1,600	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the standardized test and evluation of inertial and inertially aided aircraft navigation systems at the Central Inertial Guidance Test Facility (CIGTF). This element determines the navigational performance and operability of inertial and inertially aided aircraft navigation systems prior to their consideration for use by Department of Defense agencies. The CIGTF evaluation prevents acquistion of high risk systems through quantitative test and evaluation. This Program Element permits a standard, unbiased system evaluation under conditions closely simulating the operational environment.

BASIS FOR FY 1981 RDT&E REQUEST: Standardized tests of inertial and other DoD navigation systems will continue. Tests in cargo, helicopter and fighter testbed aircraft will be performed based on intended application. Standard Inertial Navigation System (INS) qualification tests on one new system will be completed. Two additional INSs will undergo verification testing as identified through a FY 1980 "call to industry." An aided inertial system will also begin evaluation during this period. The Completely Integrated Reference Instrumentation System will complete modification to upgrade the INS from a gimballed system to a strapdown system.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #65708F
Title: Aircraft Navigation System Verification
DoD Mission Area: Navigation and Position Fixing, # 321
Budget Activity: Intelligence & Communications, #5

DETAILED BACKGROUND AND DESCRIPTION: This program implements Department of Defense DoD direction to test new aircraft inertial and inertially aided navigation systems at the Central Inertial Guidance Test Facility (CIGTF) and to use the results of the test as a basis for system selection for the DoD use. Government and non-government agencies may request that a flight evaluation be performed on a candidate system. The CIGTF was created in 1959 to give the Air Force a quantitative evaluation capability for testing intercontinental missile guidance systems. The facility was expanded in the mid-1960s to include aircraft inertial navigation systems. The development of the Completely Integrated Reference Instrumentation System (CIRIS) allowed CIGTF to expand its capability to test a full spectrum of navigation and guidance equipment. The centralized test facility avoids costs of duplicate service test centers. Standardization of tests provides common yardsticks for comparative evaluations. A common core of personnel and equipment is maintained to insure meaningful evaluation of systems tested.

RELATED ACTIVITIES: This program element documents actual performance of inertial guidance systems which have potential application to Air Force, Navy, and Army weapon systems. This program interfaces with Program Element 65807F, Test and Evaluation Support. The test facility is also available to National Aeronautical and Space Agency, Federal Aviation Administration,, and private industry through government sponsorship on a reimbursement basis.

WORKED PERFORMED BY: This program element is managed by the Central Inertial Guidance Test Facility, Air Force Armament Development and Test Center, Holloman AFB, NM, an organization of the Air Force Systems Command. Representative contractors that have been involved are Litton Systems, Incorporated, Woodland Hills, CA; Teledyne Systems, Incorporated, San Diego, CA; Singer-Kearfott, Incorporated, Little Falls, NJ; Delco Electronics, Santa Barbara, CA; Hamilton Standard, Windsor Locks, CT; Honeywell Aerospace, Clearwater, FL; Rockwell International, Anahiem, CA.

Program Element: #65708F
DoD Mission Area: Navigation and Position Fixing, # 321

Title: Aircraft Navigation System Verification
Budget Activity: Intelligence & Communications, #5

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: More than eighteen navigation systems have completed verification tests. These include the Singer 2400 and the Carousel IV respectively selected for the F-16 full scale development models and the C-141 navigation modernization. The cargo aircraft version of the Completely Integrated Reference Instrumentation System (CIRIS) was completed. The Standard Precision Navigator completed verification testing in 1976. Standard Inertial Navigation System qualification screening tests were successfully completed on three systems during 1978. Verification testing of three prototype and two preproduction (nuclear hardended) doppler velocity sensors in support of the Common Strategic Doppler Program were completed in 1978. Two CIRIS palletized equipment stations for cargo testbed and two pod versions were fabricated. One pod version is to provide the prime reference for a fighter testbed and the second to provide the reference in support of the Strategic Offensive Avionics Program aboard a B-52 testbed. The CIRIS frequency conversion to comply with National Range requirements has been completed.

2. FY 1980 Program: Qualification testing will be completed on the three competing Standard INSs. Two additional navigation systems (pure inertial and aided inertial) will undergo verification testing. These systems will be based on service requirements and a review of industry capabilities, i.e., "call to industry." A strapdown inertial navigator will be incorporated into CIRIS to replace the current gimballed system; thereby improving system accuracy and reliability. The additional transponders required to extend the CIRIS coverage for eastern flight test will be installed, calibrated and integrated into the overall positioning system. The B-52 testing will be initiated in mid-to-late FY 30.

3. FY 1981 Planned Program: Two additional navigation systems (pure inertial and aided inertial) will undergo verification testing. These systems will be based on service requirements and a review of industry capabilities, i.e., "call to industry." Qualification testing will be conducted on one additional system for the Standard Inertial Navigation Program. The B-52 use of the CIRIS pod to validate position and velocity accuracy will be completed.

4. FY 1982 Planned Program: Verification and developmental testing will continue with the evaluation of approximately three navigation systems per year.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

Program Element: #65708F
DoD Mission Area: Navigation and Position Fixing, # 321

Title: Aircraft Navigation System Verification
Budget Activity: Intelligence & Communications, #5

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,800	1,700	1,300	1,300	Continuing	Not Applicable

The FY 1981 funding allocation has been increased by $300,000 to cover the increased cost of operating the airborne testbeds.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #31027F
DOD Mission Area: General Defense Intelligence Programs, #312

Title: FOREST GREEN
Budget Activity: Intelligence and Communications, #5

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,775	3,200	27,875*	24,456*	Continuing	Not Applicable

* Effective FY 1981 two other Program Elements (PEs) are combined with PE 31027F.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The main objective of this program is to provide the necessary Research and Development (R&D) effort required to establish,
The R&D effort is aimed at correcting deficiencies in the

Other efforts are the development of new scientific sensors, collection devices, and analytical techniques to satisfy specific intelligence needs.

BASIS FOR FY 1981 RDT&E REQUEST: This program will support continuing development efforts to improve and modernize the collection, analytical, and evaluation systems of the and to reduce operating costs while improving performance.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #31027F
DOD Mission Area: General Defense Intelligence Program, #312

Title: FOREST GREEN
Budget Activity: Intelligence and Communications, #5

DETAILED BACKGROUND AND DESCRIPTION: This is a continuing program to improve the

It takes advantage of Air Force, Navy, Department of Energy, and Defense Advanced Research Projects Agency sponsored research to reduce deficiencies in

Capabilities to monitor activities have been the subject of considerable interest as a result of recent international developments.

Program Element: #31027F
DOD Mission Area: General Defense Intelligence Programs, #312

Title: FOREST GREEN
Budget Activity: Intelligence and Communications, #5

RELATED ACTIVITIES:

To minimize redundancy, a close working relationship is maintained among Department of State, Department of Energy, and Defense Advanced Research Projects Agency.

WORK PERFORMED BY:

In addition, about 25 to 30 other contractors and agencies will be involved in FY 1981.

Program Element: #31027F
DOD Mission Area: General Defense Intelligence Programs, #312

Title: FOREST GREEN
Budget Activity: Intelligence and Communications, #5

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments:

Program Element: #31027F
DOD Mission Area: General Defense Intelligence Programs, #312

Title: FOREST GREEN
Budget Activity: Intelligence and Communications, #5

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #31027F
DOD Mission Area: General Defense Intelligence, #3.2

Title: FOREST GREEN
Budget Activity: Intelligence and Communications, #5

In FY 1978 efforts started on the

The specifications for detection concept studies have been determined, and preliminary field measurements have been performed. System considerations were extended far beyond the detection element itself. Considerations included techniques to discriminate between target signals and background and to display data for realtime determination of collection actions. Attention has been focused on systems which are inexpensive in initial investment and life cycle costs. Electro-optical and thermal measurements were made against various facilities in conjunction with the Department of Energy and other government Research and Development exercises (e.g., Air Force Weapon Laboratory exercises) as well as These measurements will be evaluated and specifications for prototype remote sensing equipment developed.

Program Element: #31027F
DOD Mission Area: General Defense Intelligence Programs, #312

Title: FOREST GREEN
Budget Activity: Intelligence and Communications, #5

2. FY 1980 Program: A strong Research and Development (R&D) effort is continued to overcome deficiencies

Program Element: #31027F
DOD Mission Area: General Defense Intelligence Programs, #312

Title: FOREST GREEN
Budget Activity: Intelligence and Communications, #5

3. FY 1981 Planned Program: Major efforts in FY 1980 will be continued in FY 1981. Primary responsibility for development of the next generation sensor will transfer from the Defense Advanced Research Agency to the Air Force

4. FY 1982 Planned Program: Major efforts in FY 1981 will be continued in FY 1982.

5. Program to Completion: This is a continuing program.

6. Milestones:

	Date
Data available	
Deployment decision date	To be determined
IOC	
FOC	

Program Element: #31027F
DOD Mission Area: General Defense Intelligence Program, #312

Title: FOREST GREEN
Budget Activity: Intelligence and Communications, #5

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

RESOURCES (PROJECT LISTING): ($ in thousands)

	FY 1978	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Costs
					Continuing	Not Applicable
					Continuing	Not Applicable
TOTAL FOR PROGRAM ELEMENT (31027F)	3,300	1,600	3,200	2,400	Continuing	Not Applicable

The total for FY 1981 for all three program elements increased from thousand in the FY 1980 budget to $27,875 thousand in this submission. This increase of thousand is due to escalation in and swapping Operation and Maintenance and Investment funds for an equivalent increase in Research and Development funds in Program Element 31027F ($3,875 thousand). The switch will allow the design and develop the advanced data processing system, required to satisfy increased tasking, in accordance with Congressional appropriation guidelines.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #31060F
DoD Mission Area: General Defense Intelligence Programs, #312

Title: Defense Dissemination Program (DDP)
Budget Activity: Intelligence and Communications, #5

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
N/A	TOTAL FOR PROGRAM ELEMENT	8,849	3,200	9,640	14,100	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: DDP rapidly disseminates Existing methods of delivering are much too slow in times of crisis. A Deployable Receive Segment Engineering Model has been demonstrated and is available to support field exercises, serve as an engineering test bed, and potentially offers a contingency back-up to the Receive Locations.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for the

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Other Procurement	4,613	2,599*	1,400	1,500	Continuing	Not Applicable

* Includes initial spares

NOTE: This program is also included in the National Foreign Intelligence Program Justification material.

Program Element: #31060F
DoD Mission Area: General Defense Intelligence Programs, #312

Title: Defense Dissemination Program (DDP)
Budget Activity: Intelligence and Communications, #5

DETAILED BACKGROUND AND DESCRIPTION: The commanders of the have unanimously stated their need for electrical dissemination of to meet operational requirements. This requirement has been validated by the Joint Chiefs of Staff. The Defense Dissemination Program (DDP) is meeting these needs by providing rapid dissemination of data to the The DDP includes those elements necessary to prepare, process, encrypt, and transmit ground/space communications media to the distant command locations and to receive and at these locations. The direct benefit derived from this program is the rapid dissemination of to the where it is used for operational planning,

The DDP has overcome these limitations by rapidly providing the In addition to the Receive Segments, a Deployable Receive Segment Engineering Model (DRSEM) has also been developed. The DRSEM will be used as, (1) an engineering test bed for evaluating receive segment design modifications, (2) a (3) a deployable unit for worldwide and (4) a means for evaluating the feasibility and operational utility of disseminating and data rates directly to tactical commanders. The DRSEM has all the basic features of a receive unit with the additional capabilities for variable data rate reception and

RELATED ACTIVITIES: There are several classified projects currently underway which will improve capabilities. The DDP has been developed in close coordination with these projects to provide the capability to rapidly at the distant locations, vastly improving the commander's ability to meet their operational requirement.

The DDP data is transmitted through the Defense Satellite Communication System which is funded in Program Element 33110F.

WORK PERFORMED BY: Air Force Systems Command's Space Division, Los Angeles, CA, is responsible for the DDP. General Systems Engineering and Integration is performed by the Aerospace Corporation. El Segundo, CA. The primary contractor is Ford Aerospace and Communications Corporation, Palo Alto, CA.

Program Element: #31060F
DoD Mission Area: General Defense Intelligence Programs, #312

Title: Defense Dissemination Program (DDP)
Budget Activity: Intelligence and Communications, #5

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Acquisition of the DDP was begun in January 1976. A pre-production receive segment was assembled and successfully tested in July 1977 (RDT&E funds) to demonstrate performance parameters prior to production of the remaining units which included the DRSEM (Deployable Receive Segment Engineering Model). The production of these remaining units was initiated during FY 78. The preproduction receive segment was delivered to the where it completed system interface and performance tests. The The DRSEM was also delivered in July 1979, and was deployed to where it was interfaced with in order to support the

5. Program to Completion: This is a continuing program. Sustaining engineering support will be required on a continuing basis. Development will be required to incorporate approved system improvements.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

Program Element: #31060F
Title: Defense Dissemination Program (DDP)
DoD Mission Area: General Defense Inteiligence Programs, #312
Budget Activity: Intelligence and Communications, #5

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	17,979	6,850	4,700	4,200	Continuing	Not Applicable

(a) The increase in the FY 1979 actual of $8,849 thousand from the FY 1979 estimate of $6,850 thousand represents studies that were accomplished to DDP to meet future requirements.

(b) The decrease in the current FY 1980 estimate of $3,200 Thousand from the previous FY 1980 estimate of $4,700 thousand represents a Congressional reassessment of the RDT&E funds required for an

(c) The increase in the current FY 1981 estimate of $9,640 thousand from the previous FY 1981 estimate of $4,200 thousand represents the funds necessary to to the DDP to meet future requirements.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #33110F Title: Defense Satellite Communications System
DOD Mission Area: Common User Communications, #323 Budget Activity: Intelligence and Communications, #5

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	34,200	22,837	21,100	16,500	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Defense Satellite Communications System (DSCS) provides Super High Frequency (SHF) satellite communications for secure voice and high data rate transmissions in support of unique and vital national security requirements for worldwide military command and control, crises management, intelligence data relay, early warning detection, treaty monitoring and surveillance information, and diplomatic traffic. The DSCS supports critical, globally distributed Joint Chiefs of Staff validated communications requirements of the National Command Authorities, the Worldwide Military Command and Control System, the Ground Mobile Forces, the Defense Communications System, the Diplomatic Telecommunications Service, the White House Communications Agency, selected Allies and special high priority national users. The Defense Communications Agency is responsible for overall DSCS program management, systems engineering, orbital operations, and satellite communications architecture. The DSCS Program is comprised of: a space segment, which is an Air Force responsibility; a multi-user terminal segment of ground, airborne, and naval elements; and an operational control segment. The authorized DSCS Space Segment consists of four operational and two in-orbit spare satellites positioned over four geographical areas to provide global (less polar) coverage. Existing DSCS II satellites will be replenished with DSCS III satellites which will provide increased channelization, flexibility, and anti-jam capability. DSCS III satellites will include Ultra High Frequency and, in the future, SHF capability for Emergency Action Message dissemination.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds to continue DSCS III full scale engineering development and to initiate orbital testing and satellite production readiness preparations. The first DSCS III Demonstration Flight Satellite (DFS) will be acceptance tested, integrated with DSCS II F15, and launched about June 1981 using a Titan IIIC launch configuration. An extensive orbital test and evaluation will be conducted following launch to evaluate satellite subsystem performance, to verify communications system and SHF tracking, telemetry, and command performance and to determine the interoperability of the DFS with varied DSCS and non-DSCS earth terminals. First time integration

efforts associated with the transition from expendable launch vehicles to the Space Shuttle will continue. In addition, as a part of the solid state amplifier development, a qualification model amplifier will be produced for possible future testing on the first Defense Satellite Communications System (DSCS) III production satellite. In the interim, improvements to existing traveling wave tube amplifier design are planned to enhance overall efficiency and reliability. These improvements include a dual-depressed unencapsulated collector, an unencapsulated electron beam gun, and an improved encapsulant. Also, DSCS III design modifications will be implemented to assure satellite compatibility with the recently revised Shuttle safety, power and environmental requirements.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Missile Procurement (3020)	13,900	17,300	93,040	113,253	Continuing	Not Applicable
(Quantities)						
DSCS II		(2)				(2)
DSCS III			(1)	(4)	(7)	(12)
Other Procurement (3080)	11,612	5,958	21,886	40,705	Continuing	Not Applicable
(Quantities)						
GMF Tactical Terminals	(10)	(0)	(8)	(17)	(65)	(100)
Military Construction (3300)	0	0	4,820	5,400	Continuing	Not Applicable

Program Element: #33110F Title: Defense Satellite Communications System
DOD Mission Area: Common User Communications, #323 Budget Activity: Intelligence and Communications, #5

DETAILED BACKGROUND AND DESCRIPTION: The need for an operational Super High Frequency (SHF) satellite communications system to provide secure connectivity evolved as an outcome of SHF satellite communications experiments conducted in the early-1960s when the Initial Defense Communications Satellite Program (IDCSP) or Defense Satellite Communications System (DSCS) Phase 1 was approved. The IDCSP, originally intended as a research and development demonstration, provided limited operational point-to-point service between 1967 and 1973, confirming the importance and utility of SHF satellite communications. However, several IDCSP performance limitations, including channel capacity and orbital position drift (due to the sub-synchronous orbit), led to approval of DSCS Phase II (DSCS II) in 1969. DSCS II satellites were developed to establish an operational SHF communications system to support military satellite communications requirements into the early 1980s. The authorized DSCS space segment consists of four operational and two in-orbit spare satellites. Based on validated and projected user requirements, the increasing dependency of high priority users on DSCS for mission execution, and the growing electronic countermeasures threat, the DSCS III satellite concept was approved in 1974. The DSCS III is the next generation in the evolution of communication satellite systems and is directed toward satisfication of the Wideband element of the Defense Communications Agency military satellite communications architecture. DSCS III will provide a three fold increase in channelization; a unique spot, area, and earth coverage; and an improved anti-jam capability; and responsive adaptability in reallocating satellite communications assets (power and bandwidth) to satisfy dynamic user connectivity requirements in an electronic jamming and/or nuclear environment.

Major commitments have been made in the DSCS terminal segment including heavy and medium terminals, as well as light terminals which will be reserved by the Joint Chiefs of Staff to support contingency operations. The Navy is acquiring SHF ship terminals and the Air Force will install an SHF prototype terminal on the Advanced Airborne Command Post (E-4B) in FY 1981. In addition, about one hundred transportable light terminals for the Ground Mobile Forces will be employed to establish high capacity links within and between units of the Army, Air Force and Marine Corps during crisis or contingency situations. Analysis of future operational requirements and user mission dependency have been performed to define the DSCS requirements and priorities in the early 1980 to mid-1990 period. During this period, DSCS II satellites will be replenished with DSCS III satellites to support increased user requirements as the planned DSCS terminal segment becomes operational and user mission execution becomes more fully committed.

RELATED ACTIVITIES: The Defense Communications Agency (DCA) is responsible for overall DSCS program management, system engineering, and satellite operations. Within DCA, the Military Satellite Communications System Office is responsible for the system architecture for all DOD satellite communications systems. The military departments are responsible for individual elements of the system. The Army budgets, develops, and procures ground terminals for the DSCS under Program Element (PE) 33142A, Defense Satellite Communications System. The Navy performs these functions for shipborne terminals under PE 33109N, Satellite Communications System. In addition to its responsibility for the space segment, the Air Force develops and integrates airborne terminals under PE 64723F and PE 11312F, Advanced Airborne Command Post, and

provides launch services for the TITAN III launch vehicle under Program Element (PE) 35119F, Space Boosters. The Inertial Upper Stage (IUS), to be used for launch with the TITAN 34D and Space Shuttle, is being developed by the Air Force under PE 63411F. IUS procurement, IUS recurring integration, and Space Shuttle launch support will be furnished under PE 35171F Space Launch Support. Development of an Air Force Satellite Communications (AFSATCOM) Single Channel Transponder for incorporation on the Defense Satellite Communications System (DSCS) III Demonstration Flight Satellites is funded under PE 33601F, AFSATCOM. The Air Force Super High Frequency (SHF) Ground Mobile Force tactical contingency terminals are acquired by the Air Force under PE 33119F. DSCS is closely coordinated with the Advance Space Communications Program, PE 63431F, which evaluates, develops, and demonstrates evolutionary communications satellite technologies for future DSCS and other Defense communications satellite programs.

WORK PERFORMED BY: The Air Force Space Division (AFSD), Los Angeles, CA, is responsible for the space segment of the DSCS. TRW, Redondo Beach, CA, is the prime contractor for the design, fabrication, test and integration of the DSCS Phase II satellites. The Martin-Marietta Corporation, Denver, CO, is the prime contractor for the TITAN launch vehicle. General Electric Company, Valley Forge, PA, and Hughes Aircraft Company, Culver City, CA, provided preliminary designs for the DSCS Phase III satellites with General Electric selected to provide DSCS III full scale engineering development. The Boeing Company, Seattle, WA, is developing the Inertial Upper Stage. The Aerospace Corporation, El Segundo, CA, provides general systems engineering/technical direction to the AFSD System Program Office.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: To demonstrate the feasibility of a military satellite communications system, twenty-six Initial Defense Communications Satellite Program satellites were placed in near synchronous orbit during 1966-1968 providing limited operational point-to-point service into 1973. The follow-on DSCS II program, which was started in 1969, now provides an operational SHF military satellite communications system. Since 1971, a total of twelve DSCS II satellites have been launched with four failing to achieve orbit due to booster malfunctions. Currently, the DSCS Space Segment consists of four operational and one limited utility spare satellite in synchronous, equatorial orbit. They are positioned over four geographical areas to provide global coverage to 72° latitude: DSCS II F4 located over the Indian Ocean; DSCS II F7 and F8 deployed over the Atlantic Ocean; and DSCS II F11 and F12 placed over the Eastern and Western Pacific Ocean respectively. DSCS II F7 functions as a limited spare because of permanent loss of its narrow coverage capability in May 1979. The successful deployment and operation of DSCS II F11 and F12 in December 1978 allowed the North Atlantic Treaty Organization (NATO) communications satellite, used over the Eastern Pacific to augment the DSCS configuration, to be returned to NATO and to be relocated to the Atlantic Ocean area. In December 1974, the Defense Systems Acquisition Review Council (DSARC) approved the preliminary design/definition phase for DSCS III, the next generation satellite in the continuing evolution of communication satellite systems. Two contractors were selected to deliver competitive designs for a DSCS III satellite during 1976. Following a favorable DSARC recommendation, the Deputy

Program Element: #33110F Title: Defense Satellite Communications System
DOD Mission Area: Common User Communications, #323 Budget Activity: Intelligence and Communications, #5

Secretary of Defense approved initiation of full scale engineering development of Defense Satellite Communications System (DSCS) III in January 1977. In February 1977, the General Electric Company was selected to complete satellite design; to develop, test, and support the launch of two DSCS III Demonstration Flight Satellites (DFS); to develop a refurbishable qualification model satellite; and to conduct and support on-orbit tests and evaluations. In addition, two Satellite Configuration Control Element (SCCE) engineering development models are being developed for eventual location to the Air Force Satellite Control Facility and Fort Detrick, MD. Also, an Air Force Satellite Communications System Single Channel Transponder is being developed as an integral part of the DSCS III satellite design. During 1979, DSCS III DFS development continued with the assembly and qualification testing of major components for the qualification satellite. Assembly of the first DFS flight components has been initiated and some component acceptance testing completed. First time integration efforts necessary to transition DSCS from expendable launch vehicles to the Shuttle/Inertial Upper Stage also continued. In addition, the development of a solid state amplifier as a replacement for the 10-watt traveling wave tube amplifiers is progressing.

2. FY 1980 Program: The DSCS III full scale engineering development program has continued to experience non-technical developmental problems which will prevent the launch of the first DSCS III DFS in June 1980. A number of factors contributed to this delay including the contractor's underestimation of the development effort, inadequate manpower, insufficient test equipment, a continuing late delivery of key subcontractor components, and an unexpected number of problems encountered during the component qualification program. Based on these problems, the DSCS III Program has been rephased to start production in FY 1982 with the first production satellite available for launch in about September 1984. The rephased DSCS III program will acquire eleven production satellites with four satellites procured each in FY 1982 and FY 1984, and three in FY 1986. In the year preceding satellite acquisition, four sets of advance buy items will be acquired in FY 1981 and FY 1983 and three sets in FY 1985.

The one year production delay with no additional DSCS II replenishment assets has made the gap associated with transitioning from DSCS II to DSCS III satellite capability more acute. By early 1983, the probability of sustaining the minimum four satellite orbital configuration will severely decline. The Defense Communications Agency will most likely be unable to maintain four operational satellites and at least one of the four geographical areas will not have satellite communications coverage during the 1983-1985 time period. This likely gap in coverage will occur during the period when user requirements are rapidly increasing and dependency of critical users on DSCS is almost total. Many users have no communications alternatives and a lack of satellite coverage will jeopardize their mission execution and our national defense posture.

In an attempt to partially mitigate this situation and provide some continuity of coverage, the refurbishment of the DSCS III qualification satellite will be expedited starting in FY 1980 using some DSCS III advance buy funding. Originally, before DSCS III production rephasing, the qualification satellite would have been refurbished starting in FY 1981 as one of the first four DSCS III production flight satellites. This approach will make the refurbished qualification satellite available in early to mid-1983 as a replenishment asset when lack of coverage is most likely.

Based on these rephased objectives, Defense Satellite Communications System (DSCS) III full scale engineering development will continue with major component assembly, integration, and acceptance testing. Assembly of the first Demonstration Flight Satellite (DFS) will be initiated in late FY 1980 and be completed in early FY 1981. The DSCS III qualification satellite will be completed and system test started with test results factored into the DFS design. Advance buy items will be acquired for the early refurbishment of the DSCS III qualification satellite which will start in FY 1981. The first Satellite Configuration Control Element (SCCE) will be delivered and installed at the Air Force Satellite Control Control Facility (AFSCF), Sunnyvale Air Force Station, CA to test the capability for Super High Frequency (SHF) command and control of DSCS III and to refine operational concepts. First time engineering and integration efforts associated with developing electrical, mechanical, environmental, and procedural compatibility between both the DSCS II and DSCS III satellites and the Titan IIIC, the Titan 34D/Inertial Upper Stage (IUS), and the Space Shuttle launch vehicle systems will continue. This effort is required to transition DSCS from expendable launch vehicles to the Space Shuttle by early-1983. The launch of DSCS II satellites F13 and F14 occured in November 1979. With this satellite pair, the DSCS Program achieved the authorized six satellite orbital configuration for the first time in DSCS history. During FY 1980, DSCS orbital assets are planned to be redeployed over the four geographical areas to continue global (less polar) coverage as follows: DSCS II F4 positioned over the Indian Ocean; DSCS II F8 located over the Western Pacific Ocean; DSCS II F11 placed over the Eastern Pacific Ocean; DSCS II F12 located over the Eastern Pacific Ocean as a spare; DSCS II F13 placed over the Atlantic Ocean; and DSCS F14 positioned over the Atlantic Ocean as a spare. DSCS F7 may be redesignated as a spare/test satellite because of permanent loss of its narrow channel coverage capability and positioned over the Indian Ocean. In addition development of a solid state amplifier as a replacement for 10-watt traveling wave tube amplifiers will be continued.

3. FY 1981 Planned Program: The DSCS III full scale engineering development will continue. The qualification satellite system test will be completed and this satellite's component and subsystem refurbishment started. The first DFS is scheduled to be launched in June 1981 paired with DSCS II F15 using a Titan IIIC launch vehicle. An extensive orbital test and evaluation will be conducted on DFS 1 to verify satellite subsystem performance, to evaluate compatibility with the various DSCS terminals, and to independently, through the U. S. Army Operational Test and Evaluation Agency, confirm DSCS III performance and capability. This testing preceeds the Defense Systems Acquisition Review Council III, which is planned for December 1981 to consider production approval. On successful test completion, DFS satellites will become operational elements of the DSCS System. The integration and test of the second DFS will continue and corrective modifications, as necessary, designed and incorporated depending on the results of the first DFS on-orbit test and evaluation. The second DFS should be available for launch with a DSCS II (F16) satellite in FY 1982 for a similar orbital test and evaluation. First time engineering and integration efforts for DSCS II and DSCS III satellites will continue. In addition, advance buy parts and items will be procured for the first four DSCS III production satellites to be acquired in FY 1982. The second SCCE engineering development model will be delivered and installed at Fort Detrick, MD

to support Demonstration Flight Satellite (DFS) 2 orbital testing and control. The solid state amplifier development will also be continued with performance evaluated using engineering and qualification models. The existing 40-watt traveling wave tube amplifier design may be enhanced to improve overall efficiency and reliability. Selected DSCS III design modifications will be implemented to assure satellite compatibility with recently revised Shuttle safety, power, and environmental requirements.

4. FY 1982 Planned Program: The Defense Satellite Communications System (DSCS) III full scale engineering development should be completed and the second DFS satellite launched using a Titan 34D/Inertial Upper Stage (IUS) for continued test and evaluation. The first DFS satellite will complete its test program and will support operational service. The refurbishment of the DSCS III qualification satellite will continue and should be available for a Shuttle/IUS launch in mid-1983. Following Defense Systems Acquisition Review Council recommendations and Deputy Secretary of Defense approval to proceed with DSCS III, the production of the first four DSCS III flight satellites will be initiated using the advance buy parts and items procured in FY 1981. First time launch vehicle integration and support will also be continued. A preproduction flight test model solid state amplifier will be completed and will be available for integration into the first production DSCS III satellite for orbital testing and evaluation.

5. Program to Completion: The second DFS satellite will complete its test program and will be available to support operational service. Production of the first four DSCS III flight satellites will continue. Four additional DSCS III production satellites will be acquired in FY 1984 with three procured in FY 1986. Advance buy parts and items for these satellites will be acquired in the year preceding satellite acquisition; fours sets in FY 1983 and three sets in FY 1985. The first time integration effort required for transitioning launch capability to the Shuttle/IUS should be completed in FY 1983. The refurbished qualification satellite will become available as a replenishment asset in mid-1983 with DSCS III production flight satellites available for Shuttle launch by September 1984. The Air Force, in conjunction with the Defense Communications Agency Military Satellite Communications System Office, is planning investigation and development efforts to provide for a future DSCS capability at Extremely High Frequency. Specific advanced communications technology efforts being pursued under Program Element 63431F, Advanced Space Communications, will be closely monitored for DSCS applicability and transitioning.

Program Element: #33110F
DOD Mission Area: Common User Communications, #323

Title: Defense Satellite Communications System
Budget Activity: Intelligence and Communications, #5

6. Milestones:

Defense Satellite Communications System (DSCS) II		DATE	
Initial Contract Award (F1 - F6)		Mar 69	
Initial DSCS II Launch (F1 - F2)		Nov 71	
Award contract for replenishment satellites (F7 - F12)		Oct 74	
Award contract for additional satellites (F13 - F16)		Jul 76	
Last DSCS II Launch (F13 - F14)	*(May 79)	Nov 79	1/
Remaining DSCS II launches - F15	*(Nov 79)	Jun 81	2/
- F16		Jun 82	

*Date presented in FY 1980 Descriptive Summary

Defense Satellite Communications System III		DATE	
Defense Systems Acquisition Review Council (DSARC) I - approval for preliminary design		Dec 74	
Award Phase I (Preliminary Design) Contracts		Dec 75	
DSCS III Preliminary Design Review		Oct 76	
DSARC II - full scale engineering development decision		Dec 76	
Award Phase 2 (Engineering Development) Contract		Feb 77	
Launch First Demonstration Flight Satellite	*(Apr 80)	Jun 81	3/
DSARC III Production Decision	*(Sep 80)	Dec 81	4/
DSCS III first production satellite launch		Dec 84	
DSCS III refurbished qualification satellite launch available		Sep 83	

*Date presented in FY 1980 Descriptive Summary

1/ Launch delayed because of launch pad conflicts with two other higher priority programs and the need to refurbish the pad between launches.

2/ DSCS F15 is launched paired with DGCS III Demonstration Flight Satellite (DFS) 1. The DSCS III full scale engineering development program has been delayed another year with DFS 1 scheduled for launch in about June 1981.

3/ Launch date changed because of additional full scale engineering development delays.

4/ DSARC III tentatively planned to occur six months after DFS 1 launch which is now scheduled for June 1981.

Program Element: #33110F
Title: Defense Satellite Communications System
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7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	60,600	34,200	22,837	11,000	Continuing	N/A

The increase in the Research Development Test and Evaluation (RDT&E) FY 1981 estimate is attributable to repricing and rephasing the first time integration effort and the impact of revised escalation indices on DSCS III satellite development, first time integration, and the solid state amplifier.

For the Missile Procurement Appropriation, the FY 1981 estimate is increased due to the impact of revised escalation indices on DSCS III production satellites, on-orbit performance incentives, and launch vehicle support. Also, some increase results from an additional requirement to procure DSCS unique IUS integration kits.

Budget Activity: Intelligence and Communications, 5

Program Element: 33110F - Defense Satellite Communications System (DSCS)

Test and Evaluation Data

1. Development Test and Evaluation: Development Test and Evaluation (DT&E) for the Defense Satellite Communications System (DSCS) II Space Segment is complete. For DSCS III, the evolutionary DSCS II replenishment satellite, DT&E is separated into two distinct phases which are coincident to the DSCS III development. During Phase One, which extended from Defense Systems Acquisition Review Council (DSARC) I in December 1974 to DSARC II in December 1976, development tests were conducted to demonstrate that technical risks had been minimized and that the satellite was "buildable". During Phase Two, which extends from DSARC II through DSARC III (production) in December 1981, design will be translated into a research and development satellite with the performance verified through a series of complex and inter-related tests.

In December 1975, two contractors were selected to accomplish DSCS III satellite preliminary design and to perform development tests to evaluate design concepts, substantiate critical areas of design as well as component environments, and verify adequacy of the system design approach by evaluating failure modes, design margins, and performance over a range of operating conditions. The Phase One test program was organized to identify design problems early so that corrective action could be taken, and to provide a high level of confidence in the ability of the hardware to meet qualification requirements. Tests constituted a demonstration of the adaptation of already-proven concepts and techniques. The development test program proceeded from parts, materials, and processes to breadboard/brassboard test on circuits and subassemblies. Also, selective testing of engineering critical items in each proposed subsystem was performed to minimize the risk associated with each. Tests of technical risk items included among others, the Multiple Beam Antenna (MBA), the Beam Forming Network (BFN), Traveling Wave Tube Amplifiers (TWTA), Super High Frequency (SHF) transponders, Attitude Control System electronics, Earth sensors, and the solar array deployment mechanism. The results of the Phase One test program were included in the respective contractor's preliminary design review. Performance and electrical characteristics of piece parts such as diode transistors, integrated circuits, hybrids, crystals, variable resistors and capacitors, were evaluated under the following conditions: thermal cycling, shock, accelerated life, mechanical environments, and survivability. Selective components and subsystems were evaluated using various tests. MBA components were tested functionally and evaluated after vibration, thermal cycling, and during thermal vacuum tests. The MBA engineering model performance was also evaluated to include critical array component stability during thermal cycling. Component survivability testing was conducted to determine the ability of components to perform in a nuclear environment. The results of these piece part tests allowed the selection of adequately hardened piece parts, utilization of most effective circuit designs, and optimized shielding to prevent function upset/outage, circuit burnout, or piece part degradation which would negate mission capability.

At the completion of the preliminary design effort, General Electric Company, Space Division, was selected to proceed with full scale engineering development and Phase Two testing following Defense Systems Acquisition Review Council (DSARC) II in December 1976 and Deputy Secretary of Defense approval in January 1977. The objective of Phase Two Development Test and Evaluation (DT&E) during full scale engineering development (February 1977-December 1982) is to continue with sufficient development testing to complete the design and attain a high confidence in DSCS III Demonstration Flight Satellite (DFS) performance. Phase Two testing is divided into three parts: in-plant, launch base, and on-orbit. The in-plant test program consists of a combination of: developmental testing using thermal, structural, and development models; qualification testing using a qualification model satellite to confirm design integrity; and acceptance testing using two DSCS III Demonstration Flight Satellites to confirm manufacturability. This testing will be incremental and will establish performance confidence as satellite integration proceeds. During launch base testing, each DFS will be tested to verify its launch readiness. Subsequent to launch, on-orbit testing will consists of three distinct sequential elements: (1) immediate post-injection evaluation of the performance of satellite support subsystems conducted by the Air Force Space Division (AFSD) via the Air Force Satellite Control Facility; (2) verification of communication subsystem and Super High Frequency (SHF) tracking, telemetry, and command (TT&C) performance via the Camp Parks radiometric test terminal; and (3) Initial Combined On-Orbit Development Test and Evaluation to evaluate the interoperability of the DFS with varied DSCS and non-DSCS earth terminals and to ensure its compatibility with the Satellite Configuration Control Element. This part of the testing will be managed by the Defense Communications Agency DSCS Program Manager and will be planned and conducted by the Army. Tests will be conducted in two distinct environments: (1) a controlled environment using the Integrated Test Facility at the U. S. Army Satellite Communications Agency, Fort Monmouth, New Jersey, and (2) a quasioperational test bed using the System Evaluation Network. The U. S. Army Operational Test and Evaluation Agency will support the combined DT&E and utilize the results, as applicable to avoid unnecessary duplication during the IOT&E evaluation phase.

In-plant testing is proceeding with the completion of thermal development model, structural development model, and development test model tests. Using the structural model, which is identical to the DFS and qualification satellite, a modal survey, solar array deployment and integrity, acoustic, and static load tests were performed. At this time, the qualification satellite communications payload and antennas are in qualification test and the qualification satellite is in initial integration test. The majority of components have started qualification and 38 have completed qualification less electromagnetic compatibility tests. The Attitude Control System simulation is complete, the 19-beam Multiple Beam Antenna has completed functional and acoustic testing, and the 61-beam Beam Forming Network completed qualification tests and is undergoing range testing. The North Panel communications system is in qualification test, and the South Panel TT&C and power subsystems are in integration tests. The following components have

or are completing qualification tests and are being integrated into the qualification satellite. The North Panel Power Controller, South Panel Power Controller, Ordnance Controller, Shunt Dissipators, batteries, power regulator unit, solar array, electrical harnesses, thermal heaters, thermal blanket supports, command telemetry unit, remote telemetry unit, beacons, Super High Frequency/S-band downconverters, S-band/intermediate frequency (IF) down-converter, attitude control electronics, sun sensor, rate gyros, earth sensor, reaction wheels, among others. For some of these, the complementary Demonstration Flight Satellite component has completed acceptance testing and integration. The results of the qualification North Panel tests verify that performance will meet or exceed some specification requirements. The 19-beam Multiple Beam Antenna and gimballed dish antenna qualification test results also meet or exceed specification requirements.

The current in-plant test schedule requires the completion of all component testing and qualification satellite assembly by July 1980. Qualification satellite testing will proceed from July 1980 through March 1981 with test results factored into the DFS design. The Qualification Test Satellite (QTS) will be subjected to electromagnetic compability tests, acoustic, pyro shock, thermal balance, and thermal vacuum environmental tests. The overall test objectives required to qualify the design of the QTS are:

(1) Verification that the satellite and its associated subsystem meet design performance characteristics.

(2) Verification of the design performance and compatibility of all subsystems for normal and backups modes of operation which are representative of mission usage.

(3) Demonstration of the design compatibility of the satellite with all electrical and mechanical support equipment in support of spacecraft level integration and test at the factory and launch base.

(4) Demonstration of the operability and functional performance of normally operating satellite subsystems and components during environmental conditions more severe than may be encountered in the launch, transfer orbit, and synchronous orbit phases of the mission.

(5) Verification that the satellite and associated subsystems survive exposure to the overstressed environment conditions and meet the design performance characteristics.

(6) Verification that the satellite and associated subsystem operational performance are not detrimentally affected and survive the spacecraft charging, electromagnetic pulse (EMP), and system generated EMP.

(7) Verification of the final thermal analytical modeling of the satellite.

(8) Demonstration of the design compatibility between the satellite and software systems.

(9) Development of the procedures and demonstration of the adequacy of these procedures for the handling, transportation, assembly, integration, and testing of the flight satellites.

2. Operational Test and Evaluation:

The Defense Communications Agency manages the overall Defense Satellite Communications System (DSCS) program, which includes the space and terminal segments. The operational test and evaluation (OT&E) program is a tri-service effort with the Air Force Systems Command Space Division (AFSD) (formerly Space and Missile Systems Organization (SAMSO) responsible for the acquisition, deployment, testing, and operational support of the space segment. The US Army is the executive agent for all ground terminal procurement, installation and testing. The Army's Operational Test and Evaluation Agency (USAOTEA) is the responsible independent test agency for OT&E.

a. The AN/FSC-78 (heavy terminal) completed a 113-day OT&E in late 1976. The OT&E was conducted by the US Army Communications-Electronic Engineering Installation Agency with Air Force Communications Command and Navy participation. The test item was a production terminal installed at Sunnyvale Air Force Station (AFS), CA. The terminal was operated and maintained by personnel assigned to Detachment 3, 1901 Communications Squadron, the operational unit at Sunnyvale AFS. The testing evaluated the operational technical performance, station and satellite interface, training, safety, human factors, logistics support, and reliability/availability/maintainability. There were no major deficiencies. The AN/FSC-78 terminal has been operational throughout the world since the OT&E.

b. The AN/GSC-39 medium terminal basically will use the AN/FSC-78 electronics, but will have a smaller antenna. The AN/TSC-86 (recently redesignated the AN/TSC-100) will be a small, transportable terminal. The Army will conduct (with Air Force and Navy participation) OT&E on these terminals in a manner similar to the AN/FSC-78 OT&E (the AN/GSC-39 in mid-1980, the AN/TSC-100 in early 1981).

c. DSCS III consists of the space segment and its Satellite Configuration Control Element. For the space segment, AFSD is responsible for the overall test and evaluation.

The USAOTEA will conduct, with tri-service participation (Air Force Test and Evaluation Center will manage the Air Force participation), a combined operational test and evaluation (OT&E). The OT&E will be conducted concurrent with development test and evaluation (DT&E) and will use DT&E-generated data when possible in order to reduce test duplication. The OT&E will begin 60 days after launch of the first satellite (currently anticipated to be June 1981) and will last for 60 days. The objectives will be to independently evaluate Defense Satellite Communications System (DSCS) III performance and operational effectiveness, to assess the anti-jam capabilities of the satellite and the Satellite Configuration Control Element (SCCE) (and the interface of these new items with current operational DSCS terminals), and to evaluate the SCCE logistics supportability and Reliability/Availability/Maintainability. The SCCE will be installed at Sunnyvale Air Force Station, CA, and will be operated by personnel from Detachment 3, 1901 Communications Squadron. The SCCE will be contractor (General Electric) maintained and supported. The first satellite will be a demonstration flight satellite and the SCCE will be an engineering development model, both of which will be quite similar to planned production items.

3. System Characteristics:

a. Satellite:

	OBJECTIVE/ DEMONSTRATED	OBJECTIVE	OBJECTIVE
Physical Characteristics	DSCS II (1-12)	DSCS IIA (13-16)	DSCS III
Size	9' Dia x 13'	9' Dia x 13'	9' x 6 1/2 x 6 1/2'
Weight (Dry)	1200 pounds	1240 pounds	1860 pounds
Stabilization	Spin 60 rpm	Spin 60 rpm	3 axis (inertial)
Mean Mission Duration	38 months	38 months	76 months
Design Life	60 months	60 months	120 months
Performance Data			
Frequency	7-8 GHz	7-8 GHz	7-8 GHz
Transponders	2-20 watt	2-40 watt	4-10 watt & 2-40 watt
EIRP (dBw), DSCS II 1/			
Earth Coverage (EC)	28	31	N/A
Narrow Coverage (NC) Both	40	40	"
Area Coverage (AC) Powered	28.5	33	"
Narrow Coverage Only (No AC)	43	46	"
Area Coverage Only (No NC)	31.5	34.5	N/A
EIRP (dBw), DSCS III 2/			
Channel 1&2 - EC (MBA) or NC (Spot) or AC (Dish)	N/A	N/A	30 or 40 or 44
Channel 3 - EC (Horn) or EC (MBA) or NC (Spot)	"	"	25 or 24 or 34
Channel 4 - EC (Horn) or EC (MBA) or NC (Spot) or AC (Dish)	"	"	25 or 24 or 34 or 38
Channel 5&6 - EC (Horn)	"	"	25
Beacons (EC)	"	"	13

1/ Consisting of two Earth Coverage (EC) Horns (1 receive and 1 transmit) and 2 parabolic dish antennas (one Narrow Coverage (2°) beam and one Area Coverage (6°) beam).

2/ Consisting of four Earth Coverage Horns (2 receive and 2 transmit), one 61 element receive Muliple Beam Antenna (MBA), two 19 element transmit MBAs and one parabolic dish antenna (3.5° beam). The spot beam refers to the use of one beam in the MBA. Channels 1 and 2 have 40 watt TWTAs. Channels 3-6 have 10 watt TWTAs.

b. DSCS Terminals:

	AN/TSC-54	AN/MSC-46	AN/FSC-78	AN/FSC-86	AN/GSC-39
Antenna size (feet)	18(folding) (Air Mobile)	38	60	20	
Gain/System Noise Temperature (dB/^{o}K)			39	26	
Effective Isotropic Radiated Power (dBm)	118	122	127	111	
Reliability:					
o Mean-Time-Between-Failure (MTBF)(HRS)					
o Objective	274	375	1003	1000	1000
o Demonstrated	1404	546	3276	*	*
o Confidence level	95	95	98	*	*
o Mean-Time-to-Repair (MTTR) (HRS)					
o Objective	.37	1.67	1.0	1.0	1.0
o Demonstrated	.74	2.14	.95	*	*
o Subsystem Element Availability					
o Objective	None	None	99.98	99.9	99.9
o Operational	99.95	99.61	99.97	*	*

*Terminals in development; no operational data existent

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 33126F
DOD Mission Area: Common User Communications, #323
Title: Long Haul Communications - DCS
Budget Activity: Intelligence and Communications #5

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	TITLE	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL PROGRAM ELEMENT	5,540	8,000	11,400	9,900	Continuing	N/A
1144	Automated Technical Control (ATEC)		659	608	416	108	18,067
2022	Automated Digital Communications Processing	1,413	2,236	3,801	3,160	Continuing	N/A
2155	Systems Control	1,037	2,065	3,490	3,114	Continuing	N/A
2157	Transmission Improvements	2,910	2,840	3,001	2,910	Continuing	N/A
2206	Digital European Backbone (DEB)	180	200	200	200	300	1,640
2440	Secure Voice Improvements Program (SVIP)			300	100	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element is the United States Air Force (USAF) portion of the tri-Service RDT&E program for the Defense Communications System (DCS). The DCS provides the long haul, point-to-point, and switched network telecommunications needed to satisfy requirements of the National Command Authorities, the Department of Defense and certain other Government agencies. The DCS RDT&E program is structured to define system and subsystem architecture, specify design parameters, and develop telecommunications technology for DCS modernization and improvement. Work in this element provides the equipment for an orderly transition to a unified second generation DCS (1985) and determines the architecture for the third generation DCS. It includes technology development and subsystem implementation in the areas of automated digital communications processing and distribution techniques, performance assessment and networks management improvements, and transmission improvements.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds to develop a Automatic Digital Network Phase II (AUTODIN II) - multi-network gateway to interconnect AUTODIN II with other data networks, to integrate control features of digital transmission upgrades into the overall DCS system control structure, and to develop improved transmission subsystem equipment.

Program Element: #33126F Title: Long Haul Communications - DCS
DoD Mission Area: Common User Communications, #323 Budget Activity: Intelligence and Communications, #5

OTHER APPROPRIATION FUNDS:	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Other Procurement (3080)						
Project 1144 (ATEC)	7,824	2,400	3,562	9,682		52,930
Project 2206 (DEB)	8,100	2,127	13,100	14,237		72,321
Project 2440 (SVIP)		5,330	2,900	2,530	Continuing	N/A
Military Construction (3300)						
Project 2206 (DEB)	2,040			2,450	3,250	7,740

Program Element: #33126F Title: Long Haul Communications - DCS
DoD Mission Area: Common User Communications, #323 Budget Activity Intelligence and Communications, #5

DETAILED BACKGROUND AND DESCRIPTION: Project 1144 Automated Technical Control (ATEC). The purpose of the equipment being procured by this project is to monitor the performance of analog and digital transmission subsystems. ATEC equipment will perform trend assessment (permitting recognition and correction of impending failure prior to an outage), fault isolation (reducing down time), and status reporting. Initial installation will be in Europe to enhance technical control of the Digital European Backbone (DEB).

Project 2022 Automated Digital Communications Processing. As the Defense Communications System (DCS) transitions to an all digital system, three units are required to provide service which meets customer needs. These units will be designed and tested under this project. First a centralized service facility assumes features of existing Automatic Digital Network switches. Second is a gateway element which will provide the interface between the DCS and other digital networks. The ability to connect the DCS to other digital networks will provide significant cost savings and more timely information exchange between Defense and non-Defense customers. Third is a feasibility demonstration of features such as automated based distribution (electronic mail), digital facsimile, and word processing. The purpose of this demonstration is to assess potential cost savings and manpower reductions accruing from their use. $206K of the funds requested for this project are for reimbursement of salaries at Rome Air Development Center (RADC).

Project 2155 System Control. The purpose of this project is to develop system control techniques, algorithms, and hardware and software specifications which provide automated traffic reroute and restoral worldwide. Basic data on traffic loading will come from DCS switches, data on system performance from ATEC equipment. The combination of ATEC and system control equipment will improve DCS traffic management effectiveness by more than thirty percent. $196K of the funds requested for this project are for reimbursement of salaries at RADC.

Project 2157 Transition Improvements. The objective of this project is to improve transmission survivability, efficiency, capacity, and reliability of Air Force and DCS communication links by operational application of new transmission media such as millimeter wave and fiber optics, and by developing transmission equipment embodying new techniques and technology.

Project 2206 Digital European Backbone (DEB). Under this project, a digital transmission system is being installed in four phases in Europe (Coltano, Italy to England). DEB is a follow-on to the prototype digital transmission system now in operation between Frankfurt and Vaihingen. DEB equipment replaces obsolete analog equipment, improves security, and increases capacity. It is the first major digital transmission subsystem in the Defense Communication System (DCS). The initital phase of DEB was completed in November 1979.

Project 2440 Secure Voice Improvement Program (SVIP). The SVIP was restructured in accordance with FY 1979 Congressional guidance. This project supports the Defense Communications Agency's program outlined in their Five Year Plan.

Program Element: #33126F
DoD Mission Area: Common User Communications, #323
Title: Long Haul Communications - DCS
Budget Activity: Intelligence and Communications, #5

RELATED ACTIVITIES: Both the Digital European Backbone (DEB) and Automated Technical Control (ATEC) projects (2206 and 1144) involve tri-Service funding. Both involve installation of equipment at Army, Navy, and Air Force sites. Overall program management for these projects is exercised by the Defense Communications Agency (DCA) through appropriate DCA Management Engineering Plans. The remaining four projects (2022, 2155, 2157, and 2440) are part of the coordinate Defense Communications System (DCS) RDT&E program as directed by the DCA Five Year Program (FYP). Each Service programs funds to support work directed by the DCS FYP.

WORK PERFORMED BY: Air Force Systems Command manages this program element through the Electronic Systems Division, Hanscom AFB, MA (Project 1144, 2206, and 2440) and the Rome Air Development Center, Rome, NY (Projects 2022, 2155, and 2157). Contractors for Rome Air Development Center (RADC) projects are: GTE Sylvania, Needham, MA (Automated Communications Performance Monitoring and Assessment); Harris Corporation, Melbourne, FL (16KBS Modem); Softech, Waltham, MA (HOL Investigation); and Plessey-Fairfield, Fairfield NJ (Communications Processor Operation System). Potential bidders include: Signatron, Inc. Lexington, MA. (Communications Software Development Package); Martin-Marietta Communications Division, Orlando, FL (Channel Reconfiguration Multiplexer, ATEC/TOCF Study). Contractor for Electronics System Division is Ford Aerospace and Communications Corp., Colorado Springs, COL (ATEC). General systems engineering is performed by the MITRE Corporation, Bedford, MA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments:

Project 1144: The Automated Technical Control (ATEC) Low Rate Initial Production (LRIP) contract was awarded on 11 August 1978 to Ford Aerospace and Communications Corp., Colorado Springs, CO. The second increment of LRIP equipment was procured for joint test and evaluation in Europe.

Project 2022: Fifty Two/four Wire Digital Subsets (digital telephones) and associated digital converters were delivered for comparative evaluation of digital non-secure voice terminals at Ft. Huachuca, AZ. These telephones can use unmodified analog base cable plants to provide the same quality digital voice service normally obtained on four wire instruments. Work continued on the Communications Oriented Language (COL) and communications software package developments.

Project Element: #33126F Title: Long Haul Communications - DCS
DoD Mission Area: Common User Communications, #323 Budget Activity: Intelligence and Communications #5

Project 2155: The System Control/Tactical Communications System Interface System addressed protocols and data exchange necessary for effective system control across the Defense Communications System (DCS)/Tactical Communications System boundary. An advanced development model of an automated control reroute unit which eliminates manual patch cords was fabricated. Prototype digital performance monitoring equipment was delivered for testing. Work continued on Interface Study and automated channel reroute advanced development model.

Project 2157: Based on the FY 1977 timing and synchronization study, an experimental model of a timing subsystem was built. Following successful FY 1978 Continental United States (CONUS) and overseas demonstration of the 16KBS data modem, full scale engineering development models were fabricated. Comprehensive development test and evaluation will be conducted prior to a Low Rate Initial Production decision. Initial efforts on an advanced development model of an associative communications multiplexer began. Advance development model fabrication of the timing subsystem continued.

Project 2206: Research and Development (R&D) funding for program office implementation and test support continued. Final Operational Capability (FOC) of Stage I (Coltano, Italy to Vaihingen, Germany) will occur in FY 1980. Equipment installation at Stage II sites (central Germany, north to Schoenfeld) began.

2. FY 1980 Program:

Project 1144: FY 1980 R&D funds will pay for Air Force Test and Evaluation Center (ATEC) costs associated with joint Initial Operational Test and Evaluation (IOT&E) of Low Rate Initial Production (LRIP) equipment in Europe. Upon successful completion of this testing, the Automated Technical Control (ATC) major production decision will be made.

Project 2022: Development of the Communications Oriented Language will be completed and the Communication Software Package development will continue. Under Department of Defense (DOD) leadership, the combined results will be used as the basis for a new task which will develop the communications subset of the standard DoD language called DOD-1. In cooperation with the Defense Communications Engineering Center (DCEC), the Air Force will design, build, and test a fifth node for DCEC's Experimental Integrated Switched Network (EISN). The purpose of the EISN is to determine the architecture, protocols, and features required for the third generation Defense Communication System. Work will begin on the gateway element between the Defense Communications System (DCS) and other digital networks.

Project 2155: The System Control/Tactical Communication System Interface study will be complete. Study results will be used to develop hardware and software specifications for modifications to ATEC and Tactical Communication Control Facility equipment. These modifications will permit the exchange of data between systems for effective system control across the DCS/Tactical Communication System boundary. The advanced development model of the automated channel reroute unit will be completed and undergo extensive in-plant testing. FY 1980 funds will also be used to begin work on modifications to the Automatic Voice Network (AUTOVON) Centralized Alarm System and Traffic Data Collection System. These modifications will improve the accuracy and availability of data from these systems and provide baseline data for worldwide automated traffic reroute and restoral. Work will begin on electronic counter countermeasures isolation techniques.

Project Element: #33126F Title: Long Haul Communications - DCS
DoD Mission Area: Common User Communications, #323 Budget Activity: Intelligence and Communications #5

Project 2157: Full scale engineering development and testing of the 16KBS data modem will be completed in FY 1980. A decision to proceed with Low Rate Initial Production will then be made. The work on an advanced development model of the associative communications multiplexer will continue. Electronic counter measures vulnerability assessments will begin to determine impact on the Defense Communications System (DCS). The assessments will use vulnerability measurements of DCS microwave and troposcatter equipment.

Project 2206: Research and Development (R&D) funding for program office implementation and test support will continue. Equipment installation at Stage II sites will continue.

Project 2440: FY 1980 other procurement funds will acquire initial production units of the AN/GSC-38 modem and interfaces to operate over AUTOVON.

3. FY 1981 Planned Program:

Project 1144: Station level Initial Operational Capability (IOC) for three stations is scheduled for FY 381. All Low Rate Initial Production equipment will be delivered and installed. Initial Production equipment will be delivered and installed. Initial Operational Test and Evaluation leading to an integrated system IOC will begin.

Project 2022: FY 1980 development efforts will continue. Delta from FY80 to FY81 due to procurement of R&D equipment to expand terrestial/satellite interface node and expanded effort on AUTODIN II multinet gateway.

Project 2155: Specifications for competitive procurement of the automated channel reroute unit will be prepared. Work will continue on modifications to the Automatic Voice Network (AUTOVON) Centralized Alarm System and Traffic Data Collection System. Automated performance assessment and monitoring for user access area communications work will begin. Contractual efforts on ECCM discriminator and interoperation of system controls will be expanded.

Project 2157: Development, test and evaluation of an advanced development model of the associative communications multiplexer will be conducted. Troposcatter adaptive antenna development will begin.

Project 2206: Research and Development (R&D) funding for program office implementation and test support will continue. Work (United Kingdom (UK) upgrade) will continue on stage II sites (central Germany, north to Schoenfeld). Stage IV construction will begin. Stage III work is held in abeyance until after a planned British microwave upgrade, known as BOXER, is formulated.

Program Element: #33126F Title: Long Haul Communications - DCS
DoD Mission Area: Common User Communications, #323 Budget Activity: Intelligence and Communications #5

4. FY 1982 Planned Program:

Project 1144: Initial Operational Test and Evaluation (IOT&E) will be completed. Upon successful completion of IOT&E, a scheduled FY3 82 integrated system initial operating capability will be realized. The follow-on production decision and contract award will be made.

Project 2022: FY 1981 development efforts will continue.

Project 2155: The modifications to the AUTOVON Centralized Alarm System and Traffic Data Collection System work will continue. The automated performance assessment and monitoring for user access area communications work will begin in FY 1981 and will continue through FY 1984.

Project 2157: Troposcatter adaptive antenna development will be completed. Work on the assessments for electronic counter measures vulnerability measurements of Defense Communications System microwave and troposcatter equipment will continue.

Project 2206: R&D funding for program office implementation and test support will continue. Fourteen links of stage II will achieve final operational capability by FY4 82. Stage IV work continues. Stage III planning will be finalized.

Project 2440: Efforts will continue in support of Defense Communications Agency's Secure Voice Improvement Program.

5. Program to Completion: This is a continuing program responsive to the Defense Communications Agency's Tri-Service program for the Defense Communication System (DCS). The two implementation projects (1144 - Automated Technical Control (ATEC), 2206 - Digital European Backbone (DEB)) are scheduled for completion as follows: ATEC - FY 84, DEB - FY 86. Technology developments projects (2022, 2155, and 2157) are continuing projects which define system and subsystem architecture, specify design parameters, develop telecommunications technology, and provide the hardware and software required for DCS modernization and improvement.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: Not Applicable, no change.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 33144F

Title Electromagnetic Compatibility Analysis Center (ECAC)

DOD Mission Area: Other Support Programs, #325

Budget Activity Intelligence and Communications, #5

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5,365	5,600	6,000	6,600	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: ECAC is a Department of Defense (DoD) facility, managed by the Air Force. ECAC is the only DOD facility that develops, maintains and utilizes the electromagnetic compatibility (EMC) analysis and communications-electronics (C-E) environment definition capability to predict and determine the electromagnetic interference (EMI) to and from United States C-E systems in development and operation. To perform these analyses, most of which are accomplished on a user reimbursed basis, ECAC must maintain and continually update via computer its C-E environmental files which characterize almost every receiver and transmitter in the world. In addition, since the frequency spectrum usage is increasing and the C-E systems in development are more complex, ECAC must develop computer tools to model C-E systems propagation media, earth terrain, and all aspects of the environment which could affect a C-E system.

BASIS FOR FY 1981 RDT&E REQUEST: This funding provides for non-reimbursed EMC analyses for DoD C-E systems; frequency spectrum allocation and assignment support to the J-12 Working Group; development and maintenance of analytical models and computational programs necessary to support EMC analyses performed by ECAC; and the development of EMC Data Bases and the Frequency Resource Record System (FRRS). In addition, the program provides a share of cost of the necessary facilities (computer, materials, services, buildings) and their operation to support approximately 672 personnel; provides civil service pay and government travel; and covers the cost of obtaining measurements from other military activities to validate models, analytical techniques, and define C-E system characteristics.

OTHER APPROPRIATION FUNDS: Not applicable

Program Element: # 33144F

Title Electromagnetic Compatibility Analysis Center (ECAC)

DOD Mission Area: Other Support Programs, #325

Budget Activity Intelligence and Communications, #5

DETAILED BACKGROUND AND DESCRIPTION: The Electromagnetic Compatibility Analysis Center (ECAC) is a Department of Defense (DoD) facility established to provide advice and assistance on electromagnetic compatibility (freedom from radio interference) problems to the Secretary of Defense, Joint Chiefs of Staff, the military departments and other DoD components. The Center, at Annapolis, MD, is managed by the Air Force, but is available to all DoD users. The Chairman Joint Chiefs of Staff, and the Assistant Secretary of Defense (ASD) (Communications, Command, Control and Intelligence) jointly provide policy guidance, assign projects and establish project priorities. The Center consists of an Air Force Commander, Deputies for Army, Navy, Marine Corps, Air Force, and Special Projects, and an in-house technical management staff assisted by a contractor. ECAC's primary function is the analysis of identified DoD inter-system and system-to-environment Electromagnetic Interference (EMI) problems and the prediction of the Electromagnetic Compatibility (EMC) of Communications-Electronics (C-E) in development and in current and projected operational electromagnetic environments. These analyses include consideration of the impact of telecommunications equipment on both civilian and military C-E environments (and vice versa), identification of the probable operational degradation of system performance and the consideration of efficient use of the available frequency spectrum to enhance spectrum management. Other analyses performed are those on frequency allocations and assignments in support of the frequency management in the military departments and the Unified and Specified Commands. To perform the EMC analyses, ECAC maintains and develops basic analysis techniques (manual and computerized) including models (propagation, receiver degradation, antennas, and inter-system), predication analysis systems (cosite radar and non-linear), and special techniques (EMC modeling for calculators, user's EMC manuals, analysis procedures, and standards analysis). In addition to the analysis techniques, ECAC maintains and develops an extensive C-E environmental data base which contains millions of pieces of data to perform the EMC analyses. The data base files include information on the location and operating characteristics of United States (U.S.) and foreign C-E equipment and systems, the equipment complements of specific vehicles or platforms (ships, army, units, aircraft, etc.), the allocation and use of the frequency spectrum and all associated U.S. and international rules and regulations, digitized topographic data (U.S. and other nations), and future C-E equipments and systems in development or conceptual stages.

ECAC also provides the necessary facilities to perform its mission. This includes computer rental and operations, administrative support, purchased supplies and services, building rental, and contract functions. ECAC is funded with both RDT&E and Operations and Maintenance (O&M) appropriations. The O&M (P3400) funds are used primarily to support the military services' operational community. This includes performance of operational analysis projects, data base and frequency resource record system (FRRS) outputs, and the maintainence and operation of the DoD EMC Data Base of which the FRRS is a part.

RELATED ACTIVITIES: ECAC performs EMC analysis for major DoD C-E systems. These system analysis projects are funded by reimbursements from users. These reimbursed funds are estimated to be $13.2 million in FY 1980, $16.5 million in FY 1981 and $19.1M in FY 1982. In FY 1980 for example, more than 164 seperate projects for the Army, Navy, Marine Corps

and Air Force will be supported. In addition, approximately 42 other Department of Defense (DoD), joint agency, and other Federal agency projects will be addressed by Electromagnetic Compatibility Analysis Center (ECAC). Examples of systems being analyzed for the Air Force are the E-3 and E-4 aircraft, Joint Tactical Information Distribution System (JTIDS), Air Force Strategic Satellite System, Global Positioning System, Continental United States (CONUS) Over-the-Horizon radar, Digital European Backbone System, and MKXII Technical Improvement Program. For the Army Topographic Support, Communications Command Systems, Division Air Defense Gun System, Pos tion Location Reporting System, and US ROLAND. Navy projects include F-18, Special Electromagnetic Interference Project, Surface Missile System (AEGIS), and PHALANX. For the Marine Corps, the projects include the Tactical Communication Electromagnetic Compatibility (EMC) Analysis and operational support to the Marine Corps. Efforts of mutual DoD and other Federal Agencies (Federal Communications Commission (FCC), Federal Aviation (FAA), Commerce, Treasury, etc.) concern include projects such as Microwave Landing System, Air Traffic Control Frequency Assignment System, the Air-Ground-Air Frequency Assignment Program, and EMC of Communications and Control Systems. The Center also exchanges data, math models, and computer programs with other agencies involved in frequency management such as the Department of Commerce, Interdepartmental Radio Advisory Committee, and the Office of Telecommunica Policy.

WORK PERFORMED BY: The responsible Air Force agency is the Electromagnetic Compatibility Analyses Center, Annapolis, MD, (administratively considered as an Air Force element of the Electronic Systems Division, Hanscom AFB, MA, which performs the contracting funtion). The current contractor is the IIT Research Institute, Annapolis, MD.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In recent years, the program element funding provided the operation, maintenance and administration, updating of data, and the continued development of capability. Timely short term responses to operational problems from Southeast Asia, Europe, and the Continental United States were provided. Frequency assignment analyses have been continuous, and analyses of equipment, proposed or in research and development, have been documented in technial reports, beginning in FY 1973, the Frequency Resource Record System (FRRS) provided major frequency record keeping functions for several Unified and Specified Commands on a test basis. In 1974, the test was expanded to include most of the Unified and Specified Commands. With this system, world-wide frequency utilization of the Commands is maintained at the Center to provide quick response assistance to the operational forces on frequency utilization questions. Other work included continued development, updating and maintenance of the data base, and advanced mathematical modeling to simulate characteristics of new types of receivers, transmitters and circuits.

In FY 1975, data base maintenance and outputs continued. Software updating improved efficiency. The Frequency Resource Records System (FRRS) continued operational test in support of most of the Unified and Specified Commands Emphasis was on analyses of equipment and systems in the development phase. Mathematical models were developed for new types of modulation and new scenarios. The FRSS continued to operate successfully in the final phase.

Program Element: # 33144F

Title Electromagnetic Compatibility Analysis Center (ECAC)

DOD Mission Area: Other Support Programs, #325

Budget Activity Intelligence and Communications, #5

During FY 1976-1979, Electromagnetic Compatibility (EMC) system analysis was perfored and continuation of Center outputs such as data base, operational analysis support, Frequency Records Resource System (FRRS), and Frequency allocation and assignment assistance was provided. Model development included improvement of the high frequuency (HF) skywave and antenna models, satellite propagation, frequency division multiplex/frequency modulated models, conventional radar antenna models, system modeling and prediction analysis system models. The FRRS development continued with the Air Force portion being completed. ECAC analyzed and formulated the Department of Defense (DoD) and Services positions relative to the General World Administratie Radio Conference (GWARC) that was held at Geneva in 1979. All world nations attend this conference. Therefore, it was imperative for the United States (U.S.) to be ready to defend or negotiate and portray its frequency spectrum needs through year 2000. RDT&E funding was also used to continue the required facility support which includes civil service pay, military and civil service travel and training, administration, computer operations, and facilities operation. Portions of this facility are supported with Operations and Maintenance (O&M) and reimbursed funds on a prorated basis. In FY 1979, the ECAC manpower to support its mission was 612 staff of which 555 were contractor and 54 military/civil service. Of the 555 contractor, 271 were used in analysis efforts, 56 in development, 86 in data base and FRRS maintenance/outputs/development, 31 in computer operations and 111 in facility support.

2. FY 1980 Program: RDT&E funding will provide continued Data Base and FRRS development and the expansion of model development capabilities in all areas of problem solution, further extending frequency ranges and improving the accuracy of existing analysis methods. The analysis project effort will expand as demand by Defense and other government agencies for analysis services continues to increase. The great majority of analysis projects, for both Defense and non-Defense activities, are financially supported by those activities through reimbursement. In addition to above, pre-GWARC activities in support of DoD and the services requirements will be completed. Post-GWARC work is anticipated. Facility support will be provided with both RDT&E and O&M funds on a prorated bases The increased Electromagnetic Compatibility (EMC) analysis requirements will increase the ECAC staff to 683 (629 contractor and 54 military/civil service). Of the 629 contractor, 321 will be devoted to analysis efforts, 48 to development support, 101 to data base and FRRS maintenance/outputs/development, 34 to computer operations and 125 to facility support.

3. FY 1981 Planned Program: The FY 1981 plan will be similar in content to the FY 1979 and FY 1980 activities shown above. Again it is anticipated that as systems become more complex and the frequency spectrum availability decreases, nationally and internationally because of more utilization, the EMC problems and requests for analysis and data will increase. Post-GWARC support is anticipated. With the anticipated increase in analysis and support, ECAC estimates that its staff will increase to 726 (672 contractor and 54 military/civil service). Of the 672 contractor, 354 will be devoted to analysis efforts, 48 to development, 101 to data base and FRRS maintenance/outputs/development, 36 to computer operations and 133 to facility support.

Program Element: # 33144F

Title Electromagnetic Compatibility Analysis Center (ECAC)

DOD Mission Area: Other Support Programs, #325

Budget Activity Intelligence and Communications, #5

4. FY 1982 Planned Program: The FY 1982 plan will be similar in content to FY 1981 activities with the completion of many analysis efforts and the undertaking of new efforts. The capability development will continue since the sophistication of electronic systems communications systems will increase. Post-General Worldwide Administrative Radio Conference (GWARC) support is expected to continue. Because of the previous fiscal year increases in requirement and complexity, it is predicted that the manpower requirements will also increase in FY 1981.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979* Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT						
	FY 1980 Descriptive Summary	5,000	5,600	5,600	5,900	Continuing	N/A

* FY 1979 adjusted to reflect actual cost.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 33401F
DOD Mission Area: COMSEC #324

Title: Communications Security (COMSEC)
Budget Activity: Intelligence and Communications #5

RESOURCES (PROJECT LISTING): ($ in thousands)

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	1100	1100	1100	1100	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The principal objective of this program is the improvement of communications security within the United States Air Force (USAF). It is a continuing effort divided into several task areas. The overall effort is part of National COMSEC Program managed by the National Security Agency with participation by other services/agencies. The USAF portion of this overall program addresses problems encountered in adapting general purpose cryptographic equipment for use in new communication systems. The efforts are primarily directed at insuring that all systems being developed by the Air Force meet current national COMSEC requirements. Specific emphasis is placed on correcting any known deficiencies.

BASIS FOR FY 1981 RDT&E REQUEST: This level of effort program supports all Air Force COMSEC Research, Development, Test, and Evaluation (RDT&E). Tasks under this project include RDT&E support of the development of advanced narrowband digital voice techniques for COMSEC applications, development of a secure telemetry capability for the national test ranges, the development of new secure communications techniques using fiber optics, and the evaluation of hazards and the means of protecting against the hazards of non-desired radiation. The project supports the USAF Electronic Security Command in providing compromising emanations testing for all Air Force cryptographic equipment.

OTHER APPROPRIATION FUNDS: Not Applicable

The procurement funds associated with PE 33401F are for procurement of COMSEC equipment developed by the National Security Agency and are not directly related to tasks being performed in the COMSEC RDT&E program.

Program Element: # 33401F
DOD Mission Area: COMSEC #324

Title: Communications Security (COMSEC)
Budget Activity: Intelligence and Communications #5

DETAILED BACKGROUND AND DESCRIPTION: This program accomplishes Communications Security (COMSEC) Research, Development, Test and Evaluation (RDT&E) for improved security in United States Air Force (USAF) systems. It is a continuing effort divided into several task areas. The overall effort is part of a National COMSEC Program managed by the National Security Agency (NSA) with participation of all the services. Such an organization fosters exchanges of COMSEC technology, reduces duplication, and insures that national COMSEC objectives are being satisfied with a high degree of commonality.

RELATED ACTIVITIES: The NSA is the overall manager of COMSEC equipment RDT&E under the policy guidance of the Assistant Secretary of Defense (Communications, Command, Control and Intelligence). The services perform efforts under common Program Element #33401. The Air Force Electronic Security Command performs COMSEC testing on off-the-shelf equipment selected for operational use in the USAF and also recommends the use of cryptographic equipment to operational commands.

WORK PERFORMED BY: All research and development tasks under this program are managed through the Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA. Contractors are: Lincoln Laboratories, Bedford, MA; National Bureau of Standards, Boulder, CO; Booz-Allen, Bethesda, MD; ARCON, Wakefield, MA; DYNASTAT, Inc., Austin, TX.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: This project has supported Air Force RDT&E on fiber optics communications and has demonstrated the use of fiber optics for both system control and COMSEC functions. NSA has tested a secure fiber optics system developed under this program. The Air Force and Navy have a joint program to provide secure telemetry for test ranges at Eglin, Edwards and Kirtland Air Force Bases and the Eastern and Western test ranges. A secure communications controller was tested at the Air Force Data Services Center and is being further developed by NSA. An automated compromising emanations analysis system to improve the manpower intensive nature of compromising emanations testing was delivered to the Air Force COMSEC Center.

2. FY 1980 Program: Fiber optics development will continue with the development of advanced intrusion resistant cables. Joint service testing in fiber optics with NSA participation will be conducted and a pilot system will be installed for the Defense Logistics Agency. Work in the voice processing area will emphasize solution of problems in high noise environments and participation in the Narrowband Secure Voice Consortium will continue. Support will continue to the Air Force COMSEC Center compromising emanations testing program with continued research into automated techniques and compromising emanations problems.

3. FY 1981 Planned Program: The Program Office will continue to provide support to the development of equipment for compromising emanations testing and intrusion resistant fiber optics and will support the Department of Defense Narrowband Secure Voice Consortium. Work will begin to define techniques for signals security analysis.

Program Element: #33401F
DoD Mission Area: COMSEC #324

Title: Communications Security (COMSEC)
Budget Activity: Intelligence and Communications #5

4. FY 1982 Planned Program: The Program Office will continue to provide support to the development of equipment for compromising emanations testing and will support the DoD Narrowband Secure Voice Consortium. Investigation of techniques for signals security analysis will continue with a goal of FY 1983 for initial operational capability.

5. Program to Completion: This is a continuing program with emphasis shifting among efforts as Air Force priorities and resources dictate. Major emphasis will continue on narrowband voice processing requirements and compromising emanations testing equipment.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: No change

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 35114F
Title: Traffic Control and Landing Systems (TRACALS)
DoD Mission Area: Navigation and Position Fixing #321
Budget Activity: Intelligence & Communications #5

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,898	4,200	3,100	2,200	Continuing	N/A
1956	TPN-19 Improvements	236	1,400	1,400	100		3,136
2026	System Support	139	200	200	300	Continuing	N/A
2148	LORAN C/D	296	2,300				25,000
2463	MK XII IFF Improvement	2,227	*	*	*		
2610	Berlin Long Range Radar			500	800		1,300
2681	GPN-22 ECCM		300	1,000	1,000		2,300

* FY 80, 81 and 82 funding within PE 64725F

BRIEF DESCRIPTION OF ELEMENT AND MISSION: The purpose of this program is to provide the Air Force with the Air Traffic Control and Landing equipments required for safe, efficient, worldwide, all weather Air Force flying operations. The TRACALS system will be improved/modernized by updating existing systems to provide increased performance/reliability and by developing new systems to support execution of the Air Force flying mission.

BASIS FOR FY 1981 RDT&E REQUEST: This year's efforts include the engineering design and development of maintenance and reliability improvements for the TPN-19, Landing Control Central. The design and development of electronic counter-countermeasures (EECM) for the Berlin long range radar will be initiated. The design, development and fabrication of ECCM fixes for the Berlin precision approach radars (GPN-22) will be completed.

OTHER APPROPRIATION FUNDS:

	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
Procurement (P-3080)	5,500	13,900	Continuing	N/A

Program Element: # 35114F
DoD Mission Area: Navigation and Position Fixing #321

Title: Traffic Control and Landing Systems (TRACALS)
Budget Activity: Intelligence & Communications #5

DETAILED BACKGROUND AND DESCRIPTION: The TRACALS program was established to provide single management of the many related programs required to modernize the electronic equipments which comprise the Air Force Traffic Control and Landing System (TRACALS). Maximum use is made of state-of-the-art, off-the-shelf equipments to meet this goal. TRACALS Research and Development efforts are aimed toward the development of technology and equipment required to satisfy the Air Force's unique military worldwide flying mission. Current efforts are concentrated in three areas. First, an effort is on going to correct Follow-on Operational Test and Evaluation deficiencies of the AN/TPN-19, Landing Control Central, that prevent safe air traffic control in medium to high density environments. Second, a development effort is being concluded to improve the reliability of the transmitter electronics in the AN/TRN-38 LORAN C/D ground chain. The goal of this effort is to design, develop and test new circuits with lower life cycle costs. Third, BAMBOO TREE is the program to assure air access to Berlin. Currently, two BAMBOO TREE programs are planned to add electronic counter countermeasures (ECCM) to the Berlin precision approach radars and to the Berlin long range radar.

RELATED ACTIVITIES: This program is related to, and coordinated with, the Federal Aviation Administration's National Airspace System as well as Army and Navy activities in the area of air traffic control.

WORK PERFORMED BY: The Air Force Electronic Systems Division, Hanscom AFB, MA is responsible for the management of the projects included under this program. Contractors are: Raytheon, Waltham, MA; Sperry Gyroscope Division, Sperry Rand Corp, Great Neck, NY; ARINC Research Corp, Annapolis, MD; Texas Instruments Inc, Dallas, TX.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The Air Force reinstated the TRACALS Program in 1969 to develop equipment for unique military requirements. Past efforts have included development of an airborne Tactical Air Navigation (TACAN) receiver, a fixed base Precision Approach Radar, radars for both fixed and mobile needs, and a Tactical LORAN C/D ground chain. Study efforts have included Collision Avoidance System investigations and Microwave Landing System studies on multipath, doppler techniques and flight profiles. Specific 1979 efforts included investigation of causes of high failure rate of the transmitter electronics of the tactical LORAN C/D ground chain.

2. FY 1980 Program: The TRACALS FY 1980 research and development efforts include the development and fabrication of an improved communications system for the AN/TPN-19, Landing Control Central. The development, fabrication and test of transmitter electronics with lower life cycle cost for the tactical LORAN C/D ground chain will be completed and a production decision made. The investigation of ECCM techniques for the AN/GPN-22 Precision Approach Radar will be accomplished. Support to the Federal Aviation Administration's Microwave Landing System has been limited to participation in technical discussions and travel to support Army source selection activities.

Program Element: # 35114F
DoD Mission Area: Navigation and Position Fixing #321

Title: Traffic Control and Landing Systems (TRACALS)
Budget Activity: Intelligence & Communications #5

3. FY 1981 Planned Program: During FY 1981, the Air Force will complete the test and evaluation of the improved communications system for the AN/TPN-19 Landing Control Central and a production decision made. The development, fabrication and test of system improvements to improve the AN/TPN-19 reliability and maintainability will be completed. The development and fabrication of electronic counter-countermeasures (ECCM) fixes for the Berlin Long Range Radar and AN/GPN-22 Precision Approach Radars will be initiated.

4. FY 1982 Planned Program: In FY 1982, the fabrication and test of ECCM fixes for the Berlin air traffic control radars will be completed and production decisions made.

5. Program to Completion: TRACALS is a continuing program.

6. Milestones: Not applicable

7. Resources: Not applicable

8. Comparison with FY 1980 Budget Data:

FY 1980 Budget Request

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4,041	3,920	4,200	2,400	Continuing	N/A
1956	TPN-19 Improvements		250	1,400	1,400		3,050
2023	Microwave Landing System	1,500					
2026	System Support	200	200	200	200	Continuing	N/A
2148	LORAN C/D	1,300	470	1,500			24,370
2209	BAMBOO TREE	500	700	1,100	800	Continuing	N/A
2463	MX XII IFF Improvement	541	2,300	*	*		

* FY 80 and FY 81 funds transferred to PE 64725F.

The FY 1979 reduction was a result of the termination of BAMBOO TREE Project number 2209, an effort to develop an improved identification system. This project's outyear funds were reprogrammed to BAMBOO TREE ECCM efforts. The FY 1981 funding was increased to study ECCM fixes for the Berlin air traffic control radars. The increased LORAN funding in FY 1980 was required to meet higher than anticipated contractor efforts.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

PROGRAM ELEMENT: #63101F
DoD Mission Area: Technical Integration/Studies and Analysis, #440

Title: Development Planning
Budget Activity: Defensewide Mission Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estinate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,000	1,100	2,000	4,100	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the connecting link between the research done in the technology base and the exploration of system concepts done in advanced development. It makes it possible for planners to identify technology that will solve problems of the operational forces. As defined by Office of Management and Budget (OMB) Circular A-109 and DoD Directives 5000.1 and 5000.2, the work done under this program element (PE) is the very beginning of the development of a new weapon (Pre-Milestone Zero). The program enables the Air Force to decide what new concepts or weapons should be pursued or deleted. With the planning conducted under this PE, significant benefits are derived because new ideas are either validated or are cancelled before they become expensive programs. Current (FY 1980) funding levels permit the Air Force to conduct development planning on seven new development concepts or urgent needs.

BASIS FOR FY 1981 RDT&E REQUEST: A new Vanguard planning initiative has recently been developed to more rigorously identify the critical needs for weapon system development. As a result, the number of identified critical needs is growing beyond in-house planning capability as supplemented by recent contract assistance levels under this PE. The FY 1981 program will allow contract assistance for the initial planning of fourteen of the expected fifty problem areas identified by mission area analysis.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63101F
DoD Mission Area: Technical Integration/Studies and Analysis, #440

Title: Development Planning
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: This program element or its equivalent has been in existence for over twenty years as the primary source of independent analytical and conceptual thinking in Air Force development planning. The primary effort, concept development and analysis/system design, consists of analyses and investigations that are required prior to the development of weapons systems. The program objectives are to: a. Identify existing and future Air Force needs and deficiencies; b. Define alternative conceptual systems in response to identified deficiencies; c. Evaluate economical and technical feasibility of future concepts; d. Analyze effectiveness of future concepts and compare with systems already in existence. These efforts are a part of the continuing examination of the Air Force mission areas and of the suitability and applicability of technology developments to Air Force needs. The results of these efforts are applied to current and proposed technology programs and help establish and clarify future Air Force system requirements.

RELATED ACTIVITIES: The efforts performed under this program provide part of the information base needed to move a program/concept from the Pre-Milestone Zero stage of the weapon system acquisition process through the Milestone 1 decision. At any point during the first two phases, efforts are transferred out of this program element (PE) into new or existing program elements. Previous efforts under this program have led to further identification of requirements in programs like: (1) PE 12412F, Dew Radar Station (SEEK FROST); (2) National Aeronautics and Space Administration (NASA)/Cargo/Logistics Airlift Systems Study; (3) Offensive Air Support Mission Analysis; (4) Intra-Theater Transmission System Development; (5) PE 64742F, Precision Location and Strike System; (6) Electronics Systems Division interoperability; (7) PE 27412F, 485L Tactical Air Control System; (8) PE 64779F, Joint Interoperability of Tactical Command and Control Systems; (9) PE 27415F, Operational Application of Special Intelligence Systems; (10) Modular Command and Control Center Analysis; (11) PE 64754F, Joint Tactical Information Distribution System; (12) PE 64201F, Aircraft Avionics.

WORK PERFORMED BY: The primary effort is performed by Air Force Systems Command (AFSC) and its product divisions and centers. Through AFSC, assistance is also provided to other Air Force commands. Efforts by the Air Force planning organizations will be supplemented by contracts with aerospace, missile, and electronic industries; institutes; and research laboratories such as: The Boeing Co., Seattle, WA; Rockwell International Corp., Columbus, OH; Hughes Aircraft Co., Canoga Park, CA; General Dynamics, Pomona, CA; Draper Laboratory, Boston, MA; Martin Marietta, Orlando, FL; General Research Corp., Santa Barbara, CA; Farnsworth Cannon Inc., McLean, VA; Consolidated Analysis Centers Inc., Arlington, VA; General Dynamics, Fort Worth, TX; McDonald Douglas Aircraft Co., St Louis, MO; Analytic Sciences Corp., Reading, PA; and Arinc, Annapolis, MD.

Program Element: #63101F
DoD Mission Area: Technical Integration/Studies and Analysis, #440

Title: Development Planning
Budget Activity: Defensewide Mission Support, #6

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The following are some representative past study efforts: (a) A Laser Hellfire Missile Evaluation program to assess the feasibility of employing Laser Hellfire on the A-10 aircraft; (b) Definition and evaluation of methods to counter jammer threats to GBU-15 data links; (c) An evaluation of existing, developmental, or planned technologies for potential application to Anti-Radiation Missile (ARM) protection systems; (d) An Advanced Conventional Standoff Missile evaluation to examine the utility of employing standoff missiles with conventional warheads in the European and anti-ship roles; (e) Defense Suppression Integration Analysis for the integrated development of defense suppression concepts, technical alternatives, and resource mix recommendations; (f) The definition of Communication/Navigation Requirements needed to improve tactical weapon system effectiveness; (g) A Nonnuclear Armament Plan to establish a guide to formulate program planning direction on United States Air Force (USAF) nonnuclear munitions development; (h) Wide Area Anti-Armor Munition (WAAM) program to provide, at the earliest possible time, a Conventional Ordnance Tactical Force effectiveness multiplier for use against the armor threat; and (i) Tactical Forward Area Air Surveillance and Control internetting evaluation to determine the functional and data processing requirements for automating certain elements such as radar tracking, track correlation, and message processing, related to future tactical forward area surveillance concepts.

2. FY 1980 PROGRAM: FY 1980 program was reduced in scope from the program submitted because of Congressional reduction in funds. Included in the $1,100,000 program are: (a) An exploration of the feasibility, survivability, and cost effectiveness of utilizing proliferated ground mobile command facilities, pseudo randomly based, to provide an enduring Command, Control, and Communication capability in support of the National Command Authority and Commanders of the Unified and Specified Commands post-attack requirements. (b) An investigation of revolutionary solutions for Strategic Cruise Missile Defense. (c) An effort to establish ways to compare overlapping weapon developments which compete for scarce resources. In each of the major mission areas, difficulty is being experienced in assessing the weapon systems that are in the inventory, those in development, and those planned for development. (d) An effort to identify the most cost effective electronic warfare developments for countering Soviet threats. The electromagnetic spectrum will be analyzed in terms of threats to the operation of available and projected USAF aircraft and communication systems. (e) An evaluation of the seriousness of the functional degradation of systems employing electromagnetic radiating and receiving subsystems in the wartime environment and to propose methods for solving and preventing these degradations.

Program Element: #63101F
DoD Mission Area: Technical Integration/Studies and Analysis, #440

Title: Development Planning
Budget Activity: Defensewide Mission Support, #6

3. FY 1981 PLANNED PROGRAM: Mission area analyses recently completed, those currently under way, and new efforts will be the source for new concepts of operational systems and equipment. The specific initiatives for the FY 1981 program will be proposed and evaluated during FY 1980. HQ Air Force Systems Command (AFSC) and Air Staff guidance will ensure that efforts are directed toward identified Air Force mission needs. Mission area analysis indicates that some of the significant areas needing planning are: attacking the emitter/jammer, follow-on weapon for Low Altitude Navigation and Targeting Infrared system for Night (LANTIRN), energy tradeoffs, and moving target detectors.

4. FY 1982 PLANNED PROGRAM: The specific investigations for the FY 1982 program will be proposed and evaluated during FY 1981. HQ AFSC and Air Staff guidance will ensure that efforts are directed toward identified Air Force mission needs. Mission area analysis results indicate that some of the broad areas that will require more specific Pre-Milestone Zero planning in the FY 1982 time frame are: strategic weapon penetration, aerial port survival, directed energy devices, man-machine interfaces, Vertical/Short Takeoff and Landing (VSTOL) cost-maneuver-tactics, and advanced surveillance system applications.

5. PROGRAM TO COMPLETION: This is a continuing program.

6. MILESTONES: Not Applicable.

7. RESOURCES: Not Applicable.

8. Comparison with FY 1980 Budget Data:

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,000	1,000	2,100	4,000	Continuing	Not Applicable

FY 1980 was reduced by the Congress to 1,100.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63401F
Title: Space Vehicle Subsystem
DOD Mission Area: Space Launch and Orbital Control #410
Budget Activity: Defense-wide Mission Support #6

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Addition to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	9,660	9,500	12,200	13,700	Continuing	NA
681D	Advanced Space Guidance Technology	3,689	1,510	1,940	2,030	Continuing	NA
682J	Advanced Space Power Supply Technology	1,538	1,650	2,350	2,000	Continuing	NA
688F	Advanced Satellite Secondary Propulsion Technology	482	100	220	450	Continuing	NA
2181	Advanced Space Computer Technology	3,895	6,180	7,620	9,080	Continuing	NA
2198	Advanced Subsystem Planning	56	60	70	140	Continuing	NA

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is the advanced development program which provides improved space vehicle subsystems capability in terms of survivability, autonomy, performance, power, and weight for Department of Defense (DOD) satellites in the 1980-1990 time period. Major efforts are directed at guidance, power supply, secondary propulsion, and computer subsystems.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds to continue development and testing of the Fault Tolerant Spaceborne Computer (FTSC), a Multi-Mission Attitude Determination and Navigation (MADAN) system, a Solid State Spaceborne Memory (SSSM), an Optimized Nickel-Hydrogen Battery, a High Efficiency Solar Panel and a 5 pound Extended Life Hydrazine thruster. The FTSC and SSSM prototype and the MADAN brassboard fabrication and testing will begin. Testing will continue on the Nickel-Hydrazine Battery. Development will be initiated for the Pulse Plasma thruster.

Program Element: #63401F
DOD Mission Area: Space Launch and Orbital Control #410

Title: Space Vehicle Subsystem
Budget Activity: Defense-wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: The projects in this program define, develop, and demonstrate the essential space vehicle subsystems technology improvements needed for Department of Defense (DOD) space missions in the 1980-1990 time period. Project 681D Advanced Space Guidance - defines, develops and demonstrates performance capabilities of selected space guidance, navigation and control subsystems and components which (1) provide autonomous, non-radiating navigation, and (2) improve satellite stability and pointing accuracy. Project 682J - Advanced Space Power Supply - defines, develops and demonstrates power systems which (1) increase nuclear survivability, (2) increase power output and lifetime, and (3) substantially reduce volume and weight. Project 688F - Advanced Satellite Secondary Propulsion - defines, develops, and demonstrates performance capabilities of advanced propulsion concepts and improvements to current technology which (1) increase satellite life, (2) improve attitude control precision, and (3) reduce secondary propulsion system weight. Project 2181 - Advanced Space Computer - defines, develops, and demonstrates performance capabilities of selected computer, memory storage, data preprocessor, and software subsystems and components which (1) increase survivability, reliability, and mission life for 5-7 year missions, (2) increase memory access capability, (3) decrease satellite-ground terminal downlink requirements, and (4) reduce weight, volume, and power requirements. Project 2198 Advanced Subsystem Planning assists in planning future technology efforts.

RELATED ACTIVITIES: The following relationships exist with other activities:

Project 681D - Conducts a joint large satellite momentum wheel development with Program Element PE 78011F (Industrial Preparedness) and PE 12431F (Defense Support Program).
Project 682J - Receives power system technology inputs from PE 62203F (Aerospace Propulsion).
Project 688F - Receives secondary propulsion technology inputs from PE 62302F (Rocket Propulsion)
Project 2181 - Provides funding for space related efforts associated with PE 63203F (Advanced Avionics for Aircraft).
- Conducts a joint satellite self-test and self-repair computer development with PE 63431F (Advanced Space Communications).
- Conducts a joint On-Board Signal Pre-Processor investigation with PE 62702F (Command, Control and Communications) and PE 62301 (Defense Advanced Research Projects Agency).

WORK PERFORMED BY: This project is under the executive management of the Air Force Systems Command. The Air Force Space Division (SD), Los Angeles, CA, is the lead agency and manager for all projects with specific responsibility for the Navigation project (681D) and the Computer project (2181). The Air Force Aerospace Propulsion Laboratory, Wright Patterson AFB, OH, manages the Power Supply project (682J) with SD participation for requirements and analysis. The Air Force Rocket Propulsion Laboratory, Edwards AFB, CA, manages the Secondary Propulsion project (688F). Principal contractors include Project 681D - Martin Marietta Corporation, Denver, CO, (Space Sextant Autonmous Guidance) and TRW, Redando Beach, CA, (Multi-Mission Attitude Determination and Navigation (MADAN) system). Project 682J - Hughes Aircraft, Culver City, CA, (Nickel-Hydrogen Battery), Hughes Aircraft, Culver City, CA, and Spectrolab, Sylmar, CA, (High Efficiency Solar Panel); Project 688F - Rocket Research Corporation, Redmond, WA, and TRW, El Segundo, CA, (Extended Life Hydrazine Thrusters); Project 2181 - Raytheon, Sudbury, MA, (Fault Tolerant Spaceborne Computer); and Rockwell International, Los Angeles, CA, (Solid-State Spaceborne Memory); and Project 2198 - ANSER Inc, Arlington, VA.

Program Element: #63401F
DOD Mission Area: Space Launch and Orbital Control #410

Title: Space Vehicle Subsystem
Budget Activity: Defense-wide Mission Support #6

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Acomplishments: Subsystems that have completed development include the Flexible Rolled-Up Solar Array, the Space Precision Attitude Reference System, the Ultraviolet Radiometer, the Velocity Vector Sensor Assembly, the Optical Angular Motion Sensor, the Hardened Array Solar Power System, the two Kilowatt Battery and the Electrically Suspended Accelerometer. In FY 1977, a development flight demonstration of gallium-arsenide solar cells and an initial flight demonstration for the Nickel-Hydrogen Battery technology was successfully conducted. Although no tasks were completed in FY 1978, the initial hardened Large Scale integrated (LSI) circuits for the Fault Tolerant Spaceborne Computer completed design and were delivered for independent verification testing. As an interim step toward a 10^9 data bit Solid-State Spaceborne Memory, a 10^7 bit brassboard demonstration unit, was delivered.

In 1979 the Space Sextant continued through flight unit fabrication and initial qualification test. The improved magnetic bearing momentum wheel for improved satellite stability was delivered to an operational program. During environmental testing the wheel experienced a material failure. A new material underwent testing during FY 1979 and continuing into FY 1980. The High Efficiency Solar Panel task completed validation of the producibility of high efficiency silicon solar cells. The optimized, high density, Nickel-Hydrogen Battery cells continued life cycle testing. Solid-State Spaceborne Memory (SSSM) demonstrated the potential component technology and processes for magnetic bubble chips that will lead to a $2x10^9$ system. The Fault Tolerant Computer hardened LSI chips evaluation was completed. Due to low yields investigation of alternate processes was initiated. The On-Board Signal Pre-Processor completed its design simulation. Development was initiated for the flight model High Energy Solar Panel and the Multimission Attitude Determination and Autonomous Navigation (MADAN) brassboard.

2. FY 1980 PROGRAM: The advanced development activities in progress in FY 1979 will be continued. In particular, the MADAN brassboard demonstration model and the High Efficiency Solar Panel design using gallium-arsenide cells, initiated late in FY 1979, will be fully underway. Due to a $2M Department of Defense funding reduction and production yield problems with the radiation hardened computer circuit chips the contract will be awarded for development of the Fault Tolerant Spaceborne Computer (FTSC) prototype flight model will be delayed until the end of the fiscal year. Life cycle testing will continue for the Nickel-Hydrogen Battery and the Extended Life Hydrazine Thrusters. The Space Sextant flight model will be delivered. With the cancellation of the Satellite Infrared Experiment alternate flight opportunities are being investigated for the Space Sextant. Development will be initiated on a high density bubble chip ($4x10^6$) for the SSSM. The 5 pound Extended Life Hydrazine Thrusters will begin a 1,000,000 pulse life cycle testing to demonstrate 7-10 year synchronous orbit and two year low earth orbit capability.

Program Element: #63401F
DOD Mission Area: Space Launch and Orbital Control #410

Title: Space Vehicle Subsystem
Budget Activity: Defense-wide Mission Support #6

3. FY 1981 PLANNED PROGRAM: The advanced development activities in progress in FY 1980 will continue. The optimized Nickel-Hydrogen Batteries will be delivered for a FY 1982 demonstration test. Flight hardware development will be initiated for the Solid-State Spaceborne Memory. Brassboard testing will be started for the Multi-Mission Attitude Determination and Navigation (MADAN) System.

4. FY 1982 PLANNED PROGRAM: The advanced development activities in progress in FY 1980 will continue. MADAN brassboard testing will be completed and flight hardware development will be initiated. Development will be started on the High Voltage Power Supply, the Cascaded Solar Cells and the High Energy Density Rechargeable Battery. The Critical Design Review will be completed for the Solid State Spaceborne Memory system and the Fault tolerant Spaceborne Computer.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

5. Program to Completion: This is a continuing program.

6. Milestones: NA

7. Resources: NA

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8,600	9,400	11,500	12,500	Continuing	N/A
681D	Advanced Space Guidance Technology	2,900	3,600	1,510	1,600	Continuing	N/A
682J	Advanced Space Power Supply Technology	920	1,300	1,650	2,100	Continuing	N/A
688F	Advanced Satellite Secondary Propulsion Technology	330	270	100	150	Continuing	N/A
2181	Advanced Space Computer Technology	4,300	4,170	8,180	8,580	Continuing	N/A
2198	Advanced Subsystem Planning	150	60	60	70	Continuing	N/A

Program Element: #63401F
Title: Space Vehicle Subsystem
DOD Mission Area: Space Launch and Orbital Control #410
Budget Activity: Defense-wide Mission Support #6

In FY 1979 the improved magnetic bearing wheel suffered a material failure during environmental testing. A new material is currently undergoing test. Nickel-Hydrogen battery life test is being continued to better model the life characteristics of the battery. Due to scheduling conflicts at the test facility the 1,000,000 pulse test on the 5 pound extended life Hydrazine Thruster is delayed until midway through FY 1980. For FY 1980, the host spacecraft for the Space sextant was cancelled. Alternate flight opportunities are being evaluated. New planned starts are the High Voltage Power Supply in FY 1981 and the Pulse Plasma thruster in FY 1982. Two million dollars has been frozen in FY80 and the Department of Defense has reduced the FY81 request by $.8M. This will delay the start of the Fault Tolerant Spaceborne Computer prototype flight model until the end of FY80 and slip delivery from FY83 to FY84. Other differences between the FY 1980 and FY1981 requests are due to inflation adjustments and minor shifting of funds between projects.

Project: #2181 Title: Advanced Space Computer
Program Element: #63401F Title: Space Vehicle Subsystem
DOD Mission Area: Space Launch and Orbital Control #410 Budget Activity: Defense-wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: Project 2181 - Advanced Space Computer - defines, develops, and demonstrates performance capabilities of selected computer, memory storage, data preprocessor, and software subsystems and components which (1) increase survivability, reliability, and mission life for 5-7 year missions, (2) increase memory access capability, (3) decrease satellite-ground terminal downlink requirements, and (4) reduce weight, volume, and power requirements. Specifically, the project is developing a Fault Tolerant Spaceborne Computer (FTSC), a Solid State Spaceborne Memory and is completing a joint project with the Air Force Rome Air Development Cener for an Advanced Onboard Signal Processor (AOSP).

WORK PERFORMED BY: This project is under the executive management of the Air Force Systems Command. The Air Force Space Division (SD), Los Angeles, CA, is the lead agency and manager. Principal contractors are Raytheon, Sudbury, MA, (Fault Tolerant Spaceborne Computer) and Rockwell International, Los Angeles, CA, (Solid-State Spaceborne Memory).

RELATED ACTIVITIES: The following relationship exists with other activities.

Project 2181
- Provides funding for space related efforts associated with PE 63203F (Advanced Avionics for Aircraft).
- Conducts a joint satellite self-test and self-repair computer development with PE 63431F (Advanced Space Communications).
- Conducts a joint On-Board Signal Pre-Processor investigation with PE 62702F (Command, Control and Communications) and PE 62301 (Defense Advanced Research Projects Agency).

PROJECT ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Acomplishments: In FY 1978 the initial hardened Large Scale Integrated (LSI) circuits for the Fault Tolerant Spaceborne Computer completed design and were delivered for independent verification testing. As an interim step toward a 10^9 data bit Solid-State Spaceborne Memory, a 10^7 bit brassboard demonstration unit was delivered.

In 1979 the Solid-State Spaceborne Memory (SSSM) demonstrate the potential component technology and processes for magnetic bubble chips that will lead to a $2x10^9$ system. The FTSC hardened LSI chips evaluation was completed. Due to low yields investigation of alternate processes was initiated. The On-Board Signal PreProcessor completed its design simulation.

2. FY 1980 PROGRAM: The advanced FTSC and SSSM activities in progress in FY 1979 will be continued. Due to a $2M OSD funding reduction and production yield problems with the radiation hardened computer circuit chips the contract for development of the FTSC prototype flight model will be delayed until the end of the end of the fiscal year Develop- will be initiated on a high density bubble chip ($4x10^6$) for the SSSM.

Project: #2181 — Title: Advanced Space Computer
Program Element: #63401F — Title: Space Vehicle Subsystem
DOD Mission Area: Space Launch and Orbital Control #410 — Budget Activity: Defense-wide Mission Support #6

3. FY 1981 PLANNED PROGRAM: Flight hardware development for the Solid-State Spaceborne Memory will be initiated.

4. FY 1982 PLANNED PROGRAM: The Fault Tolerant Spaceborne Computer prototype flight unit will be delivered. The Critical Design Review will be completed for the Solid State Spaceborne Memory system and the Fault Tolerant Spaceborne Computer.

PROJECT ACCOMPLISHMENTS AND FUTURE PROJECTS:

5. Program Completion: This is a continuing program.

6. Milestones: A

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Addition To Completion	Total Estimated Cost
2181	Advanced Space Computer Technology	3,895	6,180	7,620	9,080	Continuing	NA

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Estimated Costs
2181	Advanced Space Computer Technology	4,300	4,170	8,180	8,580	Continuing	NA

Two million dollars has been frozen in FY 1980 and the Department of Defense has reduced the FY 1981 request by $.8M. This will delay the start of the Fault Tolerant Spaceborne computer prototype flight model until the end of FY 1980 and slip delivery from FY 1983 to FY 1984. Other differences between the FY 1980 and FY 1981 requests are due to inflation adjustments and minor shifting between projects.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63402F
Title: Space Test Program
DOD Mission Area: Space Launch & Orbital Support #410
Budget Activity: Defense Wide Mission Support #6

RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	44,800	34,400	53,900	77,500	Continuing	Not Applicable
2617	Spacecraft Missions	41,938	20,900	13,525	15,885	Continuing	Not Applicable
2618	Secondary Missions	1,730	1,300	600	405	Continuing	Not Applicable
2619	Shuttle Experiment Support Equipment	1,132	11,200	31,195	45,835	Continuing	Not Applicable
2620	Shuttle Sortie Missions		1,000	8,580	15,375	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Space Test Program (STP) advances DOD space technology by providing spaceflight for demonstrating new system designs and concepts and for determining environmental effects on military systems. This tri-service program provides the only substantial spaceflight capability to perform fly-before-buy demonstrations of advanced technology designs. The STP is to be the pathfinder for exploiting the Shuttle as a manned space laboratory which should expedite the infusion of new technology into space systems through the use of simpler, incrementally-designed, man-aided systems. The experience gained from this approach will be a key element in fully defining man's military role in space.

BASIS FOR FY1981 RDT&E REQUEST: This request includes funds for the following: integration and checkout of submodules, propulsion system, and experiments on Teal Ruby spacecraft structure; flight acceptance testing of experiments for launch on National Aeronautics and Space Administration's (NASA's) Long Duration Exposure Facility (LDEF) satellite; on-orbit support for experiments being launched on classified host vehicle; subsystem level development and test initiation of Shuttle experiment support equipment for exploiting Shuttle as manned space laboratory; and work initiation in support of first Shuttle sortie mission.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #63402F
DOD Mission Area: Space Launch & Orbital Support #410

Title: Space Test Program
Budget Activity: Defense Wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: Our national security depends on the postession of space systems which are the product of a superior technology base. The role of the Space Test Program (STP) is to keep the United States at the forefront of space technology by providing the means to fully exploit the military potential of space through a broad based on-orbit research and test capability. The STP is a tri-service activity which provides spaceflight missions for conducting feasibility demonstrations of advanced concepts and designs which will contribute to new and improved space systems. The program centralizes the management for spacecraft and Shuttle experiment support equipment procurements, payload integration, launch scheduling, support services, and secondary payload space arrangement on other DOD and National Aeronautics and Space Administration (NASA) spaceflights. The STP spacecraft and Shuttle sortie missions are designed around major experiments. Additional secondary experiments are then added as the launch configuration permits. Also, flight opportunities are sought for small secondary experiments on other DOD and NASA spaceflights, but the time to respond to such opportunities is often too short for programming in advance. This program was designated by DOD to be the pathfinder in exploiting the Shuttle as a manned space laboratory for DOD experiments. This approach should expedite the infusion of new technology into space systems through the use of simpler, incrementally-designed experiments aided by man. Breadboard models can now be used on the Shuttle in a laboratory environment for testing critical system technologies years in advance of their flight on complex spacecrafts. Such spacecraft are inherently more complex since mission success is dependent upon multioption engineering approaches to compensate for limited space experience. Early test results can then lead to simpler engineering model follow-on Shuttle laboratory tests. Hence, incremental testing enables the pursuit of promising technologies with reduced system complexity. Furthermore, mission success is enhanced because payloads can be returned for reflight as needed, and by proper design of experiments to incorporate a mission/payload specialist, practical workaround opportunities increase. The experience gained from this approach will be a key element in fully defining man's military role in space. STP will serve as the transition link to effective manned control and interaction of payloads, on-orbit checkout, and on-orbit repairs. The program is tri-service documented (AFM 80-2/AR 70-43/OPNAV 76P-2) and was reoriented for the Space Shuttle era by a new DOD policy. The Air Force is DOD's executive agent. The STP program element is comprised of four projects. Project 2617 (Spacecraft Missions) supports experiments which require flight on STP-developed spacecraft. Project 2618 (Secondary Missions) supports the spaceflight of small payloads flown on a pallet, Shuttle structure, low cost free-flyer, or host spacecraft using space on other DOD and NASA spaceflights. Project 2619 (Shuttle Experiment Support Equipment) is for the procurement of equipment and corresponding flight safety analyses to enable use of the Shuttle as a manned laboratory to support experimentation. Project 2620 (Shuttle Sortie Missions) supports the spaceflight of Shuttle sortie missions, initially defined as those in which the main experiment equipment remains in the Shuttle bay and is operated either by automatic control or by a mission/payload specialist during the short time the Shuttle is on orbit.

RELATED ACTIVITIES: Atlas-F vehicles and their corresponding launch support is provided by Space Boosters, Program Element (PE) 35119F. Shuttle launch support and Inertial Upper Stage (IUS) systems are provided by Space Launch Support, PE 35171F. Payloads are supported by the following: Office of Naval Research; Naval Research Laboratory; Army Atmospheric Sciences Laboratory; Defense Advanced Research Projects Agency, PE 62301E and PE 62701D;

Program Element: #63402F Title: Space Test Program
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NASA; Atmospheric Sciences, PE 61102F; Geophysics, PE 62101F; Materials, PE 62102F; Aerospace Propulsion, PE 62203F; Advanced Weapons, PE 62601F; Space Surveillance Technology, PE 63428F; Satellite Systems Survivability, PE 63438F; Space Vehicle Subsystems, PE 63401F; Systems Survivability, PE 64711F; and Advanced Space Communications, PE 63431F.

WORK PERFORMED BY: The United States Air Force Headquarters Space Division, Los Angeles, CA, is responsible for spaceflight planning, engineering, procurement, and operational aspects required to execute the Space Test Program (STP). Systems engineering support is provided by the Aerospace Corporation, Los Angeles, CA. Current payload integrating and/or spacecraft contractors are as follows: Ball Brothers Research Corporation, Boulder, CO; Martin Marietta Corporation, Denver, CO; Lockheed Missiles and Space Company, Sunnyvale CA; and Rockwell International, Seal Beach, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY1979 and Prior Accomplishments: There have been 33 launches since the first one in 1967: 15 primary and 18 secondary. The primary missions were launched by the STP using three Thor, eight Atlas, two Titan IIIC, one Delta, and one Scout launch vehicles. The secondary missions used space on other DOD and National Aeronautics and Space Administration (NASA) flights. Ninety-nine payloads have been successfully launched to date. Two primary and one secondary missions were successfully launched in FY 1979. The primary missions launched under Project 2617 (Spacecraft Missions) were Spacecraft Charging at High Altitudes (SCATHA) and Gamma Ray Spectrometer. Also during this period, the fabrication of the Teal Ruby spacecraft structure was completed. Project 2618 (Secondary Missions) provided for the launch of the Navigational Package (NAVPAC) secondary mission on a classified host vehicle. This was the third such mission launched by the STP for testing geodetic packages to provide information to assist the Defense Mapping Agency Other project activities consisted of integrating four experiments on NASA's free-flying, recoverable satellite called the Long Duration Exposure Facility (LDEF) and initiating the design of a Host Vehicle Pallet (HVP) mission. One of the two experiments on the HVP mission had previously been assigned flight on the now-cancelled Satellite Infrared Experiment (SIRE) spacecraft. Under Project 2619 (Shuttle Experiment Support Equipment), the Request for Proposal (RFP) was generated for the procurement of sortie-mode support equipment. Other significant past STP missions include the following: Lincoln Laboratory Experimental Satellite (LES 6) demonstrated feasibility of Ultra High Frequency (UHF) space communications; LES 8/9 proved new concepts to increase the survivability of future space communications systems; Timation III was successful forerunner protytype of the Global Positioning System (GPS);

2. FY1980 Program: During the year, the following activities are planned: Project 2617 (Spacecraft Missions) - Completion of Teal Ruby spacecraft structure and submodule fabrication; Project 2618 (Secondary Missions) - NASA's technical support of experiments being flown on LDEF satellite, and integration and checkout of experiments being flown on classified host vehicle; Project 2618 (Shuttle Experiment Support Equipment) - Evaluate contract proposals

Program Element: #63402F
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for sortie-mode support equipment, generate plans for training mission/payload specialists, and begin developing documentation for use by all future DOD Shuttle users; and Project 2620 (Shuttle Sortie Missions) - Begin generation of work statement for first Shuttle sortie-mode flight.

3. FY1981 Planned Program: These project activities are planned. Project 2617 (Spacecraft Missions) will provide for integration and checkout of submodules, propulsion system, and experiments on Teal Ruby spacecraft structure. Under Project 2618 (Secondary Missions), the National Aeronautics and Space Adminstration (NASA) will provide technical support and flight acceptance testing for the four Space Test Program (STP) experiments planned for launch from the Kennedy Space Center on the NASA Long Duration Exposure Facility (LDEF) reusable, free-flying satellite. The satellite launch and retrieval dates are subject to NASA's schedule of them. Current plans reflect an on-orbit mission of over 12 months. One experiment will allow determination of space environmental effects on spacecraft materials; another one is to examine the effects on active/passive radiation hardened fiber optics components. Also under this project, on-orbit support will be provided after launch for the Host Vehicle Pallet (HVP) mission being launched on a classified host vehicle. Of the two Navy experiments being flown on this mission, one is to study solar flare energy conversion/acceleration mechanisms from solar particle isotopes and the other is to assess potential of stimulated wave-particle interactions as means to control precipitation from radiation belts. Project 2619 (Shuttle Experiment Support Equipment) will provide for the subsystem level development and test initiation of the hardware to exploit Shuttle as manned laboratory in space. The hardware includes standard experiment mounting racks, gimballed pointing system; computer graphics system for use by a mission/payload specialist to interact and control experiments, mission/payload specialist training equipment, and ground/flight support equipment. Project 2620 (Shuttle Sortie Missions) will provide, after contract award, for the design and initial development of experiment-peculiar hardware and software for first Shuttle sortie mission and for mission design and operations planning.

4. FY1982 Planned Program: Project plans are these: Project 2617 (Spacecraft Misions) - Complete testing of entire integrated Teal Ruby spacecraft system; Project 2618 (Secondary Missions) - NASA flight acceptance testing and technical support for launch on NASA LDEF satellite in late 1982, and formatting of Host Vehicle Pallet (HVP) mission data tapes for use by experimenters; Project 2619 (Shuttle Experiment Support Equipment) - Continue development and testing of hardware and training equipment in support of first Shuttle sortie mission; Project 2620 (Shuttle Sortie Missions) - Continue experiment-peculiar hardware and software development and initiate testing of it; continue mission design and operations planning; and begin mission/payload specialist training.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

Program Element: #63402F
DOD Mission Area: Space Launch & Orbital Support #410

Title: Space Test Program
Budget Activity: Defense Wide Mission Support #6

8. Comparison with FY1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	25,900	44,800	34,400	41,000	Continuing	Not Applicable
2617	Spacecraft Missions	25,500	44,100	21,500	24,300	Continuing	Not Applicable
2618	Secondary Missions	400	200	100	0	Continuing	Not Applicable
2619	Shuttle Experiment Support Equipment		500	12,800	12,000	89,800	115,100
2620	Shuttle Sortie Missions				4,700	Continuing	Not Applicable

In April 1979, the Satellite Infrared Experiment (SIRE) spacecraft contract was cancelled when 20% complete due to a projected cost growth by the contractor of over 80%, which the Air Force expected would grow to over 100%. The program could not be restructured, within available funds, to meet mission objectives. The STP was then restructured to fly the important SIRE payload in the Shuttle sortie mode instead of on an Atlas F. This mission will provide for early use of Shuttle as a manned laboratory in space and will be a first step in accomplishing the STP pathfinder role for exploitation of man in space. Another change was the delay in the Teal Ruby launch to accommodate Shuttle and Teal Ruby payload delivery dates. Also, the joint Air Force Mosaic Sensor Program (MSP) and Defense Advanced Research Projects Agency (DARPA) Mini-High Altitude Large Optics (Mini-HALO) mission will not be started. Instead, in accordance with the Congressional Authorization Conference, the Air Force will combine these efforts under a new program element called Advanced Warning System. A new secondary mission was started to fly an experiment previously assigned flight on the now terminated Satellite Infrared Experiment (SIRE) spacecraft. Now that comments have been received from experimenters and industry on the draft Request for Proposal (RFP) for the sortie support equipment, it is clear that more support hardware and autonomy needs to be incorporated than previously planned. Also, since plans are to upgrade the hardware to be fully autonomous in the future, to establish a hardware maintenance program, and to make any needed refinements, this is now reflected by showing the program as continuing.

Project: #2617 — Title: Spacecraft Missions
Program Element: #63402F — Title: Space Test Program
DOD Mission Area: Space Launch & Orbital Support #410 — Budget Activity: Defense Wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: This project supports the spaceflight of payloads on Space Test Program (STP) developed spacecraft. The missions are launched using an STP expendable launch vehicle (Thor, Atlas, Titan, Delta, and Scout) or the Shuttle. Inertial Upper Stages (IUSs) are used for orbits requiring them. When practical, STP uses standardized boosters and spacecraft modules to increase the probability of mission success.

RELATED ACTIVITIES: Atlas-F vehicles and launch support are provided by Space Boosters, Program Element (PE) 35119F. Shuttle launch support and Inertial Upper Stage (IUS) systems are provided by Space Launch Support, PE 35171F. Payloads are supported by the following: Office of Naval Reserach; Naval Research Laboratory; Army Atmospheric Sciences Laboratory; Defense Advanced Research Projects Agency (DARPA), PE 62301E and PE 62701D; National Aeronautics and Space Administration (NASA); Atmospheric Sciences, PE 61102F; Geophysics, PE 62101F; Materials, PE 62102F; Space Surveillance Technology, PE 63428F; Satellite Systems Survivability, PE 63438F; Space Vehicle Subsystems, PE 63401F; Advanced Space Communications, PE 63431F.

WORK PERFORMED BY: The United States Air Force Headquarters Space Division, Los Angeles, CA, is responsible for spaceflight planning, engineering procurement, and operational aspects required to execute the program. Systems engineering support is provided by the Aerospace Corporation, Los Angeles, CA. Listed are primary contractors for the spaceflight missions: Ball Brothers Research Corporation, Boulder, CO, for Gamma Ray Spectrometer; Martin Marietta Corporation, Denver, CO, for Spacecraft Charging at High Altitudes (SCATHA); and Rockwell International, Seal Beach, CA, for Teal Ruby.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY1979 and Prior Accomplishments: The 15 primary missions since 1967 were launched by STP using three Thor, eight Atlas, two Titan IIIC, one Delta, and one Scout launch vehicles. Sixty-one payloads have been successfully launched on these. During FY1979, two spacecraft missions were successfully launched: Spacecraft Charging at High Altitudes (SCATHA) on a Delta 2914 from Cape Canaveral Air Force Station and Gamma Ray Spectrometer on an Atlas F from Vandenberg Air Force Base. The Air Force/Navy/NASA SCATHA mission is carrying 12 experiments to learn how to protect spacecraft in geosynchronous orbit from transient outages and electric malfunctions caused from spacecraft charging, thus improving their survivability. The Gamma Ray Spectrometer mission, known by its primary DARPA payload of the same name, carries six secondary payloads. The objective of the Gamma Ray spectrometer payload is to demonstrate the feasibility of a

Also accomplished during this period was the fabrication of the Teal Ruby spacecraft structure.

2. FY1980 Program: On-orbit support is being provided for the SCATHA and Gamma Ray Spectrometer missions. Also, the following activities are being performed for the Teal Ruby spacecraft mission: completion of the critical design review; testing of the fabricated spacecraft structure; receipt of all the spacecraft subcomponents; initiate fabrication of propulsion system; initiate wire harness assembly, installation, and checkout; and begin cradle fabrication.

Project: #2617 Title: Spacecraft Missions
Program Element: #63402F Title: Space Test Program
DOD Mission Area: Space Launch & Orbital Support #410 Budget Activity: Defense Wide Mission Support #6

3. FY1981 Planned Program: Primary emphasis will be on integrating all elements on the Teal Ruby spacecraft structure and testing of the subsystems. The elements include the electronic modules, propulsion system, wire harness assembly, and payloads. Also planned is the completion of the Space Transportation System (STS) interface control documentation. The Teal Ruby mission, known by its primary Defense Advanced Research Projects Agency payload of the same name, carries three secondary payloads. The objective of the Teal Ruby experiment is to evaluate,

One of the secondary payloads is to test the National Aeronautics and Space Administration's (NASA) Mercury Ion Thruster, a millipound thruster for long-term station-keeping applications. Another secondary payload is to test an Air Force experiment to demonstrate new laser communication technologies. The third payload is to test an Army Extreme Ultraviolet (EUV) photometer.

4. FY1982 Planned Program: During this period, the total integrated Teal Ruby spacecraft will be tested for a planned launch from the Shuttle in FY1983.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
2617	Spacecraft Missions	41,938	20,900	13,525	15,885	Continuing	Not Applicable

Project: #2617 Title: Spacecraft Missions
Program Element: #63402 Title: Space Test Program
DOD Mission Area: Space Launch & Orbital Support #410 Budget Activity: Defense Wide Mission Support #6

8. Comparison with FY1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Costs
2617	Spacecraft Missions	25,500	44,100	21,500	24,300	Continuing	Not Applicable

In April 1979, the three-year Satellite Infrared Experiment (SIRE) spacecraft contract awarded in January 1978 was cancelled due to a large cost growth. The spacecraft was about 20% complete with a greater than 100% cost growth predicted. The program could not be restructured, within the funds available, to meet mission objectives while simultaneously accommodating the cost growth. The STP was then restructured to fly the important payload in the Shuttle sortie mode instead of on an Atlas F. This mission will provide for early use of Shuttle as a manned laboratory in space and will be a first step in accomplishing the STP pathfinder role for exploitation of man in space. The funding plans for the restructured program are consistent with those previously provided Congress. The SIRE payload is still being flown, but on Shuttle instead of an expendable launch vehicle. Another change was the delay in the Teal Ruby launch to accommodate Shuttle and Teal Ruby payload delivery delays. Also, the joint Air Force Mosaic Sensor Program (MSP) and Defense Advanced Research Projects Agency (DARPA) Mini-High Altitude Large Optics (Mini-HALO) mission will not be started. Instead, in accordance with the Congressional Authorization Conference, the Air Force will combine these efforts under a new program element called Advanced Warning System.

Project: #2619
Program Element: #63402F
DOD Mission Area: Space Launch & Orbital Support #410

Title: Shuttle Experiment Support Equipment
Title: Space Test Program
Budget Activity: Defense Wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: This project is for the procurement of reusable, basic standard equipment and corresponding flight safety analyses to enable economical use of the Shuttle as a manned laboratory to support sortie experimentation. The sortie support system being procured is comprised of sortie support equipment consisting of three types: flight hardware mounted in the Orbiter bay and Orbiter aft flight deck; support and test equipment required to test, support, and maintain the sortie support equipment; and mission/payload specialist training equipment required to train Orbiter flight crews and support personnel in use of sortie support equipment. Sortie support equipment includes: cradle structure on which to mount experiments; gimballed pointing system for orienting experimental sensors at space and ground objects; communications and data handling system which will provide command, telemetry, data routing, storage, security, caution and warning, and data processing; manned operations system enabling a mission/payload specialist to interact/control experiments and includes a graphics display, a keyboard, switches and status indicators, a hand controller, and a secure voice link with ground personnel; electrical power system which will receive its primary power from the Orbiter power bus; and thermal control system which will use the Orbiter heat exchanger cooling system. The design of the sortie support equipment will incorporate features compatible with "class cargo certification." The class cargo analytical certification process that will be performed is intended to minimize repetitive Shuttle integration verification analysis and test by qualification of a worst-case requirements envelope to include experiment configuration, its position within Orbiter, thermal, electromagnetic compatibility, contamination, and safety requirements. Mission/payload specialist equipment will include an aft flight deck mockup, hardware/software required to simulate the cargo bay equipment and aft flight deck equipment, and a training computer system to execute software. After the first two sets of sortie equipment are developed and checked out, future plans are to further upgrade certain subsystems to make them autonomous with respect to power, thermal control, and data handling. Autonomy is desired to reduce the time required to obtain flight, to increase flight opportunities, and to protect the security of classified payloads.

RELATED ACTIVITIES: Maximum utilization will be made of hardware, software, and data developed or being developed by the DOD, National Aeronautics and Space Administration, European Space Agency, and others.

WORK PERFORMED BY: The United States Air Force Headquarters Space Division, Los Angeles, CA, is responsible for the hardware procurements. Systems engineering support is provided by the Aerospace Corporation, Los Angeles, CA. Potential bidders include Rockwell International, Seal Beach/Downey, CA; TRW, Redondo Beach, CA; RCA, Heightstown, NJ; McDonnell Douglas, Huntington Beach, CA/Huntsville, AL; Martin Marietta Aerospace, Denver, CO; Sperry Rand Corporation Space Support Division, Huntsville, AL; General Electric CO, Valley Forge, PA; Hughes Aircraft Corporation, Culver City, CA; Lockheed Aircraft Corporation, Sunnyvale, CA; General Dynamics Corporation, San Diego, CA; and Boeing, Seattle, WA; and European Space Agency contractors.

Project: #2619 Title: Shuttle Experiment Support Equipment
Program Element: #63402F Title: Space Test Program
DOD Mission Area: Space Launch & Orbital Support #410 Budget Activity: Defense Wide Mission Support #6

1. FY1979 and Prior Accomplishments: The Request for Proposals (RFP) was generated for purchase of sortie support system. After the draft RFP was issued to obtain feedback on it from experimenters and potential contractors, the RFP was revised.

2. FY1980 Program: The Request for Proposal will be released and proposals evaluated, plans will be generated for training mission/payload specialists, and Shuttle documentation will be started for use by all DOD Shuttle users.

3. FY1981 Planned Program: The preliminary design review for the support system will be completed and the associated subsystem will be in development. The documentation will be continued for use by all DOD users and includes that covering common integration procedures of sortie payload with the Space Transportation System, NASA interfaces, launch base procedures, and methods of training and operation. Also, the envelop of the cargo elements will be established as part of the "class cargo" analysis.

4. FY1982 Planned Program: The critical design review for the support system will be completed, and the first (support Mission 1) of two sets of hardware will be mostly fabricated and then undergo testing. Two sets of hardware are required since missions will be overlapping. The general DOD sortie documentation will be mostly completed. Also, "class cargo" analyses will be continuing with application to first sortie missions.

5. Program To Completion: The second set of hardware is planned for delivery in FY1985. This hardware will predominently be dependent on use of orbiter support services. Later, autonomy will be incorporated with respect to power, thermal control, and data handling.

6. Milestones: Not Applicable

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimate Costs
2619	Shuttle Experiment Support Equipment	1,132	11,200	31,195	45,835	Continuing	Not Applicable

8. Comparison With FY1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimate Costs
2619	Shuttle Experiment Support Equipment		500	12,800	12,000	89,800	115,100

Project: #2619 Title: Shuttle Experiment Support Equipment
Program Element: #63402F Title: Space Test Program
DOD Mission Area: Space Launch & Orbital Support #410 Budget Activity: Defense Wide Mission Support #6

Generation of the draft Request for Proposal (RFP) and the review by experimenters and contractors made evident the need for the following changes to the sortie support equipment. Some of the sortie support equipment subsystems can not be totally dependent on the Orbiter services if experiment requirements are to be met; hence, partial autonomy must now be planned for incorporation into the initial system. Also, additional support hardware must now be purchased to support the first missions. These changes, in conjunction with a better definition of the support hardware needed to exploit and train mission/payload specialists and with refined cost estimates, have altered the original funding profile. Since plans are to upgrade the hardware to be fully autonomous in the future, to establish a hardware maintenance program, and to make any needed refinements, this is now reflected by showing the program as continuing.

Project: #2620
Program Element: #63402F
DOD Mission Area: Space Launch & Orbital Support #410

Title: Shuttle Sortie Missions
Title: Space Test Program
Budget Activity: Defense Wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: This project supports the spaceflight of Shuttle sortie missions, initially defined as those in which the main experiment equipment remains in the Shuttle bay and is operated either by automatic control or by a mission/payload specialist during the short time the Shuttle is on orbit. This project provides for the integration of DOD experiments with the sortie support system as a sortie mission payload, the integration of the sortie mission payload by the National Aeronautics and Space Administration (NASA) (through the DOD payload integration contractor), mission/payload specialist training, on-orbit support, and sortie support system refurbishment.

RELATED ACTIVITIES: Shuttle launch support is provided by Space Launch Support, Program Element 35171F. Payloads flown are provided by the military services or DOD agencies.

WORK PERFORMED BY: The United States Air Force Headquarters Space Division, Los Angeles, CA, is reponsible for spaceflight planning, engineering, procurement, and operational aspects required to execute the program. Systems engineering support is provided by the Aerospace Corporation, Los Angeles, CA. The primary contractor for this effort is expected to be the same as that procuring the sortie support system under Project 2619, at least for the first mission.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY1979 And Prior Accomplishments: Not Applicable.

2. FY1980 Program: Preparation will begin on the statement of work for the first Shuttle sortie mission integration effort. The mission will consist of two seven day flights. The primary experiment is the Air Force Space Infrared Experiment (SIRE). Secondary experiments have not been chosen yet.

3. FY1981 Planned Program: After contract action for the first mission effort, the following activities are planned: design and development start of mission peculiar hardware and software; mission design and operations planning; and development of experiment, NASA, and other interface documentation. The SIRE payload is to provide a proof-of-concept demonstration for a long wavelength infrared space-based system for surveillance of space objects.

4. FY1982 Planned Program: For the SIRE mission, the critical design review will be conducted; experiment-peculiar hardware and software development will be continued and testing of it begun; and mission/payload specialist training will begin. The first flight of the mission is planned for FY1984 and the second in 1985.

Project: #2620
Program Element: #63402F
DOD Mission Area: Space Launch & Orbital Support #410

Title: Shuttle Sortie Missions
Title: Space Test Program
Budget Activity: Defense Wide Mission Support #6

5. Program To Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimate Costs
2620	Shuttle Sortie Missions		1,000	8,580	15,375	Continuing	Not Applicable

8. Comparison With FY1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimate Costs
2620	Shuttle Sortie Missions				4,700	Continuing	Not Applicable

The funding profile has been adjusted to initiate work earlier in FY1981, thus extending the integration contract to decrease risk in meeting launch date of first sortie mission.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63707F
DOD Mission Area: Global Military Environmental Support #420

Title Weather Systems (Advanced Development)
Budget Activity Defense-wide Mission Support #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT			700	600	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force critically needs the ability to observe and collect essential weather information in battle areas not under friendly control. This need has been stated by Military Airlift Command and validated by the Air Force.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for development of candidate prototype systems to observe and collect battlefield weather data.

OTHER APPROPRIATIONS: Not Applicable.

Program Element: #63707F
DOD Mission Area: Global Military Environmental Support #420

Title: Weather Systems (Advanced Development)
Budget Activity: Defense-wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: The Air Force critically needs the ability to observe and collect target weather data in uncontrolled or enemy-controlled battle areas and airspace. Weather is a major factor in determining the success or failure of tactical air missions and timely weather information is vital to the battle director in making effective tactical decisions. In particular, weather data are needed to support effective employment of weapon systems which depend on visible, infrared, or radar sensors.

RELATED ACTIVITIES: Results of Advanced Development projects accomplished in this Program Element (PE) feed into PE 64707F, Weather Systems (Engineering Development).

WORK PERFORMED BY: Program Management is provided by Air Force Geophysics Laboratory, Hanscom Air Force Base, MA. No contractors are involved at this time.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not Applicable.

2. FY 1980 Program: Not Applicable

3. FY 1981 Planned Program: Begin sensitivity analysis of sensor systems to relevant environmental parameters. Initiate development of prototype specifications and observing/forecasting technique development. Initiate airborne measurement and data analysis program.

4. FY 1982 Planned Program: Continue technique development, airborne measurement, and data analysis efforts.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: Not Applicable. This program element begins in FY 1981.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64211F
DoD Mission Area: Aerial Targets, #452

Title Advanced Aerial Target Development
Budget Activity Defensewide Mission Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total 1/ Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	8,007	16,500	16,900	19,400	Continuing	N/A
2459	Target System Technology 2/			700	3,200	Continuing	N/A
2535	Full Scale Aerial Target (FSAT) 3/	1,700	5,500	6,200	2,200		15,600
469A	High Altitude High Speed Target (HAHST)	6,307	11,000	10,000	14,000	14,500	83,400 4/

1/ This PE will be a continuing program to include all aerial target technology, prototyping, and engineering development.
2/ This project was transferred from PE 63232F which will be cancelled at the end of FY 1980.
3/ Includes Range-Range Vector miss distance indicator.
4/ Includes $27.6 million for High Altitude Supersonic Target (HAST) under Program Element 63232F.

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The overall objective is to develop aerial target systems and subsystems for aircrew training and weapon systems testing, based on Statement of Need (SON) and Mission Element Need Statements (MENS) as submitted by the Services. This program also includes investigation of target system technology concepts applicable to new target vehicles, target augmentation, scoring systems, tracking and control systems, and new target concepts.

Program Element: #64211F
DoD Mission Area: Aerial Targets, #452

Title Advanced Aerial Target Development
Budget Activity Defensewide Mission Support, #6

BASIS FOR FY 1981 RDT&E REQUEST: The High Altitude High Speed Target (HAHST) will begin Full Scale Engineering Development with initial flight tests and augmentation and scoring devices integration. Engineering designs of command and control, scoring, and telemetry devices will be continued for the conversion of the F-100 to the QF-100, a full scale aerial target (FSAT) to replace the PQM-102, which is nearing depletion from the inventory. In addition, the Vector Miss Distance Indicator (VMDI) will be integrated with the QF-100 FSAT. The ability of the VMDI to obtain miss distance and direction of the miss will enhance the evaluation of advanced weapon systems. The Target System Technology project includes improved infrared and radar augmentation devices, threat emission and electronic countermeasures simulations, improved scoring techniques and devices (electro-optical), target control devices and other supporting subsystems.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #64211F
DoD Mission Area: Aerial Targets, #452

Title Advanced Aerial Target Development
Budget Activity Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: This program includes full scale development of the High Altitude High Speed Target (HAHST) vehicle and the conversion of the F-100 to the QF-100 Full Scale Aerial Target (FSAT). The HAHST project will provide threat simulations in the supersonic high altitude spectrum and replace the depleting inventories of BQM -34F and BOMARC targets. The FSAT project will include design and integration of remotely controlled autopilot modifications, command and control telemetry devices, programmable maneuver profiles, and the Vector Miss Distance Indicator (VMDI) scoring system on a fighter aircraft being retired from the active inventory. This program also provides for the advanced development and validation of target systems and subsystems and the development of technologies to continuously improve Air Force and Tri-Service threat simulation capabilities. The Target System Technology project provides for technology developments at the system and subsystem level addressing deficiencies of existing targets. The project includes analysis, development, and test in the areas of infrared (IR) augmentation, radar augmentation, threat Radio Frequency (RF) emission, scoring technology, and vehicle technology. Tasks are elevated to project status when appropriate to provide for improved threat simulation with existing or advanced targets.

RELATED ACTIVITIES: The Air Force, Army, and Navy are actively involved in the development of various target systems and subsystems. A Joint Logistics Commanders' Panel (JLCP) studied the Tri-Service requirements and recommended a division of tasks which will insure a cooperative effort. The technical approach to some of the areas such as the VMDI differs between Services because of different Service requirements. Tri-Service coordination is conducted frequently to assure non-duplication of efforts. Under the Joint Logistics Commanders (JLC), a Joint Service Operational Requirement (JSOR) for Aerial Targets has been developed. This JSOR identifies deficiencies, recommended programs, and lead Service for development. The JSOR is presently in coordination within the three Services. When ready for production, systems are procured under PE 35116F, Aerial Target Drones.

WORK PERFORMED BY: The office of primary responsibility within the Air Force is the Armament Division (AD), Eglin AFB, FL. There are several industry contractors involved with AD including: Radar augmentation - Teledyne Ryan, San Diego, CA; RCA, Phoenix, AZ; Infrared Augmentation - Hayes International, Huntsville, AL; HAHST vehicle prime contractor - Teledyne Ryan Aeronautical, San Diego, CA; Target Control System - VEGA Precison Laboratory, Vienna, VA; HAHST rocket/ramjet - United Technology, Sunnyvale, CA; Bullet Hit Indicator - Motorola, Scottsdale, AZ and Cartwright Engineering, Inc., Anaheim, CA; Digidops Scoring System-Cartwright Engineering Inc., Anaheim CA; Aerial Gunnery Target Vehicle-Prototype Development Associates, Santa Ana, CA; QF-100 FSAT - Sperry Flight Systems, Phoenix, AZ. The Gulf Coast Test Range at Tyndall AFB, FL, and White Sands Missile Range, NM, conduct flight tests of all systems under development by the AD. The Air Force Test and Evaluation Center is responsible for HAHST Operational Test and Evaluation.

Program Element: #64211F
DoD Mission Area: Aerial Targets, #452

Title Advanced Aerial Target Development
Budget Activity Defensewide Mission Support, #6

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The High Altitude Supersonic Target (HAST) completed feasibility demonstration. The Tri-Command Required Operational Capability (ROC) 502-77 was validated and planning was completed for the High Altitude High Speed Target (HAHST) full scale development (under PE 64211F). The program name has been changed from HAST to HAHST to match the Tri-Command ROC title. Source selection for the HAHST program was conducted. Engineering Development of the QF-100 Full Scale Aerial Target (FSAT) (conversion of an F-100 aircraft) was initiated in August 1979. The QF-100 program will include the Range-Range Vector Miss Distance Indicator (VMDI). The TDU-30 Tow Target development and delivery was completed. Target System Technology effort continued with flight testing of the plume generator, initiation of the electro-optical Missile Attitude Measurement System (MAMS) development, development/test of a Radar Augmentation System (RAS), and continuation of analytical and study support for Tri-Service requirements development. Advanced development continued for the Advanced Aerial Gunnery Tow Target System (AAGTTS) and Bullet Hit Indicator (BHI). Although the planned full scale engineering development program has been cancelled, the AAGTTS and BHI technology may be applicable to the SECAPEM-90/B Interim Gunnery Target System procurement program as product improvements.

2. FY 1980 Program: Integration of the VMDI with the QF-100 FSAT will continue. The HAHST contract will be awarded and the HAHST vehicle will begin its flight performance and recovery tests using residual advanced development models. Target System Technology efforts emphasize infrared (IR) and radar augmentation and radio frequency (RF) emission/electronic countermeasures (ECM) for improved simulation of threat aircraft.

3. FY 1981 Planned Program: Critical design review will be conducted for the HAHST. Prototype and environmental testing as well as test bed flights will continue. Payload development (scoring and radar augmentation) will be completed for the QF-100 FSAT, integration of the VMDI will continue, and flight testing will be conducted. Target system technology efforts will again emphasize IR and radar augmentation and RF emission/ECM.

4. FY 1982 Planned Program: HAHST vehicle design and qualification testing will be completed and development test vehicles fabricated. Development test and evaluation (DT&E) will also be initiated for HAHST. Flight testing of the QF-100 will be completed with a production decision planned for January 1982. Target system technology efforts will again emphasize IR and radar augmentation and RF emission/ECM.

Program Element: #64211F
DoD Mission Area: Aerial Targets, #452

Title Advanced Aerial Target Development
Budget Activity Defensewide Mission Support, #6

5. Program to Completion: This program is a continuing effort. The High Altitude High Speed Target development test and evaluation and Initial Operational Test and Evaluation will be completed in FY 1984 leading toward full production go-head in mid FY 1984. Technology activities will continue on developing improved, more accurate scoring and tracking systems for aerial targets. Further study for development of new target vehicles and the necessary subsystems and payload will proceed to provide threat representative targets for training and weapons testing for the three Services.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT		8,500	17,500	21,800	Continuing	N/A
2588	Vector Miss Distance Indicator (VMDI)		1,300	1,500	800	500	4,100
2587	Advanced Aerial Gunnery Two Target System (AAGTTS)			1,000	3,000	8,200	12,200
469A	High Altitude High Speed Target (HAHST)		5,500	11,000	12,000	24,000	52,500
2535	Full Scale Aerial Target (FSAT)		1,700	4,000	4,000	2,000	13,700

This Program Element has been combined with PE 63232, Aerial Target Technology. The HAHST program has been restructured to compress the development schedule and introduce competition as a result of funding issues. The Vector Miss Distance Indicator development has been combined with the QF-100 Full Scale Aerial Target. The VMDI for subscale targets such as HAHST has been discontinued because of technical obstacles. The Advanced Aerial Gunnery Tow Target System program has been reduced to a limited development program. The FY 1981 technology program was reduced by $1.0 million and the FY 1982 program increased by $1.0 million to coincide with phasing of expenditures. Other adjustments were made for inflation.

Project: #469A
Program Element: #64211F
DoD Mission Area: Aerial Targets, #452

Title: High Altitude High Speed Target (HAHST)
Title: Advanced Aerial Target Development
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The High Altitude Supersonic Target (HAST) successfully completed its technical feasibility flight demonstrations, and advanced development was halted in FY 1977 pending a formal requirement and its validation. The requirement for a High Altitude High Speed Target (HAHST) was validated in November 1977 . Full scale development of HAHST, in response to the ROC, will be initiated in FY 1980. HAHST will provide threat simulation target presentations for evaluation of weapons systems and aircrew training. This system is necessary because of the performance characteristics of emerging threat and the depletion of the limited performance BQM-34F and BOMARC targets.

RELATED ACTIVITIES: The HAHST development will draw heavily on the expertise and data collected in the HAST work done in PE 63232F. In addition, the Digidops scoring system, radar augmentation, and Drone Target Control System (DTCS) will be integrated on the HAHST.

WORKED PERFORMED BY: The office of primary responsibility within the Air Force is the Armament Division (AD), Eglin AFB FL. There are several industry contractors involved with AD including: Radar augmentation - Teledyne Ryan, San Diego, CA; RCA, Phoenix AZ; and Target Control System - VEGA Precision Laboratory, Vienna, VA. The Gulf Coast Test Range at Tyndall AFB, FL conducts flight tests of all systems under development by the ADTC. The HAHST vehicle prime contract is in source selection - Beech Aircraft, Wichita, KA or Teledyne Ryan, San Diego, CA; HAHST rocket/ramjet - United Technology Sunnyvale, CA.

1. FY 1979 and Prior Accomplishments: Not applicable. HAHST feasibility demonstration occurred in PE 63232F. Source selection for full scale engineering development was conducted during FY 1979.

2. FY 1980 Program: Contract for the initiation of HAHST full scale engineering development will be awarded. Ground and flight testing of radar augmentation and scoring devices will be conducted. Performance and recovery testing using residual Advanced Development models will be initiated. Design of engineering models will also be initiated.

3. FY 1981 Planned Program: Engineering Development vehicle design will continue. Improved components and subsystems will be integrated with test bed vehicles for flight test and evaluation. Fabrication of Engineering vehicles will be initiated. Critical design review will be conducted in third quarter FY 1981.

Project: #469A
Program Element: #64211F
DoD Mission Area: Aerial Targets, #452

Title: High Altitude High Speed Target (HAHST)
Title: Advanced Aerial Target Development
Budget Activity: Defensewide Mission Support, #6

4. FY 1982 Planned Program: Fabrication will continue with first Engineering Development vehicle delivery. Test bed flights will continue with emphasis on design verification of improved subsystems. Development test and evaluation will begin with fifteen planned fights.

5. Program to Completion: Long lead production release is planned for October 1982. Development Test and Evaluation (DT&E) will be completed in FY 1983. Initial Operational Test and Evaluation (IOT&E) will be performed during FY 1983-84. Plans include twenty-five IOT&E flights. Production decision is scheduled for FY 1984.

6. Milestones: Not Applicable.

7. Resources:

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
469A	HAHST	6,307 1/	11,000	10,000	14,000	14,500	83,400 2/

1/ New Start
2/ Includes $27.6 million for High Altitude Supersonic Target (HAST) under Program Element 63232F.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1989 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
469A	HAHST		5,500	11,000	12,000	24,000	52,500

Program has been restructured to compress the development schedule and introduce competition as a result of funding issues. Total estimated cost includes HAST funding from Program Element 63232F.

Project: #2535
Element: #64211F
DoD Mission Area: Aerial Targets, #452

Title: Full Scale Aerial Target (FSAT) Program
Title: Advanced Aerial Target Development
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The QF-100 Full Scale Aerial Target (FSAT) is intended to replace the PQM-102 beginning in FY 1983. Full scale engineering development was initiated in FY 1979 to convert F-100 aircraft retired from the active inventory to the QF-100 for target drone operation. The QF-100 FSAT project will include design and integration of remotely controlled autopilot modifications, command and control telemetry devices, programmable maneuver profiles, and a scalar or Vector Miss Distance Indicator (VMDI) scoring system. The FSAT will provide a realistic fighter threat simulation for test and evaluation of weapons systems and aircrew training.

RELATED ACTIVITIES: The QF-100 FSAT will use the same technology previously applied to the PQM-102 target drone. The VMDI or Digidops scoring system and Drone Target Control System (DTCS) will be integrated into the FSAT.

WORK PERFORMED BY: The office of primary responsibility is the Armament Division (AD), Eglin AFB, FL. There are several industry contractors involved with AD including: Drone Target Control System - VEGA Precision Laboratory, Vienna, VA; Digidops Scoring System - Engineering, Inc., Anaheim, CA; and the Prime Vehicle Contractor - Sperry Flight Systems, Phoenix, AZ.

1. FY 1979 and Prior Accomplishments: The FSAT prime contract was awarded to Sperry Flight Systems in August 1979 for full scale engineering development.

2. FY 1980 Program: Full scale engineering development will continue. Development will include hardware fabrication, subsystem integration of scoring and control systems, and subsystem test. The critical design review will be conducted in April 1980. Contractor development test and evaluation (DT&E) flight tests will be initiated.

3. FY 1981 Planned Program: Contractor and Air Force DT&E will be conducted.

4. FY 1982 Planned Program: Initial Operational Test and Evaluation will be completed and deficiences will be corrected. The production decision is scheduled for March 1982.

5. Program to Completion: The program will be completed in FY 1982.

6. Milestones: Not applicable.

Project: #2535
Element: #64211F
DoD Mission Area: Aerial Targets, #452

Title: Full Scale Aerial Target (FSAT) Program
Title: Advanced Aerial Target Development
Budget Activity: Defensewide Mission Support, #6

7. Resources:

Project Number	Title	FY1979 Actual	FY1980 Estimate	FY1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
2535	FSAT	1,700	5,500	6,200	2,200		15,600

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Cost
2535	FSAT		1,700	4,000	6,000	2,000	13,700

Project 2588, Vector Miss Distance Indicator, was combined with Project 2535. Other adjustments were made for inflation.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64227F
Title: Flight Simulator Development
DOD Mission Area: Non-System Training Devices, #430
Budget Activity: Defense-Wide Management and Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11,835	6,300	17,900	27,600	Continuing	Not Applicable
2201	B-52 Aerial Refueling/KC-135 Boom Operator Part Task Trainers	135	400				9,435
2269	B-52 Electro-Optical Viewing System	1,100	2,000	200			8,100
2325	Simulator Development Activities	700	700	1,000	1,600	Continuing	Not Applicable
2360	Tactical Combat Trainer	9,900	3,200	16,700	26,000	23,300	88,000

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a continuing Program Element (PE) for the engineering development of aircrew flight simulation techniques and training devices. Increasing costs of flying hours, limited airspace and reduced energy resources point to the need for development of synthetic training devices capable of training the full spectrum of the Air Force mission roles. The objective of this PE is to adapt flight simulation technology developed in the laboratories and industry for satisfying current training requirements. Prototype training devices and subsystems developed under this element will be evaluated for training effectiveness and supportability prior to follow-on production decisions and/or integration with training devices in acquisition.

BASIS FOR FY 1981 RDT&E REQUEST: Upgrade of the B-52 Electro-Optical Viewing System to production configuration will be completed. The Critical Design Reviews for the Tactical Combat Trainer (TCT) will be completed. Specific interest will be given to develop objectives such as high resolution visual area of interest, multiple target processing/display and correlation of visual displays with the electronic warfare sensors. The A-10 simulators will be delivered to the TCT contractors to begin visual integration efforts. Based on a reduced level of effort in FY 1980 for TCT due to budget constraints, the FY 1981 efforts will be a significant effort increase. This increased emphasis on TCT must be sustained.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #64227F Title: Flight Simulator Development
DOD Mission Area: Non-System Training Devices, #430 Budget Activity: Defense-Wide Management and Support, #6

DETAILED BACKGROUND AND DESCRIPTION: This Program Element was started to conduct programs and activities normally accomplished as part of the development phase of the acquisition cycle, but are inappropriate to fund with procurement funds programmed for simulator acquisitions. The B-52 Aerial Refueling Part Task Trainer (ARPTT)/KC-135 Boom Operator Part Task Trainer (BOPTT) project is for development of prototype devices which will be used to evaluate the feasibility of substituting ground training for airborne training in aerial refueling tasks. These Par Task Trainers consist of a B-52 cockpit and a KC-135 boom operator station with camera-model visual systems to display the required visual scene. The B-52 Electro-Optical Viewing System (EVS) project is for development of a prototype real time simulation of the B-52 EVS (forward-looking infra-red, low light level television) display using the Defense Mapping Agency Digital Data Base and Computer Generated Imagery for the B-52 Weapon System Trainer. It will provide training for B-52 pilots and navigators in the low level penetration mission. The project for Simulator Development Activities provides the Program Director flexibility in funding quick response and consultive efforts. Activities are conducted on a continuing basis in the areas of systems requirements, trade-off analysis, modular design studies, test instrumentation, and data reduction. The Tactical Combat Trainer (TCT) project is for competitive prototype development and evaluation of dual interactive cockpit wide field-of-view visual systems. The visual system will be used for training tactical air-to-air combat and air-to-ground weapons delivery. The competing prototype will be initially installed and evaluated on A-10 Operational Flight Trainers (OFTs). Follow-on production visual systems are programmed for the A-10, F-15, and F-16 simulators. The TCT development is structured to effectively combine varied research elements into a cohesive system which will permit a comprehensive evaluation of visually aided aircrew training. Significant efforts being combined in the TCT development are high resolution area of interest, multiple moving targets and electronic warfare (EW) correlation with the visual system including terrain occulting.

RELATED ACTIVITIES: Projects in this element rely on the technologies from inter-service coordination of technology base programs. This element relies heavily on the Air Force Human Resources Laboratory technological base programs. Specific programs which support this element are: Program Element (PE) 62205F, Training and Simulation Technology; PE 63227F, Advanced Simulator Development; PE 63715F, Innovations in Education and Training.

WORK PERFORMED BY: The Deputy for Simulators, Wright-Patterson Air Force Base, OH, is the in-house organization responsible for this element. The only in-house efforts are the KC-135 BOPTT and some tasks within the Simulator Development Activity project. The major contractors for the remaining projects are: Redifon Flight Simulation, Ltd, Crawley, England (B-52 ARPTT); the Boeing Company, Wichita Division, Wichita, KS (B-52 EVS); Singer-Link Division, Binghamton, NY (B-52 EVS and TCT) and General Electric, Space Systems Division, Daytona Beach, FL (TCT).

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Initial Operational Test and Evaluation (IOT&E) on the B-52 Aerial Refueling Part Task Trainer (ARPTT) and KC-135 Boom Operator Part Task Trainer (BOPTT) was completed. Production decision reports have been prepared and trainers turned over to the Strategic Air Command for Follow-on Test and Evaluation (FOT&E). The B-52 Electro-Optical Viewing System (EVS) prototypes were integrated with the B-52 Weapon System Trainer

(WST) pilot production units being procured under PE 11113F, B-52 Squadrons. Preliminary design reviews were completed on the Tactical Combat Trainer (TCT) development.

2. FY 1980 Program: Procurement of data and support equipment for the B-52 Aerial Refueling Part Task Trainer and KC-135 Boom Operator Part Task Trainer will be completed and development contracts closed out. Test and evaluation of the B-52 Electro-Optical Viewing System (EVS) will be conducted with the Qualification Operational Test and Evaluation of the B-52 Weapon System Trainer pilot production units. Production decision will be made and prototype upgrade to the production configuration started. Development of the Tactical Combat Trainer (TCT) will be continued at a reduced level due to FY 1980 budget constraints.

3. FY 1981 Planned Program: Upgrade of the B-52 EVS to production configuration will be completed. The Critical Design Reviews for the TCT will be completed. The A-10 simulators will be delivered to the visual contractors for initial integration efforts.

4. FY 1982 Planned Program: The development Test and Evaluation of both competing TCT contractors will be conducted. Key points of evaluation will be visual resolution, multiple moving targets and correlation of the visual scene to the electronic warfare sensors.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: ($ in thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	15,325	12,200	6,300	17,200	Continuing	Not Applicable
2201	B-52 Aerial Refueling/KC-135 Boom Operator Part Task Trainers	1,600	500	400			9,800
2269	B-52 Electro-Optical Viewing System	3,100	1,100	2,000	200		8,100
2325	Simulator Development Activities	1,525	700	700	1,000	Continuing	Not Applicable

Program Element: #64227F Title: Flight Simulator Development

DOD Mission Area: Non-System Training Devices, #430 Budget Activity: Defense-Wide Management and Support, #6

2360	Fighter/Attack Simulator Visual System	9,100	9,900	3,200	16,000	18,300	56,500

The funding change in this program as compared to the FY 1980 submittal is in FY 1981. The Project 2360 funding was reduced in FY 1981 by $4,000K due to fiscal constraints. The Project 2360, previously identified as Fighter/Attack Simulator Visual System, is now called the Tactical Combat Trainer (TCT) to more accurately reflect the training objective. The total estimated cost of the TCT has increased $31,500K above the FY 1980 budget estimate. The increase is primarily based on the FY 1980 funding constraints. These constraints have caused a one year extension of the development effort along with contractor repricing based on the restructured application of effort. A smaller portion of the increase is required to both correct problems encountered during test and addition of risk reduction demonstrations. The risk reduction efforts were recommended during an independent technical review and will, when completed, provide an improved evaluation capability and a more effective lower risk production program.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Project: #2360 Title: Tactical Combat Trainer (TCT)
Program Element: #64227F Title: Flight Simulator Development
DOD Mission Area: Non-System Training Devices, #430 Budget Activity: Defense Wide Management and Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The Tactical Air Forces (TAF) do not have the capability to train crew members in all aspects of the tactical mission. To train the full tactical mission a synthetic training capability is required for: (1) air-to-ground weapons delivery, (2) air-to-air combat, (3) formation flying, (4) air refueling and (5) take-off and landing. This project is for the development of a visual system that can provide the visual cues required to train these tasks. A competitive engineering development and evaluation of dual, interactive cockpit wide field-of-view visual system prototypes will be conducted. The two prototypes will utilize alternative technological approaches and be installed on A-10 Operational Flight Trainers (OFTs) for operational evaluation. Successful completion of this development will lead to a production program for the visual systems for the A-10, F-15, and F-16 OFTs. Integration of the visual systems with the A-10, F-15, and F-16 OFTs will give TAF the ability to train pilots in a full mission scenario including a realistic threat environment. This training capability will significantly improve the operational readiness of TAF aircrew members and has the potential for flying hour cost avoidance.

RELATED ACTIVITIES: This project has been coordinated with the Air Force Human Resources Laboratory (AFHRL), Brooks Air Force Base, TX. Related effort being conducted by AFHRL/AS, Wright-Patterson Air Force Base, OH under P.E. 63227F, Advanced Simulator Development is Project 2363 - Advanced Tactical Air Combat Simulation.

WORK PERFORMED BY: The Deputy for Simulators, Wright-Patterson Air Force Base, OH is the in-house organization responsible for this project. The contractors are General Electric, Space Systems Division, Daytona Beach, FL and Singer-Link Division, Binghamton, NY.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Contract was awarded 29 September 1978. Design of the prototypes commenced. The instructor/operator station mock-ups were completed.

2. FY 1980 Program: Development will continue at a reduced level due to budget constraints. Preliminary design reviews will be completed.

3. FY 1981 Planned Program: Development efforts will continue. Critical Design Reviews will be completed. The A-10 simulators will be delivered to the visual contractors for initial integration efforts.

Project: #2360
Program Element: #64227F
DOD Mission Area: Non-System Training Devices, #430

Title: Tactical Combat Trainer (TCT)
Title: Flight Simulator Development
Budget Activity: Defense Wide Management and Support, #6

4. FY 1982 Planned Program: The Development Test and Evaluation of both competing contractors will be conducted. Key points of evaluation will be visual resolution, multiple moving targets and correlation of the visual scene to the electronic warfare sensors.

5. Program to Completion: On-site integration will be completed and the visual systems will undergo an evaluation in the dual, interactive cockpit configuration. The contractors production proposals will be submitted and evaluated and a production decision will be made in April 1984.

6. Milestones: Not applicable.

7. Resources: ($ in Thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
2360	Tactical Combat Trainer	9,900	3,200	16,700	26,000	23,300	88,000

8. Comparison with FY 1980 Budget Data: ($ in Thousands)

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Costs
2360	Tactical Combat Trainer	9,100	9,900	3,200	16,000	18,300	56,500

The total estimated cost of the TCT has increased $31,500K above the FY 1980 budget estimate. The increase is primarily based on the FY 1980 funding constraints. These constraints have caused a one year extension of the development effort along with contractor repricing based on the restructured application of effort. A smaller portion of the increase is required to both correct problems encountered during test and addition of risk reduction demonstrations. The risk reduction efforts were recommended during an independent technical review and will, when completed, provide an improved evaluation capability and a more effective lower risk production program.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64268F
Title: Aircraft Engine Component Improvement Program (CIP)
DOD Mission Area: General Management Support, #471
Budget Activity: Defense Wide Management & Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual*	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT		80,000	105,500	107,600	Continuing	Not Applicable

*This was funded under the procurement appropriation.

BRIEF DESCRIPTION OF PROGRAM ELEMENT AND MISSION NEED: Aircraft engine component improvement programs (CIP) are initiated after an engine/component has successfully completed all of the required development tests, meets the specification in the development contract, and the first production funded aircraft using the engine/component is accepted by the Air Force. Historically, systems add offensive/defensive equipment, have mission and/or tactics changes, and operate in different environments to meet the ever changing threats. It has been demonstrated that an active engine component improvement program is an effective means of reducing the cost of engine ownership, and improving system operational readiness through improvements in durability, maintainability, operability, reliability, reparability, and suitability of the engine as operational conditions change and service time is accumulated. System changes continue throughout the operational life of a system; therefore, the engine component improvement program must continue at a reasonable level to provide the engineering support required to obtain engine changes which are essential for satisfactory system performance in operational use at a cost affordable to the Air Force. The funds being requested represent the Air Force requirements only and do not include funds required from other Services or Foreign Military Sales on joint programs.

BASIS FOR FY 1981 RDT&E REQUEST: A CIP is required for each operational engine in order to be able to identify and resolve operational problems and potential cost avoidance that arise during service use. The CIP for each engine generally consists of the following types of efforts: (1) analytical and test efforts to identify the life limiting parts of an engine so that corrective actions can be initiated before operational use is impacted; (2) evaluation of new hardware for reducing adverse engine impact on the environment; (3) demonstrations to provide review/revision of maintainability actions to establish and update inspection limits and techniques for field and overhaul activities; (4) investigation of field and test failures to determine the significance and where appropriate generate changes on a timely basis to reduce the impact on the aircraft mission; (5) reduction of maintenance and spare parts costs through the development, evaluation, qualification, and introduction of repair techniques or redesigned parts; and (6) flight and ground tests on engines/components to provide immediate investigation of service-revealed discrepancies and to evaluate proposed engineering changes. Age, use, quantity of engines and operational experience are factors considered in determining the resource allocation to each of these efforts within a given engine CIP. A continuing program is conducted for each of the following engines/components to provide the efforts deemed necessary:

Program Element: #64268F Title: Aircraft Engine Component Improvement Program (CIP)

DOD Mission Area: General Management Support, #471 Budget Activity: Defense Wide Management & Support, #6

ENGINE MODELS	AIRCRAFT APPLICATION	FY 1981 ($ IN MILLIONS)
TF41	A-7	5.75
TF34	A-10	15.00
J85-21	F-5	1.20
TF33	E-3A	1.42
J79	F-4	0.84
F100	F-15	16.35
F100	F-16	39.31
J57	KC-135	0.92
J75	F-105	0.50
J69	T-37	0.35
TF56	C-130	1.24
J85	T-38	1.20
TF30	F-111	14.00
TF33	C-141	1.94
TF39	C-5	3.90
T58	HH-3	0.40
T64	HH-53	0.40
T400	UH-IN	0.40
GTU/T76	ALL/OV-10	0.38
	TOTAL:	105.50

OTHER APPROPRIATION FUNDS: Not Applicable.

DETAILED BACKGROUND AND DESCRIPTION: The Navy/Air Force/Army have found it necessary to maintain an engineering support capability for aircraft engines after the engine development period to address problems that occur over the operational lifetime of that engine. It is this effort that is referred to as the engine Component Improvement Program (CIP). Prior to FY 1980, this program was funded in Aircraft Procurement Appropriation, Budget Activity 7, Aircraft Support Equipment and Facilities. During the engine development program, attempts are made to satisfy all known engine requirements. These are in terms of performance, weight, durability, maintainability, reliability, and other specification requirements. It is also recognized that in the time normally available for engine development, most problems will be identified and solved. However, the limitations of ground testing and a comparatively short flight testing period will not uncover all possible operational difficulties. Experience has indicated that the engine will not achieve its final maturity level until after it has been in operational use for several years. It is during these subsequent years when many of the engine's problems are identified and solved.

Program Element: #64268F Title: Aircraft Engine Component Improvement Program (CIP)
DOD Mission Area: General Management Support, #471 Budget Activity: Defense Wide Management & Support, #6

As the engine progresses through its life cycle, increased component failure or malfunctions, operational problems, and hardware condemnation will occur with increasing age and changing use. These service revealed problems must have timely corrective action through modification with redesigned components. Also there are instances where suppliers of new components or spare parts go out of business, discontinue manufacturing items for lack of production volume, change increasing prices for low quantity orders, or consolidate divisions within a parent company which entails relocation of tooling and training new people. Engineering surveillance and/or qualification testing of alternate or second source of parts is required to maintain a supply of needed components.

The CIP is the vehicle by which engine problems are investigated and resolved. It is essential that such a program exists and operates for the engine to reach maturity and remain a useful power plant throughout its life cycle. Without timely engineering solutions of the service revealed problems, reduced operational readiness and increased maintenance overhaul costs will occur and thereby jeopardize the capability of the fleet to achieve its mission requirements.

CIP is an engineering effort obtained from the original engine manuafacturer and procured and managed by the Air Force or Navy, or jointly. The specific efforts undertaken are determined by the contracting agency (Air Force or Navy) after consideration of the development and operational experience, and the recommendations of all the engine users. In addition, the maturity and logistics goals established for the particular engine are used as program guidelines. Historically, during the early production periods the CIP effort concentrates on resolving early operational problems found with the engine and the redesign of engine parts to reduce the production cost. As the engine matures, greater emphasis is placed on engine component durability, maintainability, reliability through redesign of parts which limits engine use and the development of repair procedures to return used parts to a serviceable condition. The end result of the CIP is a better operational readiness of the engine, longer engine useful life, and lower acquisition and support costs.

RELATED ACTIVITIES: For requisite technology, this program draws on "core" engine technology (compressor, combustor, and high pressure turbine) from Program Element (PE) 63216F, Advanced Turbine Engine Gas Generator. Fan and low pressure turbine technology are provided by PE 63202F, Aircraft Propulsion Subsystem Integration. Materials processing and component fabrication demonstration come from PE 78011F, Manufacturing Technology Proram. Additional component/engine test data is contributed by PE 64218F, Engine Model Derivative Program. The Navy has a supporting engine component improvement program.

WORK PERFORMED BY: The overall program is managed by the Aeronautical Systems Divsion, Deputy for Propulsion, Wright-Patterson AFB, OH. Individual engine component improvement programs are managed by the Aeronautical Systems Division, Deputy for Propulsion and the Air Force Logistics Command's San Antonio Air Logistics Center and Oklahoma City Air Logisitics Center. In-house test and evaluation efforts are conducted at the Arnold Engineering Development Center, Tullahoma, TN and the Air Force Flight Test Center, Edwards AFB, CA. Contractors include Detroit Diesel Allison Division, Indianapolis, IN (T56, TF41 engines); General Electric Company, Evendale, OH (J79, TF39 engines);

General Electric Company, Lynn, MA (J85, J85-21, TF34, T64, T58 engines); Air Research (Garrett) Phoenix, AZ (T76 and GPU): Pratt and Whitney Aircraft of Canada, Ltd (T400); Pratt and Whitney Aircraft, West Palm Beach, FL (J57, J75, F100, TF30, TF33 engines); Solar Division of International Harvester, (GTU); and Teledyne CAE, Toledo, OH (J69 engine).

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: This engine component improvement program was funded in the procurement appropriation in FY 1979 and prior. Accomplishments cited below were made under the procurement funding. Specific accomplishments include:

F100 Engine:
(1) Developed engineering changes which resulted in over $2.0 million cost avoidance.
(2) Resolved major operational problems such as stall-stagnation.
(3) Reduced in flight shutdowns from over 6 to less than 2 per 1000 engine flight hours.
(4) Increased the maximum operating time for the various modules by a factor of 2 to 3.

TF34 Engine:
(1) Realized over $12.5 million in production savings from CIP demonstrated improvements
(2) Corrected the number 3 bearing problem.
(3) Demonstrated fixes which have reduced the depot cost per flying hour from $1,176 to $305; and which have reduced the total cost per flight hour from $5,762 to $588.
(4) One year's CIP effort resulted in production cost reduction of $4,300 per engine and $68 million in logistics cost avoidance.

TF30 Engine:
(1) Demonstrated engineering improvements which resulted in excess of $179.8 million in logistic cost avoidance.
(2) Demonstrated a redesigned first stage turbine disc with a low cycle fatigue life of 6000 hours versus an original disc life of 1600 hours.
(3) Redesigned the compressor to prevent rotor drum fixes which had resulted in two major aircraft accidents and one test cell incident.

TF41 Engine:
(1) Reduced unscheduled engine removals from about 8 to 3 per 1000 flight hours.
(2) Redesigned the turbine blades to correct a safety of flight condition.
(3) Identified the critical life limits on forty-one (41) cycle sensitive parts and conducted a risk assessment using service experience, test data, and finite element analysis techniques.
(4) Redesigned the seventh stage high pressure compressor vane to adequately endure static and vibratory stresses.

OTHER ENGINES: The maximum operating time has been increased dramatically for all engines in the Component Improvement Program (CIP). In a recent five year span, engineering changes on the J57 resulted in over $131.1 million in cost avoidance, and the TF33 has had over $249.6 million in cost avoidance changes.

2. FY 1980 Program: Although this program provides continuing engineering support for all engines and related hardware in the Air Force inventory, the major effort will be directed to the following programs:

F100 Engine: This program contains over 114 specific tasks which are intended to (1) reduce air aborts and Class A and Class B accidents; (2) reduce premature engine removals per 1000 engine flight hours by 15 percent on the F-15 engine; (3) reduce maintenance man hours per engine flight hour by 12 percent (4) achieve a 5% reduction in cost per engine flight hour. Major effort will be directed toward improving hot section durability through work on a shower head first stage blade, first to second stage spacer, and second stage turbine vane cooling. Efforts will be conducted to improve control system reliability/durability by obtaining better stepper motor reliability in the electronic engine control; (2) improve the wear resistance of the boost pistons in the unified fuel control; (3) increase rotor shaft strength and reduce shaft spline wear in the Main Fuel Pump; and (4) provide self test flag for the Events History Recorder and shock isolation to the Electronic Engine Control. Several tests are planned to improve augmentor/nozzle durability and to demonstrate fixes to extend module maximum operating hours. Many repairs (about 200 per year) are planned to reduce spare parts cost and increase the durability of engines.

TF34: This program is structured to provide a cost effective engineering program to design, qualify and introduce hardware changes which will address the following goals: (1) reduce the percent of engines not mission capable by 17 percent; (2) reduce unscheduled removals per 1000 engine flight hours by 37 percent; (3) reduce scheduled removals per 1000 engine flight hours by 10 percent; (4) reduce maintenance manhours per engine flight hour by 44 percent; and (5) reduce depot and spares costs from per engine flight hour by 23 percent. Effort will also be directed toward the elimination of failure modes which impact safety of flight, and toward the improvement of operational readiness. The program includes a life management program which provides a means for predicting and tracking hardware low cycle and thermal cyclic life limits; design changes to engine accessories to reduce support costs and increase readiness; development and evaluation of component repair procedures to reduce the frequency of repair and replacement of major components. Extensive factory Accelerated Mission Testing (AMT) and component testing will be accomplished.

TF30: The contractural engineering effort for this engine will cover the continued redesign/modification necessary to resolve flight safety failures, to evaluate and correct service revealed deficiencies, and to provide engineering design for developing and testing cost effective repairs for depot and field implementation. In addition, the TF30 Engine Improvement Program, AMT, and low cycle fatigue analysis/redesigns will

be continued to identify and eliminate potential problems before fleet failure. Goals include: (1) reduce engine not mission capable from 25% to 17.4%, (2) reduce total engine removals per 1000 engine flight hours, by 3 percent, and (3) increase the average age of installed engines from 382 hours to 400 hours.

TF41: This program will continue to require engineering effort to resolve flight safety problems; to address service revealed deficiencies; and to assist logistics support with repair engineering, life cycle cost analysis and component life/risk assessments. Effort will continue on the combustion section to increase durability by redesigning: (1) a transpiration cooled combustor liner and dome assembly to reduce high temperature exposure by 250°F, and (2) a discharge nozzle utilizing a modified cooling pattern. Special attention will be given to the causes of compressor stalls. This will include: (1) removal of cadmium plating from the fuel wetted surfaces of the high pressure fuel pump (a current safety of flight problem), and (2) modification of the control system to prevent compressor stalls. Continuing efforts will be directed toward determining the low cycle fatigue lives of critical engine parts and increasing these lives. Major split line seals in the oil wetted sumps require design changes for resolution of major oil leaks which are one of the top ten reasons for unscheduled engine removals. These and other planned tasks should permit: (1) reduction in engine removals per 1000 engine flight hours by 24 percent , (2) reduction of maintenance manhour per engine flight hours by 4 percent, and (3) a 30% reduction in air aborts.

TF39: Engineering effort will be directed towards resolving service revealed problems and conducting fleet leader engine testing to provide early problem identification and correction as well as verifying fixes for the service revealed deficiencies. Major effort will be directed toward the development of repair procedures which will reduce the discarding of expensive parts. Titanium fires require fan/compressor modification and redesign effort is needed to reduce fan blade interlock wear. The CF6, a commercial derivative of the TF39, is accruing operating time at twice the rate of the TF39. Problems being experienced in the CF6 such as (1) wear of compressor blades, (2) stage 3-9 spool life, (3) stage 14-16 spool life, (4) stage 1 and 2 high pressure compressor blade tip rub, (5) stage 1 high pressure compressor vane life, (6) stage 2 high pressure compressor disc life, and (7) compressor rear frame cracking, will be evaluated and fixes developed where appropriate for the TF39.

TF56: The program will continue to address: (1) Safety of flight problems, (2) improvements in the capability to meet mission requirements, (3) reduce field maintenance manhours and costs, (4) reduce overhaul and spare parts costs, (5) reduce premature engine removals, and (6) develop repair procedures. Efforts planned include: (1) Series 1 rear turbine bearing, (2) improved 1st and 2nd stage turbine blades, (3) improved 1st stage turbine vanes, and (4) temperature datum valve improvements for better reliability.

OTHER ENGINES: The programs for the other engines are directed toward the resolution of service revealed problems and development of repair procedures or work arounds to maintain logistic support for the engines. Limited testing is done to qualify fixes and repairs.

Program Element: #64268F
DOD Mission Area: General Management Support, #471

Title: Aircraft Engine Component Improvement Program (CIP)
Budget Activity: Defense Wide Management & Support, #6

3. FY 1981 and 1982 Planned Program:

a. The Engine Component Improvement Program (CIP) is a continuous program carried on throughout the service life of the engines. Engineering effort will include the following general areas in conducting a CIP for each engine and related hardware.

(1) Investigation, definition and correction of service revealed deficiencies.
(2) Improve engine reliability and maintainability by improving on the design of marginal components.
(3) Extend the maximum operating time of the engines.
(4) Reduce overhaul cost by qualifying new wear limits and determining part life.
(5) Maintain engine specification requirements.
(6) Provide a review of maintainability actions, establish and update inspection limits and techniques for field and overhaul activities.
(7) Provide early disclosure of any weakness that would limit engine life and would normally appear only after extended service operation.
(8) Reduce maintenance and spare parts cost through the review, evaluation and introduction of repair techniques.
(9) Initiate action to redesign and improve the marginal parts/components as soon as investigation and identification of potential weaknesses indicates such action is appropriate.

b. The general activity above applies to all engines in the Air Force inventory to one degree or another. The major efforts will be as follows:

F100: Investigate and develop repair procedures; extensive testing to qualify repairs/redesigns and find potential problems ahead of fleet experience; work on 10 tasks contributing to Class A mishaps; reduce air aborts by approximately 0.2 per 1000 EEH; reduce maintenance manhour per engine flight hour by about 20 hours; reduce hardware cost per flight hour by developing a composite external nozzle flap, improving EHR reliability, improving the durability of the divergent flaps and several other items; and respond to UERs.

TF34: Effort on this engine will be directed to identifying and resolving engine weaknesses before they occur in the field. This will involve extensive testing and analysis. Work will also be directed toward reduction of life cycle costs. Typical tasks are: fan blade FOD limit extension and repair; fan disk and blade life verification, long life combustor; redesign of #2HPT disk and outer liner redesign. Investigation and resolution of service revealed deficiencies will also require significant effort.

TF30: There will be testing effort to verify fixes resulting from the concentrated Engine Improvement Program and to continue extending the time on lead the fleet test engines. There are four models of the engine which forces more testing due to significant mission differences. There are impending flight

safety failures which must be addressed as well as the redesign of rotating and static components with identified LCF life to provide cost effective and logistically manageable component life. Tasks such as 4th stage low pressure compressor disk life extension; low pressure turbine blade and vanes; first stage turbine blade baffle, first stage turbine vane durability and high pressure compressor disk will be worked. Effort will also be directed toward the identification and resolution of service revealed problems.

TF41: Accelerated mission tests (AMT), accelerated cyclic turbine tests, engine performance tests, component lives and life cycle cost analysis will be conducted on many critical parts for analyzing their desirability for incorporation into production. The LP compressor sump and vane support assemble will be redesigned to alleviate excessive torsional, bending, and vibratory stresses with the vanes currently in service. Shroud wear and untwist limits within the LP turbine blades will be analyzed for their effect on excitation and life and appropriate correction action initiated. New repairs and reevaluation of serviceable limits will be necessary due to the fact the fleet is maturing and many engines are wearing beyond current serviceable limits.

TF39: The major drive for this engine is to reduce support costs by providing repair procedures and redesign parts showing distress for any early removal of the engine. Some testing will be done to maintain a lead over the operational engines and to qualify repairs and redesigns. The maximum time between overhaul is being extended. It is anticipated that some parts will be unable to survive 5000 hours and will have to be redesigned to improve the cost avoidance potential for this change.

TF56: This program will concentrate primarily on the investigation, definition and correction of service revealed deficiencies preventing engines from achieving the full maximum time between overhaul and driving up the cost of logistic support. Effort will be directed toward actions necessary to maintain engine specification requirements as the engine ages and review maintainability actions to establish and/or update inspection limits and techniques for field and overhaul activities.

OTHER ENGINES: The other engines in CIP are relatively mature and the effort on these programs is directed toward maintaining operational capability at reasonable logistic expense. As the engine ages new failure modes surface which must be addressed. Repair and maintenance procedures are continually reviewed and updated to meet the changing characteristics of the engines and their use.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

Program Element: #64268F Title: Aircraft Engine Component Improvement Program (CIP)
DOD Mission Area: General Management Support, #471 Budget Activity: Defense Wide Management & Support, #6

8. Comparison with FY 1980 Budget Data: In FY 1980, the Aircraft Engine Component Improvement Program (CIP) was submitted as a part of the Procurement Budget. Congress directed that CIP be transferred to the RDT&E budget and also reduced the FY 1980 funding from a request of $104.4 million to $80.0 million. This significant cut in the FY 1980 budget resulted in reduction in the engineering effort on all major engine programs and delayed the development and qualification of needed fixes. The FY 1981 request reflects the resources required to return the program to the level required to address critical engine problems. The FY 1981 request is consistent with the FY 1980 request.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64411F, 63411F
Title: Space Shuttle
DOD Mission Area: Space Launch and Orbital Support, #410
Budget Activity: Defense-wide Mission Support #6

RESOURCES (PROJECT LISTING): ($ in Thousands)

PROJECT NUMBER	TITLE	FY 1979 ACTUAL	FY 1980 ESTIMATE	FY 1981 ESTIMATE	FY 1982 ESTIMATE	ADDITIONAL TO COMPLETION	TOTAL ESTIMATED COSTS
	TOTAL FOR PROGRAM ELEMENT	169,600	206,900*	230,100	187,800	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program has as its main objectives: (1) supporting the National Aeronautics and Space Administration (NASA) development and assuring the utility to DOD of the Space Transportation System (STS); (2) conducting the planning and efforts necessary to transition critical national defense satellites from their current expendable launch vehicles to the Shuttle; (3) developing an Inertial Upper Stage (IUS) for use with the Shuttle; and (4) acquiring and operating general purpose Shuttle launch and landing facilities at Vandenberg Air Force Base (VAFB), CA. The Air Force, as the DOD executive agent is responsible for the planning, development, and activation activities necessary to achieve these objectives. DOD use of the STS is projected to reduce launch operations costs and increase the effectiveness of military space operations in the future.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes the funds to continue the IUS full scale development phase to provide an initial launch capability in mid-1981. Costs for the IUS development have increased significantly from earlier projections. Funds are also included to continue the acquisition of the Vandenberg AFB Ground Support System (GSS) leading to a VAFB initial operating capability (IOC) in December 1983. Development continues on airborne support equipment and payload integration equipment in preparation for DOD Shuttle launches from Kennedy Space Center. Implementation of the controlled mode for secure DOD mission operations continues at Johnson Space Center (JSC), Houston, TX to support a first launch in 1982. A modified approach to processing DOD payloads for launch from Kennedy Space Center (KSC) will be implemented and is expected to reduce overall DOD costs while improving the effectiveness of DOD operations. Modifications to KSC systems - similar to those at JSC - will be performed to protect classified data for DOD missions.

OTHER APPROPRIATION FUNDS:

	FY 1979 ACTUAL	FY 1980 ESTIMATE	FY 1981 ESTIMATE	FY 1982 ESTIMATE	ADDITIONAL TO COMPLETION	TOTAL ESTIMATED COSTS
Procurement (Missile) (PE 12449F)	91,700	162,500	131,093	93,227	Continuing	N/A
Procurement (Other) (PE 12449F)	13,525	25,151	24,022	12,341	Continuing	N/A
Military Construction (PE 12449F)	113,500	74,700	127,100	14,300	Continuing	N/A

*Includes planned FY 1980 reprogramming request to provide additional funds required to develop the Inertial Upper Stage for use on the Space Shuttle.

Program Element: #64411F, 63411F
DOD Mission Area: Space Launch and Orbital Support, #410

Title: Space Shuttle
Budget Activity: Defense-wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: The Space Task Group, established by the President in 1969, recommended that a Space Transportation System (STS) be developed to provide more flexible and effective access to space at lower costs than current United States expendable launch vehicles. In January 1972 the President authorized the National Aeronautics and Space Administration (NASA) to proceed with the development of the reusable Space Shuttle as a national means for transporting payloads to and from space. The STS consists of a Space Shuttle which will carry payloads to low earth orbit and return to land on a runway; upper stages to transfer payloads from low earth orbit to higher orbits; and associated ground and airborne support systems. The first stage of the Space Shuttle is a pair of recoverable solid rocket motors which will provide initial boost acceleration for the system. The second stage is the reusable Orbiter which will carry the upper stage and/or other spacecraft into orbit. The Orbiter will have a 15x60 foot payload bay and the capability to boost 32,000 pounds of payload to a near-polar (98°) orbit, or 65,000 pounds into an Easterly (28°) orbit. Thrust augmentation will be required to achieve full specification performance. After reentry, the Shuttle will land on a runway using a high speed, unpowered approach.

Since the Space Shuttle will eventually replace the current expendable launch vehicles, the Air Force must assure that critical national defense missions will continue to be supported in an effective manner. This includes the capability to support polar-orbit operations as well as assuring that a capable upper stage is available to transfer certain critical DOD satellites from the low-earth orbit attained by the Space Shuttle to higher orbits (e.g., earth synchronous). Although NASA is responsible overall for the STS, they cannot properly define DOD operational and support requirements, or assess the effect of Shuttle design changes on DOD national security missions. The Air Force efforts address DOD unique needs to assure operational utility. Air Force analyses indicate that the Space Shuttle offers the potential for improving DOD space mission capability and reducing launch costs when compared with existing expendable boosters. In addition, the long term advantages of the Shuttle to DOD appear to be substantial, particularly in the areas of payload retrieval, on-orbit repair, assembly of very large structures in space, and the availability of an orbital test bed, all of which are modes of operation unavailable without the Shuttle.

To minimize the operational impact and cost of modifying DOD payloads, and to make early effective use of the Shuttle, the DOD and NASA have reached an agreement that the Air Force will develop an expendable upper stage for use with the Shuttle; this stage is called the Inertial Upper Stage (IUS). It is planned to have the IUS operational coincident with the first operational need dates at the Kennedy Space Center (KSC). The IUS will be used on Shuttle by both DOD and NASA, and is also planned to be used as an upper stage for the Titan III launch vehicle.

The DOD has also agreed to acquire and operate the Space Shuttle launch and landing facilities at Vandenberg AFB (VAFB), CA, with a target IOC date of December 1983. This agreement was reached after an extensive study had determined that DOD and NASA requirements could not be satisfied from one launch site, and that use of a second site at VAFB was necessary for polar orbit missions. The heavier near-polar missions cannot be accomplished from the Kennedy Space Center (KSC), FL, since that would require overflight of the continental US while sub-orbital and result in the large Shuttle external tank being released on a ballistic trajectory over the Sino-Soviet land mass for impact in the Indian Ocean.

Program Element: #64411F, 63411F
DOD Mission Area: Space Launch and Orbital Support, #410

Title: Space Shuttle
Budget Activity: Defense-wide Mission Support #6

RELATED ACTIVITIES: This program is directly related to, and paced by, the National Aeronautics and Space Administration (NASA) Space Shuttle development program. Under current agreements, NASA will fund for all Shuttle Orbiters, provide the general purpose launch and landing facilities at Kennedy Space Center (KSC), FL, and perform Shuttle mission control at Johnson Space Center (JSC), Houston, TX. The DOD portion of the program will include the development of the Inertial Upper Stage (IUS), the acquisition and operation of Space Shuttle facilities at Vandenberg Air Force Base (VAFB), and the funding for the unique DOD requirements levied on the NASA-developed Space Transportation System (STS) elements. A joint NASA/United States Air Force (USAF) STS Committee, co-chaired by the Assistant Secretary of the Air Force (Research, Development, and Logistics) and the NASA Associate Administrator for Space Transportation System Acquisition, assures that the STS will meet the needs of both agencies. DOD payload planning efforts are addressed by the DOD Space Shuttle User Committee which includes representatives of the Army, Navy, Air Force, Office of the Secretary of Defense (OSD), and Joint Chiefs of Staff. The USAF Director of Space Systems and Command, Control, Communications chairs this body, and also has the responsibility for research and development efforts involving Air Force payloads, expendable launch vehicles and the Shuttle program. IUS production, VAFB operations and maintenance, and Shuttle flight charges paid to NASA for USAF users are funded under PE 35171F (Space Launch Support). Titan III/IUS integration is funded under PE 35119F, Space Boosters. Related activities for near term utilization of the Space Shuttle sortie mode capabilities are being pursued by the Space Test Program under PE 63402F. The Air Force is planning a Consolidated Space Operations Center (CSOC), funded under PE 35130F for an FY 1985 operational capability, to augment and backup the present satellite control capabilities of the Satellite Test Center and to provide a dedicated DOD Shuttle control capability.

WORK PERFORMED BY: The Air Force Space Division (SD); formerly the Space and Missile Systems Organization (SAMSO), Los Angeles, CA, of the Air Force Systems Command is the development agency for the Air Force Space Shuttle activities. The Aerospace Corporation, Los Angeles, CA, provides SD with general systems engineering support. Martin Marietta (Denver), VAFB, CA, was awarded the contract for the detailed design criteria for VAFB facilities and for development of support equipment and software specifications. Martin Marietta is also the payload integration contractor. The Boeing Company, Seattle, WA, was awarded the contract for IUS full scale development, and is also performing spacecraft to IUS integration activities. TRW Systems, Inc., Redondo Beach, CA is supporting development of the secure Shuttle mission control capability at the Johnson and Kennedy Space Centers. International Business Machines (IBM), Houston, TX, is under contract to evaluate specialized Orbiter flight software for DOD missions.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Preliminary DOD system level requirements for the STS were developed in 1971 and continue to be refined. The Validation Phase for the expendable, solid propellant IUS was completed, and the Full Scale Development (FSD) Phase began following a March 1978 Defense Systems Acquisition Review Council Milestone II (DSARC II) review. The final two stage IUS configuration was baselined at the system Critical Design Review

during 1979. Problems with development of the IUS solid rocket motors and the flight software were identified and will cause a stretch in the development program and increase the total development cost. IUS processing modifications to the Solid Motor Assembly Building (SMAB) began at Cape Canaveral AFS, FL. The Vandenberg AFB (VAFB) construction program began in January 1979 with modifications to the existing launch pad. Design of unique DOD ground support equipment and software development for the launch processing system were started. Procurement of unique ground support equipment (GSE) was initiated, and co-procurement continues for GSE and launch processing equipment common to Vandenberg Air Force Base (VAFB) and Kennedy Space Center (KSC). The impact of supporting a thrust augmented Space Shuttle was evaluated and modifications to the launch pad were defined to accept this new configuration. Development began on interface verification equipment and payload integration capabilities. Conceptual studies of large space structures were completed and indicated that such structures are technically achievable when mission requirements dictate. The "controlled mode" configuration was identified to allow the Johnson Space Center (JSC) to conduct classified DOD Shuttle missions, and development was started. Studies of the KSC security requirements were completed and showed the need for modifications similar to those being done at JSC. Further analysis of payload processing requirements for KSC-launched DOD missions resulted in a new approach which promises to reduce DOD costs while making launch operations more effective; this "off-line" processing method is based on additional modifications to the Solid Motor Assembly Building (SMAB) which will be performed in FY 1981.

2. FY 1980 Program: The development of the basic, two-stage Inertial Upper Stage (IUS) continues. The delays caused by solid rocket motor and software problems will not impact user launch needs. The full scale development contract will continue into 1982 for completion of the two stage IUS development and for delivery of pre-production vehicles. Reprogramming authority will be requested for the additional FY80 funding required to support IUS development. The procurement of long lead materials for the follow-on production will begin, with funding provided by the National Aeronautics and Space Administration (NASA) and PE 35171F, Space Launch Support. Engineering design activities for the Vandenberg Ground Support System (GSS) will continue, keyed to the construction of VAFB facilities. Construction of the second package of VAFB Shuttle facilities begins; it includes the Orbiter maintenance and checkout facility, the first cell of the hypergolic maintenance and checkout facility, the Titan solid rocket booster (SRB) storage facility relocation, utilities, and modifications to the launch pad (an FY 1979 project) to incorporate thrust augmentation impacts. Equipment installation begins in the launch control center.

Payload integration activities continue to support early DOD Shuttle flights. Implementation of the controlled mode continues and facility modifications begin at Johnson Space Center (JSC) to provide adequate security to conduct DOD Shuttle operations. Independent software validation and verification activities continue. The manned orbital flight tests of the Shuttle, planned to begin in 1980, will be evaluated to assure its capability to meet DOD requirements.

3. FY 1981 Planned Program: The Inertial Upper Stage (IUS) development, including fabrication of nine pre-production vehicles to meet early operational requirements, continues into FY 1982 to meet an initial operational capability (IOC) now projected for July 1981 on Titan and September 1981 on Shuttle. The IUS production phase is planned to

begin following a Defense Systems Acquisition Review Council Milestone III (DSARC III) review. Funding is provided by NASA and PE 35171F, Space Launch Support. Development continues on the NASA-funded twin-stage planetary IUS configurations to support a first mission in 1983.

The Vandenberg AFB (VAFB) Ground Support System (GSS) equipment installation continues and checkout begins on facilities begun in the FY 1979 and FY 1980 construction programs. Construction begins on the facilities in the third VAFB military construction package; these include the solid rocket booster (SRB) refurbishment and subassembly facility; the SRB retrieval and disassembly facility; the airfield and mate/demate facilities; transportation facilities; the external tank storage and checkout facility; the logistics facilities; the integrated operations support center; and the Space and Missile Test Organization Management and Engineering Facility relocation. The installation and checkout of the controlled mode hardware and software begin at Johnson Space Center (JSC). Modifications will begin to enable the Solid Motor Assembly Building (SMAB) at Cape Canaveral AF Station to process DOD payloads for Shuttle launch. Payload integration will be nearing completion for the initial flights and continues for later flights.

4. FY 1982 Planned Program: Development of the two-stage Inertial Upper Stage (IUS) will be completed with analysis of the first Titan/IUS and first Shuttle/IUS flights. Delivery of the remaining pre-production vehicles is planned. National Aeronautics and Space Administration (NASA) funded unique development continues to meet NASA requirements. IUS production continues (funded by PE 35171F, Space Launch Support, for Air Force vehicles, and by NASA).

The Vandenberg Ground Support System (GSS) installation and checkout continue toward providing an initial launch capability in December 1983 to support civil and Defense missions projected for 1984. The facilities funded in the FY 1982 military construction program (harbor modifications, parachute refurbishment, and flight crew systems) will complete the initial facility set and provide an initial capability of six launches per year and allow moderate growth (to a 10-12 flight per year rate) as requirements dictate.

Payload integration activities continue. The Johnson Space Center (JSC) controlled mode will be completed to support the first classified experimental mission in 1982.

5. Program to Completion: The Vandenberg AFB (VAFB) GSS activation will continue at a rate determined by projected launch requirements. If necessary, a final military construction package (currently projected for FY 1983) would be used to remove Shuttle processing restrictions and allow growth to 20 evenly spaced launches per year by mid calendar year 1985. Additional facilities are projected for FY 1983 to fully accommodate thrust augmentation to support a mid 1985 NASA Spacelab mission. Testing and activation will be completed on the Cape Canaveral Solid Motor Assembly Building (SMAB) to enable off-line processing of DOD payloads for Shuttle launch. Security modifications to the Kennedy Space Center (KSC) will be completed. Launch operations will begin at Vandenberg. Payload integration activities will continue until all DOD payloads have transitioned to the Shuttle.

Program Element: #64411F, 63411F
DOD Mission Area: Space Launch and Orbital Support, #410

Title: Space Shuttle
Budget Activity: Defense-wide Mission Support #6

6. Milestones:

	Date	
VAFB Design Criteria Start	Oct 75	
IUS Validation Phase Start	Sep 76	
IUS Full Scale Development (FSD) Start	Apr 78	
VAFB Construction Start	Jan 79	
IUS Initial Launch Capability	*(Jul 80) Jul 81	(Titan)
	Sep 81	(Shuttle)
VAFB Initial Operational Capability	Dec 83	
VAFB Full Operational Capability	Jul 85	
First Thrust-Augmented Launch	*(None) Jul 85	

*Date presented in FY 80 Descriptive Summaries.

Explanation of Milestone Changes: The Inertial Upper Stage (IUS) Full Scale Development (FSD) contract began in April 1978 and was structured to meet civil and Defense launch requirements then projected for July 1980. The IUS has incurred a series of development problems, primarily with the solid rocket motors and the flight software, which will force extension of the development schedule and a significant increase in projected development costs. An evaluation of alternative upper stages has determined that, even with current cost estimates, the IUS is still the most economical way to meet both Department of Defense (DOD) and National Aeronautics and Space Administration (NASA) operational requirements. Consequently, the Air Force will continue the IUS program and request reprogramming authority for the additional FY 1980 funding required.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

SPACE SHUTTLE	FY 1978 ACTUAL	FY 1979 ESTIMATE	FY 1980 ESTIMATE	FY 1981 ESTIMATE	ADDITIONAL TO COMPLETION	TOTAL ESTIMATED COSTS
TOTAL FOR PROGRAM ELEMENT	124,300	168,400	175,500	159,500	Continuing	N/A

The FY 1979 increase of $1.2 million reflects the cost of performing special studies of DOD Shuttle mission control options as directed by the Office of Management and Budget (OMB). All of the FY 1980 increase, as well as $52.0 million of the FY 1981 increase, results from the development problems encountered by the Inertial Upper Stage (IUS) program. Virtually all of the balance of the FY 1981 increase (beyond that incurred by the IUS) results from the application of the revised OSD escalation rates to the Shuttle program.

Program Element: #64411F, 63411F
DOD Mission Area: Space Launch and Orbital Support, #410

Title: Space Shuttle
Budget Activity: Defense-wide Mission Support #6

The IUS program received Defense Systems Acquisition Review Council (DSARC) Milestone II approval in March 1978 and entered full scale development. Both the DSARC schedule goal and threshold were established as July 1980. Based on that accelerated development schedule, the DSARC cost goal was set at $285 million (FY 1978$) and the cost threshold established at $313 million (FY 78$). The original Milestone II decision was constrained by launch requirements for the NASA Tracking and Data Relay Satellite (TDRS) and the Defense Satellite Communications System (DSCS), both of which were projected for July 1980. Consequently, no viable option existed except to attempt to complete IUS development on a success oriented schedule. Since that time, both launches have been delayed. The IUS program has encountered development difficulties with the solid rocket motors and the flight software, and IUS development cannot be completed before mid-1981. Our current cost projections also take into account this more realistic technical assessment for the IUS development. Our current cost estimate for the DOD Shuttle/IUS development is $387 million (FY 1978 $); the cost threshold has not yet been set pending an analysis of program impacts that could result if IUS users are not ready to launch on the currently projected schedule. We are predicting the IUS will be ready for launch on the Titan III(34)D in July 1981 and on the Shuttle in September 1981. This revised schedule meets all projected operational requirements.

A thorough analysis has been performed to determine if an alternate upper stage (i.e., Centaur, Transtage, or Agena) could meet operational requirements more economically. The results of this analysis were reviewed, along with the current IUS program status, by senior Air Force management in late November and early December 1979. This review resulted in decisions to continue the IUS program, to request reprogramming authority to cover the additional FY 1980 RDT&E requirements, and to include the additional FY 1981 funding and FY 1982 funding in the DOD budget.

Budget Acitivty: Defensewide Mission Support
Program Element: #64411F, 634111F, Space Shuttle

Test and Evaluation Data

1. Development Test and Evaluation: The National Aeronautics and Space Administration (NASA) has the development responsibility for the Space Shuttle, the East Coast Shuttle launch and landing facilities at Kennedy Space Center (KSC), FL, and the flight control facilities at the Johnson Space Center (JSC), TX. The DOD will develop the Inertial Upper Stage (IUS) and will develop and operate a West Coast Space Shuttle launch and landing facility at Vandenberg Air Force Base (VAFB), CA. The Air Force is planning a Consolidated Space Operations Center (CSOC), funded under PE 35130F for a FY 85 operational capability, to augment and backup the present satellite control capabilities of the Satellite Test Center and to provide a dedicated DOD Shuttle control capability. This is a unique National program. NASA and the USAF are each developing and operating a portion of the common-use hardware and facilities; there are only four Orbiters currently approved, one equatorial launch site (KSC), one polar launch site (VAFB), and only one flight control site (JSC) until the advent of the DOD Consolidated Space Operations Center. NASA verification activities do not recognize the distinction between development and operational testing, and USAF developed systems do not include hardware for exclusive test use. Consequently, USAF DT&E activities will be conducted as part of a combined DT&E/OT&E test program.

DOD Assessment of NASA Segments: The NASA Space Shuttle program does not make a distinction between developmental and operational testing and refers to all T&E as verification activities. The Air Force Systems Command (AFSC)--with Air Force Test and Evaluation Center (AFTEC) participation and support from other Air Force agencies--will assess the capability and the availability of the NASA developed segments to support DOD requirements. This evaluation activity will consist primarily of monitoring and evaluating major NASA STS verification efforts.

USAF test participation began with monitoring of the Approach and Landing Tests (ALT), conducted at Edwards AFB (EAFB) from February 1977 to March 1978, that successfully demonstrated the low speed flying and manual landing characteristics of the Orbiter vehicle as well as the adequacy of the ferry capability of a modified Boeing 747 Shuttle Carrier Aircraft (SCA). Subsequently, the successful Mated Vertical Ground Vibration Test (MVGVT), conducted at the Marshall Space Flight Center (MSFC) from March 1978 to February 1979, was monitored and found to satisfactorily provide the required information to validate the analytical model used to design and verify the structural capability of the Space Shuttle Vehicle (SSV).

Progress of the Space Shuttle Main Engine (SSME) development has been continuously monitored since January 1978 due to its significant problems. The engine has performed at up to 100% of rated power level; however, hardware design and reliability problems have caused major program delays. The Main Propulsion Test (MPT) at the National Space Technology Laboratories (NSTL) in Bay Saint Louis, LA began in April 1978, and after four successful short duration tests - 1.3, 20, 40 and 100 seconds - was discontinued to wait for flight configuration SSMEs. Continuation of this test program started in May 1979 with a successful readiness firing of 0.5 seconds. However, three subsequent

attempts to conduct a flight duration run (520 seconds) were terminated after shortened run times: the first due to facility instrumentation problems in June 1979; the second due to a failure of one main fuel valve in July 1979; and the third due to the failure of a high pressure oxidizer turbopump in November 1979. A full duration firing was successfully conducted in December 79. Testing will continue in early 1980.

The Shuttle Avionics Integration Laboratory (SAIL) at the JSC is planned to verify avionics hardware/software compatibility and provide confidence in the ability of these subsystems to successfully perform the flight sequences planned for the Orbital Flight Test (OFT) Program and subsequent missions. This ongoing program started in March 1979 and has been successful in identifying and correcting a number of hardware and software configuration discrepancies. The USAF will continue monitoring the test progress and results from this activity.

The Orbital Flight Tests (OFT), scheduled from late 1980 through 1981, will culminate the USAF participation in formal NASA verification activities. Since all of NASA and DOD concerns will not be answered during OFT, USAF participation will continue through at least the twentieth STS launch.

IUS Test Program: A Defense Systems Acquisition Review Council (DSARC) Milestone II review of the IUS program was held in March 1978 and approved proceeding with full scale development; the DSARC also approved production of an initial quantity of nine IUS vehicles (5 NASA; 4 DOD) to meet planned flight schedules. Because of the high cost and immediate operational use of DOD developed STS flight hardware (e.g., there will be no test launches of an IUS), a combined DT&E/OT&E program is being conducted. The Boeing Aerospace Company (BAC) is on contract for the full scale development phase.

Interface testing of the IUS with the Titan III(34)D is underway. IUS separation and shock testing was completed in November 1978 and demonstrated that the actual shock spectrum was less than predicted. Structural qualification testing was initiated in September 1979, and is expected to be completed in February 1980. Joint Titan III(34)D/IUS electronics interface testing is scheduled to occur in the period from March to June 1980. These unique Titan/IUS activities are funded by PE 35119F, Space Boosters.

The most critical IUS development items are the flight software, the long duration burn solid propellant rocket motors, and the redundant avionics system. The flight software is being developed by the TRW corporation and tested at the BAC facility in Kent, WA. Qualification testing of the IUS avionics began in August 1979 and is currently estimated to be completed during 1980. The primary problem affecting the avionics system is the availability of high reliability, space qualified electronic piece parts. In the IUS software area, the prototype flight software has been designed, coded, and is now being tested with the avionics system with good results. The mission data load software has been designed and coded, and the support software is essentially complete. The primary problem now in

the software development is in flight software sizing. A major review and refinement of the software design was conducted to decrease the software sizing from a peak estimate of 70,500 words to within the 65,500 words available in the computer memory. This effort has reduced the size of the prototype software to 60,100 words and provides some margin for growth during testing. This significant development activity will be followed by hardware/software compatibility testing in the BAC Systems Integration Laboratory (SIL) and by an independent software verification and validation effort to be performed by the Martin-Marietta Corporation (MMC).

Development of the propulsion system is now the pacing item in completing IUS development. Burst tests of the solid rocket motor cases began in October 1978, and five successful case burst tests have been completed. The first full scale development solid rocket motor (SRM) firing was accomplished in March 1979 at the Arnold Engineering and Development Center (AEDC) with a total of four firings now completed. Nine additional firings at AEDC remain, all of which should be completed in 1980. Thirteen qualification motor firings will also be performed. Primary problems in the propulsion development have not been in the technical area but rather in the manufacturing process control and quality control areas and have affected motor case fabrication and propellant processing. Actions are underway to correct these problems, including qualification of an alternate motor case manufacturer. For the total IUS vehicle, all component qualification, except for the SRMs, is planned to be completed in the last quarter of 1980; SRM and vehicle qualification will be completed in mid-1981. The ground test portion of the IUS program will be concluded with a series of environmental simulation tests to be performed on a qualification test vehicle at Boeing, and with processing of the IUS Pathfinder vehicle at Cape Canaveral Air Force Station and the Kennedy Space Center (KSC). AFTEC will independently evaluate and report on data gathered from this combined testing. The IUS T&E will focus on system performance, reliability, maintainability, and compatability with the Space Transportation System (STS).

The actual buildup and checkout of the IUS will be handled by contractor personnel. This test activity begins with IUS factory checkout conducted by Boeing and will continue through the first Shuttle launch of a DOD payload by an IUS vehicle.

Vandenberg AFB (VAFB) Ground Support System (GSS) Testing: The Martin Marietta Aerospace Company is on contract to complete the requirements definition, equipment specifications, and facilities design criteria for the VAFB launch and landing site. Testing is planned on Air Force designed ground support equipment for Vandenberg. NASA designed equipment is also planned for use at Vandenberg. The Air Force will ensure that this equipment meets DOD requirements, and will modify and test NASA equipment when appropriate. A combined test program is planned to satisfy both DT&E and OT&E objectives. The test program will include acceptance testing of facilities, installation and ground system tests of support equipment, and integrated system tests of the ground support system with the flight vehicle hardware, leading to an initial operational capability target date of December 1983 in order to support the first launch of

Space Shuttle Vehicle (SSV) from VAFB scheduled for early 1984. Experience with preparing the SSV for launch will allow VAFB capability to grow to about 10-12 launches per year; an additional increment of facilities and equipment (currently planned for FY 83) will lead to full operational capability of 20 launches per year in mid-1985. GSS testing will focus on compatibility of ground processing equipment with the SSV, ground operations, supportability, USAF manpower/resources, and contractor support. Much of the ground processing data obtained at KSC will be applicable to VAFB due to the similarity of STS equipment, facilities, and procedures. The GSS evaluation will continue through the VAFB full operational capability scheduled for mid-1985.

Operations Capability Development: All the activities (other that IUS and Vandenberg) necessary to provide an orderly transition of Defense payloads to the STS are included in this area: IUS flight planning and control; the effort needed to incorporate DOD security requirements into NASA Shuttle systems; development of the facilities, hardware, and analytical services needed to integrate DOD payloads into the Shuttle; and the documentation and services needed to effectively support DOD Shuttle users. Test planning for these activities is being done as needed to support overall program milestones.

2. Operational Test and Evaluation: Air Force test activities are being conducted as part of a combined DT&E/OT&E test program in which the Air Force Test and Evaluation Center (AFTEC) will participate with the Air Force Systems Command (AFSC) in NASA verification activities and will independently evaluate and report on DOD test activities.

DOD Assessment of NASA Segments: AFTEC will participate with AFSC in monitoring the NASA test activity and assessing the capabilities of the STS to satisfy DOD requirements. This evaluation activity will primarily consist of monitoring NASA STS verification efforts, which will be conducted at KSC, JSC, and Edwards AFB (EAFB). The primary focus of USAF involvement in NASA activity will be to determine the availability and the capability of the STS to support DOD requirements.

IUS Test Program: IUS T&E will focus on system performance, reliability and maintainability, and compatibility with the STS. IUS test activity will be performed at the Boeing facilities in Kent, WA, and Cape Canaveral Air Force Station, FL. The actual buildup and checkout of the IUS will be handled by contractor personnel. This test activity begins with IUS factory checkout and will continue through the first Shuttle launch of a DOD payload by an IUS vehicle. AFTEC will provide an independent evaluation of the IUS test program.

Vandenberg AFB GSS Testing: VAFB GSS testing will focus on compatibility of ground processing equipment with the SSV, ground operations, supportability, USAF manpower/resources, and contractor support. Much of the ground processing data obtained at KSC will be applicable to VAFB due to the similarity of STS equipment, facilities, and procedures. The test team will initially be located at KSC to begin collecting data for the GSS and will subsequently

transition to VAFB during FY 83. The GSS evaluation will continue through the VAFB full operational capability scheduled for mid-1985. AFTEC will provide an independent evaluation of the VAFB GSS.

Operations Capability Development: AFTEC will participate in testing of the other DOD segments and provide an independent assessment of their operational suitability and effectiveness.

3. System Characteristics: The key performance parameters for the NASA and DOD developed segments are shown below:

NASA SEGMENTS

ITEM	OBJECTIVE	CURRENT ESTIMATE	DEMONSTRATED	REMARKS
Space Shuttle				
Payload (KSC) 150NM, 28° Inclination	65,000 lb.	63,000 lb.		Without Thrust Augmentation
Payload (VAFB) 150NM, 98° Inclination	32,000 lb.	24,000 lb.		Without Thrust Augmentation

AIR FORCE SEGMENTS

ITEM	OBJECTIVE	CURRENT ESTIMATE	DEMONSTRATED	REMARKS
Inertial Upper Stage (IUS)				
Payload to Geosynchronous (STS)	5,000 lb.	5,005 lb.		
Payload to Geosynchronous (Titan)	4,000 lb.	4,030 lb.		
Reliability	0.96	0.976		
Accuracies (STS) Geosynchronous Injection				
Position	92 NM	48 NM		
Velocity	78 ft/sec	32 ft/sec		
Inclination	0.12°	0.047°		

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64735F
DOD Mission Area: Other Test and Evaluation Support, #454

Title Improved Capability for Operational Test and Evaluation (OT&E)
Budget Activity Defense Wide Mission Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	14,700	12,200	12,700	26,300	Continuing	N/A
2152	Mission/Engineering Support	1,200	1,800	1,700	2,600		
2197	Scoring Systems	1,900	1,900	700	1,900		
2285	Threat Systems	8,500	7,000	6,800	16,100		
2286	Instrumentation	3,100	1,500	3,500	5,700		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Wartime experience has shown that a disproportionate number of losses occur among aircrews during their first ten combat missions. There is a continuing requirement to reduce these losses by more realistic training and testing. Additionally, the growing costs of modern weapon systems makes it imperative that the effective utilization of test and training resources be increased as much as possible. This program contributes to the qualitative improvement of combat operational forces by developing instrumentation and threat simulator systems to increase the effectiveness of the operational test, training and exercise ranges world wide.

BASIS FOR FY 1981 RDT&E REQUEST: This request includes funds for four projects as shown above. The Mission/Engineering support project is mainly to fund a Systems Engineering Technical Assistance contractor who will conduct engineering and management evaluations, and write specifications and statements of work. The Scoring Systems project begins development of the Envelope Scoring which will be completed in FY 82. The Instrumentation project funds continued development of the Air Combat Maneuvering Instrumentation (ACMI) and the Advanced Time-Space-Position Indicator (TSPI) for the range at Nellis AFB, NV. Also, initial development will begin for the Missile END-Game Evaluation System (MEES). The largest project, Threat Systems, provides development completion for the Ground Jammer and MSQ-T13 efforts. Development is continued on Simulator Validation, Communication Data Link Jammers, and a Soviet Command and Control System. New efforts include a Laser Jammer, Advanced Low Altitude Threat Radar, Modular Threat Emitter (MTE) Update, and a Visual Cueing (Antiaircraft Artillery (AAA) Flashes, Surface-To-Air Missiles (SAM), etc) systems.

OTHER APPROPRIATION FUNDS: Not applicable

Program Element: # 64735F
DOD Mission Area: Other Test and Evaluation Support, #454

Title: Improved Capability for Operational Test and Evaluation (OT&E)
Budget Activity Defense Wide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: A Presidential Blue Ribbon Defense Report, General Accounting Offices (GAO) Reports and other documents identify deficiencies in the Air Force ability to conduct Operational Test and Evaluation (OT&E) and training in a realistic combat environment. These deficiencies have a direct impact on the combat effectiveness and survivability of strategic and tactical aircrews and weapon systems. Although much of the current OT&E and training is still conducted in an environment which provides little realistic threat simulation and poor measures of performance, this program, in conjunction with the procurement programs noted in the next section, is a part of the Air Force's overall "Range Improvement Plan." This program provides the front end by conducting full-scale engineering development efforts aimed at increased realism in test and training. It conducts numerous low cost efforts in instrumentation, simulation and scoring as a part of the integrated "Range Improvement Plan" noted above. The relatively low cost of the program is expected to pay high dividends in eliminating the test and training deficiencies which currently exist. The end result will be improved weapon system effectiveness, increased aircrew combat proficiency, and a reduction in anticipated aircrew and weapon system combat losses.

RELATED ACTIVITIES This program element in conjunction with the procurement programs in PE 11897F (Training Offensive) and PE 27429F (Range Improvement Equipment) form the integrated USAF Range Improvement Program. This program is integrated with the other services range modernization plans.

WORK PERFORMED BY: This program is managed by the Armament Division, Eglin AFB, FL. Major contractors include: Cubic Corp., San Diego, CA., General Dynamics, Ft Worth, TX., Emerson Electric Corp, St Louis, MO., and Metric Corp., Ft Walton Beach, FL.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In conjunction with the Navy, this program funded nonrecurring engineering associated with development of Air Combat Maneuvering Instrumentation (ACMI) which is now in operation in several locations. Also funded were ACMI related enhancements for use in joint Navy/Air Force Air Combat and Air Intercept Missile Evaluations. A standard instrumentation pod was developed for use on multiple ranges. A series of Multi-Threat Radar Simulators were developed to improve the realism of the test and training ranges. Testing was completed on a remote television Scoring System to provide scoring for weapon release and evaluation on unmanned ranges. The majority of the work relating to Modular Threat Emitters (MTE's), AN/MSQ-T13 Threat Radar and a Radar Bomb Scoring System for Strategic Air Command was completed.

Program Element: # 64735F
DOD Mission Area: Other Test and Evaluation Support, #454

Title: Improved Capability for Operational Test and Evaluation (OT&E)
Budget Activity: Defense Wide Mission Support, #6

2. FY 1980 Program: During this period a threat training study to identify the most economical method of providing in-flight electronic warfare training will be completed. Also completing development will be a communications jammer which could be used for testing and evaluating such systems as the Joint Tactical Information Distribution System (JTIDS) and the Precision Locator Strike System (PLSS). Development efforts will continue on Ground Jammers, MTE's and Simulator Validation, as well as development of functional duplicates of Tactical Command and Control Systems to be used in aircrew Electronic Countermeasures (ECM) training and equipment testing. New starts will include development of an advanced, lower cost Time-Space-Position Instrumentation (TSPI) system and a jammer for use against lasers.

3. FY 1981 Planned Program: Plans are to complete work on the MTE's and Ground Jammers as well as the major portion of Electronic Warfare Threat Simulator and Scoring development work will continue on Tactical Command and Control Systems, Electro-Optical Laser Jammer and Simulator Validation. New starts will include development of an Advanced Low Altitude Threat Radar; a Modular Threat Emitter that duplicates other SAM threat radars, a functional duplication of the radar, and a Visual Cueing System which simulates the sights of combat (AAA flash, SAM smoke, etc.). Also, a study will be conducted to evaluate Missile END-Game Evaluation Systems (MEE's) which will be used to evaluate performance of Air-to-Air Missiles.

4. FY 1982 Planned Program: The FY 1982 effort will complete the Envelope Scoring Program begun in FY 1981, the command and control (C^4) system, the Advanced TSPI system and the missile END-Game Evaluation System. The majority of the work will be in the Threat Simulator Systems area including continuation of the Communications Data Link Jammer, Visual Pair, and Advanced Tactical and Advance Strategic SAM's.

5. Program to Completion: This is a continuing effort

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data: No Change

Project Number: #2285
Program Element: # 64735F
DOD Mission Area: Other Test and Evaluation Support, #454

Title: Threat Systems
Title: Improved Capabilities for OT&E
Budget Activity Defense Wide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: Operational range deficiencies exist in the USAF ability to conduct responsive, effective operational training, testing and evaluation under realistic combat conditions. With improved test facilities, realistic test and training programs can prevent costly errors in the estimated operational suitability and survivability of new weapon systems and the combat readiness of strategic, tactical, and air defense aircrews. This project seeks to correct the range and facility deficiencies in realistic combat conditions by developing replicas and emitter systems designed to simulate enemy surface-to-air missile fire control radars, AAA gun laying radars, early warning and acquisition radars, jamming equipment, Identification Friend or Foe (IFF) systems, and air defense command and control systems. An emitter simulator will simulate some of the threat system's emitted characteristics. An Emitter-Receiver Simulator simulates some of the threat radar's Radio Frequency (RF) characteristics and provides some representation of its basic receiver and/or displays. An Emitter-Receiver-Processor Simulator is an electrical representation of the threat radar system. A replica is a functional representation of the complete threat system.

RELATED ACTIVITIES: Hardware developments under this project are coordinated with procurements programmed under Program Elements: 11897F, Training Offensive; and 27429F, Range Improvement Equipment. There are no procurement funds in Program Element (PE) 64735F. This project relates to PE 64738F, Protective Systems which provides enemy threat simulators for Development, Test and Evaluation.

WORK PERFORMED BY: Tasks under this project are managed by Armament Division, Eglin AFB Fl. The major contratcor is General Dynamics, Fort Worth TX.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: A study of a Command, Control and Communications System used by the enemy in air defense wat completed. Also protototypes simulators of enemy threat radars (such as as/MSQ-T13) was accomplished. Work continued in Modular Threat Emitters and duplicates of tactical command and control systems to be used in aircrew Electronic Counter Measures (ECM) training and equipment testing.

2. FY 1980 Program: Work on the Communications Data Link Jammer and Threat Training Study will be completed. Simulator Validation continues from previous years. Work will continue on a functional duplication of the Soviet Tactical Command and Control System; the Modular Threat Emitter; and Ground Jammers. Development of a Jammer for use against Electro-Optical Lasers will be initiated.

Project Number: # 2285
Program Element: # 64735F
DOD Mission Area: Other Test and Evaluation Support, #454

Title: Threat Systems
Title: Improved Capability for Operational Test and Evaluation (OT&E)
Budget Activity: Defense Wide Mission Support, #6

3. FY 1981 Planned Program: Work is completed on Modular Threat Emitter and Ground Jammer. Work continues on tactical command and control systems and Electro-Optical jammer. Simulator Validation from previous years continues. There are four new starts: development of an Advanced Low Altitude Threat Radar; development of modular updates for the Modular Threat Emitter that duplicates Advanced SAMS Threat Radar; development of a system that functionally duplicates the Radar; and development of a Visual Cueing System which simulates the sights of combat (e.g., anti-aircraft artillery flashes, surface-to-air missile smoke, etc.).

4. FY 1982 Planned Program: Effort will continue on the Communications Data Link Jammer, Visual Cueing, Low Altitude Threat Radar and MTE update. New simulator developments will include those for and Advanced Tactical and Advance Strategic SAMs.

5. Project to Completion: This is a continuing project.

6. Milestones: Not Applicable.

7. Resources:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Estimated Costs
RDT&E	8,500	7,000	6,800	16,100	Continuing	N/A

8. Comparison with FY 1980 Budget Data: No Change

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64747F
DOD Mission Area: Other Test and Evaluation Support, #454

Title Electromagnetic Radiation (EMR) Test Facilities
Budget Activity Defensewide Mission Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	18,725	6,600	3,000	3,100	Continuing	N/A
1209	Nuclear Effects Simulation Facilities	16,314	5,100	1,700	1,700	Continuing	N/A
2064	HAVE NOTE	2,411	1,500	1,300	1,400	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Nuclear weapon detonations cause electronic component burn out or upset through a radiation effect known as electromagnetic pulse (EMP). Non-nuclear radiation, such as from intentional or unintentional jamming, can cause weapon systems to malfunction and therefore impair their mission effectiveness. This program is for the development and acquisition of teat facilities and analysis capabilities to simulate nuclear weapons effects (NWE) environments, Project 1209, and non-nuclear EMR effects environments, Project 2064, in which the forces (aircraft; satellites; command, control and communications; and strategic and tactical weapons systems) may be required to operate.

BASIS FOR FY 1981 RDT&E REQUEST: Test support of the EMP and EMR test facilities will continue. EMP testing of the Air Launched Cruise Missile the NAVY A-7 and F-14 aircraft will be conducted. The EMR hardness program for air launched ordnance will be completed and a handbook will be published. Use of the improved EMR analysis and testing techniques including special purpose EMR antennas is planned.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #64747F
DoD Mission Area: Other Test and Evaluation Support, #454

Title: Electromagnetic Radiation (EMR) Test Facilities
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: This program is for the development, acquisition and support of test facilities which simulate the nuclear and non-nuclear environments in which the forces may be required to operate. The principal nuclear simulation facilities are the electromagnetic pulse (EMP) dipoles and the in-flight EMP simulation facility (TRESTLE). The TRESTLE facility will be used to conduct EMP tests of aircraft, including tests of systems in the ground alert mode. Program Management Changes (PMD) have added instrumentation development efforts required for simulation tests to this program. The non-nuclear effort, Project 2064 (HAVE NOTE), provides facilities for assessing the susceptibility of weapon systems to non-nuclear electromagnetic radiation (EMR). This EMR comes from hostile or friendly sources such as radios, radars, jammers or other electronic devices. These sources can illuminate the weapon for lengthy periods of time ie., when the weapon is on the aircraft approaching a target or when the weapon is enroute to the target. The data collected during testing is also used to update test methods and acquisition specifications, design standards, and maintenance technical orders to insure that the weapon system is immune to those Radio Frequency (RF) emanations which it may encounter during its life cycle from stock pile to target. Weapon systems program offices arrange for testing time and provide test resources and test costs.

RELATED ACTIVITIES: Project 1209 is related to program element 64711F - Systems Survivability (Nuclear Effects). Project 2064 (HAVE NOTE) is the Air Force implementation of the Office of the Undersecretary of Defense Research & Engineering directed Special Electromagnetic Interference (SEMI) Project. SEMI directs all three services to test their own weapons and share findings and conclusions. Tri-service reviews are held periodically. Separate service agreements call for joint participation on common problems such as a field test (Army Lead).

WORK PERFORMED BY: Project 1209 is managed by Air Force Systems command through the Air Force Weapons Laboratory, Kirtland Air Force Base, NM. Dynalectron, Washington, DC, is the EMP facilities support contractor. Project 2064 is managed by Air Force Systems Command through the Rome Air Development Center, Griffiss Air Force Base, NY. The Project 2064 in-house test contractor is Atlantic Research Corp., Washington, D.C. Hardness criteria work for acquisition specifications and standards is performed by Electrical Engineering Station, Georgia Institute of Technology, Atlanta, GA. The facility upgrade contract is with Emerson Electric Co., Redondo Beach, CA.

Program Element: #64747F
DoD Mission Area: Other Test and Evaluation Support, #454

Title: Electromagnetic Radiation (EMR) Test Facilities
Budget Activity: Defensewide Mission Support, #6

PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In Project 1209, construction of the TRESTLE electromagnetic pulse (EMP) aircraft simulator was completed. Major items include the test stand, fire protection system, data instrumentation system pulsers, test article support system, antenna and terminator system and soil stabilization program. This concludes a six year, $59 million effort to complete this inflight, horizontally polarized, bounded wave EMP simulator. EMP testing of the E-3A, the E-4B, the B-52, the NAVY C-130Q Take Charge and Move Out (TACAMO) aircraft and an air launched cruise missile was completed.

In Project 2064, the anechoic chamber upgrade continued and the initial operational capability was achieved. The testing of inventory tactical weapons was completed. Use of the Air Force Electromagnetic Compatibility (EMC) Intra-system Analysis Program (IAP) support center for analysis of weapon system parameters began. And the Electromagnetic Compatibility Analysis Center (ECAC) studies were integrated into the weapon test scenario for more accurate analyses and testing.

2. FY 1980 Program: In Project 1209, EMP testing of the advanced fighter aircraft using the F-16 aircraft as the test bed, the NAVY TACAMO, B-52 will be completed. Baseline support for the EMP test facilities will be provided.

In Project 2064, full operational capability of the anechoic chamber will be achieved. An interim electromagnetic radiation (EMR) hardness handbook for missile systems will be developed. Use of the ECAC threat scenario and the IAP support center for analysis and testing of air launched ordnance will continue. Baseline support for the EMR test facility will be provided.

3. FY 1981 Planned Program: In project 1209, only Researach and Development (R&D) test support of the completed facilities will be provided because of budget reductions. Development of mobile Electromagnetic Pulse (EMP) simulators, X-ray and electron beam efforts have been deferred indefinitely. EMR Testing of the NAVY A-7, F-14 and ground launched cruise missile is planned.

In Project 2064, testing of the Infrared MAVERICK system and low level Laser Guided Bomb will begin. The Electromagnetic Radiation (EMR) hardness program will be completed and a handbook will be published. Baseline support for the EMR test facility and use of the ECAC and IAP programs will continue. Special purpose test antennas for weapon system testing will be installed.

Program Element: #64747F
DoD Mission Area: Other Test and Evaluation Support, #454

Title: Electromagnetic Radiation (EMR) Test Facilities
Budget Activity: Defensewide Mission Support, #6

4. FY 1982 Planned Program: In Project 1209, Electromagnetic Pulse (EMP) testing of the B-1, NAVY F-18, NAVY C-130Q and B-52 is planned. Baseline support for the EMP test facilities will be provided.

For project 2064, the Infrared Maverick, low level Laser Guided Bomb testing will be completed. Testing of the Hard Structure Munition (HSM) weapon and the High Altitude High Speed Target system (HAHST) will begin. Baseline support for the test facility and use of the Electromagnetic Compatibility Analysis Center (ECAC) and Intrasystems Analysis Programs (IAP) programs for testing and analysis of weapons will continue.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data: Not Applicable, no change

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65101
DOD Mission Area: Studies and Analysis, #440

Title: Project AIR FORCE
Budget Activity: Defense-wide Mission Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11,000	11,700	12,500	13,500	Continuing	Not applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is devoted to assisting Air Force decision making by furnishing information and objective findings derived from independent research and analysis of aerospace problems. The program objective is to recommend preferred methods, techniques and instrumentalities for the development of aerospace power. The program funds a Federal Contract Research Center operated by The Rand Corporation.

BASIS FOR FY 1981 RDT&E REQUEST: This is a level-of-effort program providing assistance to the Air Force in the creation and objective application of modern analytic techniques. The Air Force has a continuous need for multi-disciplinary research. For about 33 years, the Air Force has encouraged Rand to develop a professional staff capable of providing objective in-depth research. The work focuses on the future roles of air forces with emphasis on issues which will underlie decisions to be made for the '80s and beyond. New research studies for FY 1981 will be selected by General Officer level personnel comprising the Air Force Advisory Group for Project AIR FORCE. These studies will be based on perceived needs at that time and research completed in FY 1980. The FY 81 request maintains the program at a stable level of approximately 150 Members of the Technical Staff (MTS) intended by DOD and to accommodate the Air Force's urgent need for a greater number of studies on important issues which cut across organizational lines. Funding in FY 1981 and FY 1982 continues Project AIR FORCE manning at the 150 MTS level.

OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #65101F
DOD Mission Area: Studies and Analysis, #440

Title: Project Air FORCE
Budget Activity: Defense-wide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: This program provides the Air Force a broad program of long-term study and research on problems in the development and employment of aerospace power. The program's continuing independent, objective and knowledgeable research analyzes and expands available policy, support and operational alternatives and assists the Air Force in making better decisions on major issues. Over the years, the Air Force has implemented many suggestions from this program. Some have resulted in cost savings, some have increased existing force effectiveness, others have allowed the Air Force to seize technological opportunities, and others have helped the Air Force to better understand the nature of future military threats and how to respond to them in a timely manner. Current research is in six program areas: Technology Applications Program which studies military needs, technological opportunities, and R&D planning for both strategic and general-purpose missions; the Strategic Systems Program which includes research on issues of strategic policy, systems, and forces as well as Soviet/Chinese studies; the Theater Conflict Program which studies the nature of future regional conflict and evaluates applicable concepts; the Operations and Readiness Improvements Program which focuses primarily on policies and techniques to improve Air Force readiness and combat capabilities in a dynamic wartime environment and certain issues in life-cycle analysis and avionics design; the Manpower, Personnel and Training Program which includes analysis of Air Force personnel policy alternatives; and the Systems Acquisition Management Program which investigates issues of quality in research, development, and initial production. Members of the Air Force Advisory Group (AFAG) provide guidance on the overall program, monitor specific projects within each of these areas, and sponsor new projects as needs arise.

RELATED ACTIVITIES: Project AIR FORCE studies and analyses are conducted to assist Air Force top management in the decision making process. The studies span traditional, functional and organizational lines and result in recommendations concerning overall future Air Force actions. Consequently, the broad studies and analyses under this Project relate to and are used in many different activities of the Air Force. Relevance is assured and unnecessary duplication of effort is avoided by formal reviews of the entire program held semiannually by the AFAG and Rand and numerous informal reviews of individual projects. New projects are formally screened by the Air Force Director of Concepts and Analyses, and the research results are deposited with the Defense Documentation Center The reviews and screening consider past and present efforts in other analyses both within the DOD and by other Government agencies.

WORKED PERFORMED BY: The Director of Operational Requirements, DCS/Research, Development and Acquisition, Headquarters USAF, is the Executive Agent and is responsible for the administration of the Project, as approved by the AFAG. All work is performed by The Rand Corporation, Santa Monica, CA.

Program Element: #65101F
DOD Mission Area: Studies and Analysis, #440

Title: Project AIR FORCE
Budget Activity: Defense-wide Mission Support #6

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The FY 1979 and prior year programs included: (1) Technical Applications: definition of future battle management capabilities, assessment of space as a military medium, infrared surveillance issues and technologies; analysis of satellite communication system requirements to support battle management; potential impact of space-based systems on nonnuclear theater conflict; define strategic warfare simulation capability for real-time battle simulation. (2) Strategic: analysis of different aspects of contemporary strategic policy; analysis of the role of resource constraints on the evolution of Soviet military posture; assessment of emerging strategic and regional roles of the PRC; analyze China's relationship with the Soviet Union and the U.S. as they affect global strategic environment; assess economic constraints on China's military modernization; develop and apply new methods for analyzing strategic balances which reflect greater operational realism, greater sensitivity to Soviet perceptions and known views about strategic conflict; quantitative analysis of U.S. antisatellite requirements. (3) Theater Conflict: examine opportunities for disrupting Warsaw Pact offensive tactical rear; to support NATO in the 1980's by analyzing technical options for improving tactical air performance at night, in adverse weather, and in the face of severe air defenses; identify actions to enhance NATO's capability to deter a surprise attack or to reduce possibilities that Warsaw Pact could successfully launch and sustain such an attack; analysis of future U.S. forces for non-NATO applications; develop improved methods of analyzing joint air-ground warfare to allow more realistic tradeoff analyses of airpower and ground-power in theater level joint operations. (4) Operations and Readiness Improvements: Research on how to improve combat sortie production in dynamic wartime environments; evaluation of command and control (C^2) systems and the evolutionary development of C^2 requirements; research demonstration that automatic test equipment in avionics intermediate shops would create a serious bottleneck in supporting required sortie production in a European contingency involving deployed forces; use of a decision oriented scheduling system as an aid to strategic aircrew and aircraft scheduling; analysis of the software requirements management process. (5) Manpower, Personnel and Training: research concerned with delivering medical care given the current and anticipated future shortage of physicians; improving enlisted force planning; evaluating the effects of personnel and compensation policy changes on the officer force, and reducing the costs of alcohol abuse. (6) Systems Acquisition Management: policy studies of systems acquisition; study of acquisition policy alternatives that may be realistically considered; relationship of technology and acquisition costs; study of the effectiveness of value engineering and analytical tools for quantitative risk assessment in acquisition; identification and analysis of system acquisition policy options appropriate to the economic and technological environment of 1980s; extension and documentation of earlier research on competitive prototyping and phased acquisition; acquisition options for fighter aircraft; USAF participation in Co-National acquisition programs. (7) Supporting Research: Development of analytical methods and data bases for use in Air Force studies and mission analyses; backup research on a guided bullet concept; cost analysis concepts applied in USAF weapon system and policy studies; data automation research.

2. FY 1980 Program: Accomplishments are anticipated in the following areas: (1) Technical Applications: Examine the organizational aspects of battle management research and development; evaluate the payoffs from some aspects of real time force management; investigation of the performance capabilities of space-based radars; exploratory research

which will emphasize technology that leads to improved weapons and delivery systems and a more effective conventional warfighting capability; illustrate the versatility of new simulation techniques for real-time battle management; (2) Strategic: distribution of a study which examines the mismatch between U.S. and Soviet deterrence concepts; completion of work on the magnitude and growth of the Soviet military activity and the economic and political burden it imposes; final report on Chinese political factionalism; substantial reports on Soviet strategic campaign characteristics, various aspects of Soviet doctrine, campaign outcomes as a function of scenario, and an overall assessment of the strategic balance from the Soviet perspective; assessment of mixed strategic force postures and mixed aerodynamic force concepts; quantitative analysis of U.S. antisatellite requirements; (3) Theater Conflict: analysis of disruption to Warsaw Pact offensive by concentrating tactical airpower on Pact rear vulnerabilities; methodology and capabilities for night/adverse weather attack; analytical assessment of nuclear conflict in Europe and a Soviet approach toward third area conflict; initial assessment of the technological state of the art required and available to support the Cooperative Air Defense Systems; (4) Operations and Readiness: Quantification of command and control requirements for air resources during a crisis in Europe; report on alternative policies for aircrew and aircraft scheduling; assessment of how to improve sortie output and minimize costs in a dynamic wartime environment; analysis of the vulnerability of war reserve materiel and non-rated support personnel in a dynamic war; assessment of the combat value and costs of an assured intra-theater transportation system for the European theater; preliminary results of how the Soviets do long range planning; (5) Manpower, Personnel and Training: statistical estimation of the parameters of the Dynamic Retirement Decision Model; publication of a study of the cost effectiveness of the Air Force substance abuse program; (6) Systems Acquisition Management: exploration of spacecraft acquisition and bomber development strategies; phased acquisition concepts; Air Force participation in multinational co-production; improved strategies for product improvement; technical risk analysis and Air Force acquisition problems; (7) Supporting Research: identification of the potential value and practicality of pre-strike weather surveillance of tactical target areas; development of an integrated weather support concept for the employment of precision guided munitions; ordnance technology; data automation research.

3. FY 1981 Planned Program: The emphasis will be on broad, far-term issues and problem areas that are of top priority to Air Force management and which apply across Air Force functional elements. The research of the six program areas will continue to be interrelated. Specific studies will evolve according to results from FY 80 research and the establishment of priorities by the Air Force Advisory Group (AFAG). They will each be reviewed in detail by the AFAG and Rand prior to being implemented in the FY 81 program.

Program Element: #65101F
DOD Mission Area: Studies and Analysis, #440

Title: Project AIR FORCE
Budget Activity: Defense-wide Mission Support, #6

4. FY 1982 Planned Program: The program will evolve as for FY 1981 under careful planning by the Air Force Advisory roup. Only projects which are not duplicated elsewhere and are strongly needed by the Air Force will be included. They must require the objectivity and independence of Project AIR FORCE.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT	9,500	11,000	11,700	12,400	Not applicable

Costs for FY 1981 and FY 1982 have been adjusted for inflation to insure that Project AIR FORCE remains at the desired 150 Members of the Technical Staff manning level. A detailed comparison of FY 81 plans shown in this and last year's descriptive summaries is not possible since the composition of research efforts in any year's program is largely determined by the needs perceived just prior to or during that year.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # 65304F

Title: Acquisition and Command Support
Telecommunications and General Support

DOD Mission Area: General Management Support, #471

Budget Activity: Defensewide Mission Support #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,873	3,900	4,400	5,000	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides essential communications services to: Headquarters, Air Force Systems Command (AFSC); Aerospace Medical Division (AMD); Aeronautical Systems Division (ASD); Electronic Systems Division (ESD); Space Division (SD), and the Ballistic Missile Office (BMO).

BASIS FOR FY 1981 RDT&E REQUEST: This is a continuing program which provides the following: switchboards at ESD and SD; local tielines; equipment rentals; mobile radios for command/disaster control/security policy; and official toll calls, AFSC postage and printing charges.

OTHER APPROPRIATIONS FUNDS: Not Applicable.

Program Element: # 65304F

Title: Acquisition and Command Support Telecommunications and General Support

DOD Mission Area: General Management Support, #471

Budget Activity: Defensewide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: This program element provides communication support to Air Force Systems Command (AFSC), Aerospace Medical Division (AMD), Aeronautical Systems Division (ASD), Electronic Systems Division (ESD) and the Space Division (SD) and the Ballistic Missile Office (BMO). It includes:

The base communications administrative switchboards at ESD and SD; local tielines into commercial systems; recurring charges including associated equipment rentals, main telephone lines, extension telephones, and key systems; and dedicated support to the AFSC Advanced Management and Information System (AMIS) and AFSC Network.

Command and control voice network and administrative tielines circuits between HQ AFSC, Divisions, Centers, Ranges and SD; circuits between SD and the National Ranges used to transmit launch information from the ranges to the program offices; and the telephone lines required to support the program offices.

Funds to lease/maintain nontactical radios for command/disaster control/Civil Engineering/security and maintenance expediter nets at ASD and SD.

Official tolls, Wide Area Telephone Service, and message unit charges for local calls from the bases to surrounding civilian communities. There are no free calls off stations.

AFSC postage and printing charges.

RELATED ACTIVITIES: This program element is in direct support of the Acquisition and Command Support, Program Element 65806F.

WORK PERFORMED BY: American Telephone Company, New York, NY; RCA Corporation, New York, NY; Western Union Corporation, Mohwah, NJ; New England Telephone and Telegraph Company, Boston, MA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: This is a continuing program.

2. FY 1980 Program: This program continues funding for leased communication lines, switchboards and associated equipment required to carry-out the AFSC mission. Other requirements include: non-tactical radios, AFSC postage and franked envelope printing charges, and sustain implementation of the Advanced Management and Information System and AFSC network systems.

Program Element: # 65304F

Title: Acquisition and Command Support Telecommunications and General Support

DOD Mission Area: General Managment Support, #471

Budget Activity: Defensewide Mission Support #6

3. FY 1981 Planned Program: Provides funding for continuation of communication support to Air Force Systems Command (AFSC) and its divisions and offices. While deletion of some circuits and addition of others will occur, requirement is expected to remain constant with allowance for escalation due to inflation.

4. FY 1982 Planned Program: Provides funding for continuing operation, maintenance, and leased costs of circuits and communications services.

5. Program to Completion: This is a continuing program.

6. Milestone: Not applicable.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data: Not applicable.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: # #65806F
DOD Mission Area: General Management Support, #471

Title: Acquisition and Command Support
Budget Activity: Defensewide Mission Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	211,978	211,364	230,000	237,600	Continuing	N/A
	Hq, Air Force Systems Command*	10,972	11,815	13,050	13,480	Continuing	N/A
	(AFSC) Support Activities	93,178	92,005	97,767	100,769	Continuing	N/A
	Aeronautical Systems Division (ASD)	48,281	48,447	52,373	54,101	Continuing	N/A
	Electronic Systems Division (ESD)	12,330	12,461	13,370	14,015	Continuing	N/A
	Aerospace Medical Division (AMD)	36,712	31,208	34,892	36.043	Continuing	N/A
	Space Division (SD)	10,505	10,428	11,048	11.445	Continuing	N/A
	Armament Division (AD)	-0-	5,000	7,500	7.747	Continuing	N/A
	Ballistic Missile Office						

*Funding for Headquarters Air Force Systems Command and 6590th Support Squadron are shown in Program Element (PE) 65898F (Management Headquarters - Research and Development).

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Acquisition and Command Support (ACS) provides the resources to support the commander, his staff, the technical mission, and support functions at each of the organizations listed above. Categories of cost include pay and the related costs of civilian personnel, travel, transportation, rents, utilities, contractual services, supplies, and equipment. Effective in FY 1978 the resources which support Headquarters AFSC and the 6590th Support Squadron were transferred to PE 65898F (Management Headquarters - Research and Development).

BASIS FOR FY 1981 RDT&E REQUEST: This program provides the resources to support the commander, his staff, the technical mission, and support function of each of the organizations listed above. FY 81 funding is increased by 15.2 million over the appropriated level to insure level support in FY 81, including the annualization of the 1 Oct 79 civilian pay raise, additional civilian authorizations for Space Transportation System, Missile-X and Space Defense System, and repricing of non-personnel support costs due to inflation.

OTHER APPROPRIATION FUNDS: Military Construction (3300)	3,030	9,010	4,200	14,420	Continuing	N/A

Program Element: #65806F
DOD Mission Area: General Management Support, #471

Title: Acquisition and Command Support
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: This program element provides the resources to support the commander, his staff, the technical mission and base support functions of Aeronautical Systems Division (ASD), Electronic Systems Divsiion (ESD), Aerospace Medical Division (AMD), Space Division (SD), Ballistic Missile Office (BMO), and the Armament System Program Offices of the Armament Division (AD), Eglin AFB, FL. Starting in FY 1979 the Procurement and Plans Offices of AD Armament Systems Program Offices were transferred into thi program element from Program Element 65807F (Test and Evaluation Support) as a result of a management engineering team survey. In FY 1978, the transfer of Headquarters Air Force Systems Command (HQ AFSC) and the 6590th Support Squadron to PE 65898F (Management Headquarters Research and Development (R&D) was accomplished.

RELATED ACTIVITIES: This program supports nearly all Air Force RDT&E program elements and the procurement programs assigned to AFSC. Communication support for this element is in PE 65304F (Acquisition and Command Support (ACS) Telecommunitions and General Support). Management activities by Headquarters AFSC are supported in PE 65898F (Management Headquarters - R&D).

WORK PERFORMED BY: Aeronautical Systems Division, Wright-Patterson AFB, OH, - responsible for management of aeronautical systems acquisition. Electronic Systems Division, L.G. Hanscom AFB, MA - responsible for command, control, and communications systems. Aerospace Medical Division, Brooks AFB, TX - provides biomedical support for aerospace systems. Space Division, Los Angeles AFB, CA - plans programs, and manages space systems. Armament Systems Program Offices, Armament Division, Eglin AFB, FL - manages the validation, development, and production of nonnuclear air armament systems, Ballistic Missile Office, Norton AFB, CA - plans, programs, and manages the DoD basllistic missile programs. HQ AFSC Activities, various locations - provide support to HQ AFSC.

PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments : Not applicable

2. FY 1980 Program: This is an in-house effort by the organizations cited above which support many program elements and projects in the Research, Development, Test and Evaluation community, and procurement of weapon, space, missile and avionic systems.

3. FY 1981 Planned Program: The main cost of this program is for pay of personnel. 75 percent of the total is for pay of personnel.

Program Element: #65806F
DOD Mission Area: Other Management Support, #471

Title: Acquisition and Command Support
Budget Activity: Defensewide Mission Support, #6

4. FY 1982 Planned Program: Major changes are foreseen in the nature of this element for support of the Space, Transportation System, Space Defense System, and Missile-X program.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

8. Comparison with FY 1980 Budget Data:

FY 1978	FY 1979	FY 1980	FY 1981	Additional to Completion	Total Estimated Costs
198,825	204,310	211,434*	217,165	Continuing	N/A

The FY 1981 Budget reflects an increase over FY 1980 due to Congressionally approved civilian pay raises as well as increased costs to support the acquisition and command support efforts. There has not been an overall increase in scope of the program.

* Does not include funds for the 1 Oct 79 civilian pay raise.

Project: N/A

Title: Headquarters Air Force Systems Command (AFSC) Support Activity

Program Element: # #65806F

Title: Acquisition and Command Support

DOD Mission Area: Other Management Support, #471

Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The mission of AFSC is to advance aerospace science and technology, apply it to aerospace systems development and improvement, and acquire qualitatively superior aerospace systems and equipment needed to accomplish the Air Force mission. The following organizations funded from this program element provide support to the AFSC: 6591st Computer Services Squadron, provides data automation services to HQ AFSC; 6592nd Management Engineering Squadron, provides AFSC field commands base level manpower and organization services to include developing and maintaining manpower standards; 6593rd Field Printing Squadron provides composition, lithograph, duplicating, printing and bindery services for HQ AFSC, and other units. This program funds for pay and related costs of civilian personnel, travel, transportation, rents, contractual services, supplies, and equipment.

RELATED ACTIVITIES: This program element directly supports HQ AFSC's management headquarters which is funded from Program Element 65898F (Management and Headquarters - Research and Development). Communication Support is funded in Program Element 65304F (ACS Telecommunications and General Support).

WORK PERFORMED BY: Major contracts include: Honeywell Corporation, McLean, VA, for automatic data processing equipment rental; Xerox Corporation, Arlington, VA, for lease of reproduction equipment.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not Applicable

2. FY 1980 Program: This is an in-house effort by the organizations cited above which support many program elements and projects in the Research, Development, Test and Evaluation community.

3. FY 1981 Planned Program: This is a level of effort program. The main cost of which is for pay of personnel. 75 percent of the total is for pay of personnel.

4. FY 1982 Planned Program: Major changes are foreseen in the nature of this element in the near term for support of the Space Transportation System, Space Defense System and Missile-X programs.

5. Program to Completion: Continuing Program

6. Milestones: Not applicable

Project: N/A

Title: Headquarters Air Force Systems Command (AFSC) Support Activity

Program Element: #65806F

Title: Acquisition and Command Support

DOD Mission Area: General Management Support, #471

Budget Activity: Defensewide Mission Support, #6

7. Resources: ($ in thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E: Funds*	10,972	11,815	13,050	13,480	Continuing	N/A

* Excludes reimbursements

8. Comparison with FY 1980 Budget Data: The FY 1981 Budget reflects an increase over FY1980 due to Congressionally approved civilian pay raises as well as increased costs to support the acquisition and command support efforts. There has not been any overall increase in scope of the program.

Project: N/A
Program Element: #65806F
DOD Mission Area: Other Management Support #471

Title: Aeronautical Systems Division (ASD)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: ASD manages acquisition of aeronautical systems, subsystems, and related equipment programs and projects until transfer of responsibility to Air Force Logistics Command (AFLC); accomplishes systems engineering and technical direction to designated programs and provides general engineering support in applicable disciplines; exercises overall responsibility for Development Test and Evaluation (DT&E) for assigned advanced and engineering development; and exploits exploratory and advanced development products, including foreign technology, ASD has responsibility for approximately 27 program offices, including major programs such as the F-16, F-15, A-10, and Strategic Systems; and has project office responsibility for numerous system projects.

RELATED ACTIVITIES: ASD establishes technology needs with the Air Force Systems Command (AFSC) laboratories for exploratory and advanced development required to satisfy new capabilities or eliminate deficiencies; provides engineering support to AFLC; ensures, in collaboration with AFLC, that logistic support considerations are an integral part of systems, subsystems, and equipment acquisition; performs flight tests and related moficiations in support of ASD and AFSC laboratories/projects in the exploratory and advanced development areas of propulsions avionics, flight dynamics, weightlessness, electronic warfare, life support systems, and materials; furnishes flight test support to the Department of Defense (DoD) agencies, National Aeronautics and Space Administration (NASA), and Federal Aviation Administration (FAA) as directed; manages the international, DoD, Air Force, and AFSC engineering standardization programs in support of ASD, AFSC laboratories, and AFSC divisions, evaluates and applies intelligence provided by Foreign Technology Division (FTD) which is relevant to ASD development and production programs and projects; and manages all phases of procurement and production including management of government-owned industrial facilities, systems, Research and Development (R&D), services, material transportation, supplies, and support as delegated by HQ AFSC. Related Program Elements are: 65304F, ACS Telecommunications and General Support; and 65807F, Test and Evaluation Support (TES), which finances the 4950th Test Wing activities.

WORK PERFORMED BY: Aeronautical Systems Division, Wright-Patterson AFB, OH. Major contractors include: Synergy Inc., Enon, OH, provides computer operators; Systems Research Laboratories, Dayton, OH, provides computer maintenance; Foreman Industries, Inc., Dayton, OH, provides installation, modification and repair services; Control Data Corp, Minneapolis, MN, provides computer rentals and support; Burroughs Corp, Paoli, PA, provides computer rental; Xerox Corp., Rochester NY, provides reproduction equipment; and 230 other contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable

2. FY 1980 Program: This is an in-house effort by the organization cited above which supports many program elements and projects in the Research, Development, Test and Evaluation community.

Project: N/A
Program Element: #65806F
DOD Mission Area: Other Management Support #471

Title: Aeronautical Systems Division (ASD)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

3. FY 1981 Planned Program: This is a continuing program. The main cost of which is for pay of personnel. 75 percent of the total is for pay of personnel. Increase effort on the Missile-X program.

4. FY 1982 Planned Program: No major changes are foreseen in the nature of this element at this time.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable

7. Resources: ($ in thousands)

		FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E:	Funds*	93,178	92,005	97,767	100,769	Continuing	N/A

*Excludes Reimbursements

Project: N/A
Program Element: #65806F
DOD Mission Area: General Management Support, #471

Title: Electronic Systems Division (ESD)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUD AND DESCRIPTION: ESD plans and manages the acquisition and related engineering development of command, control and communications, and intelligence electronic systems, subsystems, and equipment; plans and conducts research and exploratory and advanced development programs in areas of information sciences, intelligence for command, control and communications; accomplishes assigned engineering development; exploits exploratory and advanced development products, including foreign technology; manages the operations of the Electromagnetic Compatibility Analysis Center; and manages assigned Foreign Military Sales (FMS) programs. ESD has responsibility for approximately 25 Program Offices and major programs such as Traffic Control Approach and Landing System (TRACALS), Tactical Information Processing and Interpretation (TIPI) System, Airborne Warning and Control System (AWACS), Over the Horizon Radars, Advanced Airborne Command Post, and Tactical Long Range Navigation (LORAN). ESD also has project office responsibility for over 100 projects.

RELATED ACTIVITIES: The ESD establishes technology needs with the Air Force Systems Command (AFSC) laboratories for exploratory and advanced development required to satisfy new capabilities or eliminate deficiencies; renders assistance to Headquarters United States Air Force (USAF) in preparation of automatic data processing equipment (ADPE) specifications; acts as contracting agent for MITRE support to the Department of Defense (DoD); monitors and controls MITRE support to the Air Force; acquires, analyzes, evaluates, and applies intelligence relevant to ESD acquisition programs and projects; and contributes results of intelligence analysis and evaluations to AFSC intelligence projects. A related Program Element is 65304F, ACS Telecommunications and General Support.

WORK PERFORMED BY: Electronic Systems Division, Hanscom AFB, MA. Major contractors include: Multi-Service Maintenance Boston, MA; Chambers - Thompson Moving and Storage Co., Brooklyn, MA; Miller Disposal Inc., Boston, MA; Charles Bank Laundry, Cambridge, MA; American Linnen Co., Worcester, MA; Service Filter Co., Boston, MA; New England Speedwash Co., Boston, MA.; Collins Inco., Office Outfitter, and Olivetti Corp., Boston, MA.; Univac Corp., Boston, MA; Booz Allen and Hamilton, Boston, MA; and 65 other contractors.

PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable

2. FY 1980 Program: This is an in-house effort by the organizations cited above which supports many program elements and projects in the Research, Development, Test and Evaluation community.

3. FY 1981 Planned Program: This is a level of effort program. The main cost of which is for pay of personnel. 75 percent of the total is for pay of personnel.

Project: N/A
Program Element: #65806F
DOD Mission Area: General Management Support, #471

Title: Electronic Systems Division (ESD)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

4. FY 1982 Planned Program: No major changes are foreseen in the nature of this element at this time.

5. Program to Completion: This is a continuing program.

6. Milestone: Not applicable

7. Resources: ($ in thousands)

		FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E:	Funds*	48,281	48,447	52,373	54,101	Continuing	N/A

* Excludes Reimbursements

Project: N/A
Program Element: #65806F
DOD Mission Area: General Management Support, #471

Title: Aerospace Medical Division (AMD)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The AMD plans and executes the Air Force Systems Command (AFSC) exploratory, advanced, and engineering development programs to provide biomedical support for aerospace systems; advanced aerospace biotechnology; determines the personnel hazards of aerospace environments and establishes human tolerance to them; extends human capabilities and enhances integraton of man in weapon systems provides biomedical support for the personnel subsystems; improves Air Force health services; and provides technical or management assistance in these areas to support studies, analysis, development planning, acquisition, test, evaluation, modification or operation of aerospace systems and related equipment. Specifically, the AMD provides the principal Air Force interface with scientific industrial, educational, and government agencies and acts as AFSC focal point in the areas of AMD technical responsibility; executes assigned projects for and works closely with other major commands (MAJCOMs), Army, Navy, Defense Advanced Research Projects Agency (DARPA), National Aeronautics and Space Administration (NASA), Defense Nuclear Agency (DNA), Health, Education and Welfare (HEW), and other government agencies; supports foreign aerospace technology activities as provided in the Consolidation Intelligence Program; maintains a competent and comprehensive in-house research, development, test, and evaluation capability; conducts research and development to sustain and effectively use man in aerospace and ground operational environments; plans and conducts educational programs including graduate level courses, aerospace, and clinical medicine and related subjects; provides base health services for the Lackland Military Training Center; and provides the focal point with the Command and government-owned, contractor operated chambers under the jurisdiction of AFSC. AMD's 6570th Air Base Group operates and maintains Brooks AFB and provides support to AMD's Air Force School of Aerospace Medicine and Wilford Hall United States Air Force Medical Center. Support is also provided to the Headquarters, Air Force Human Resources Laboratory, the United States Air Force (USAF) Occupational and Environmental Health Laboratory, HQ USAF Medical Service Center (AFMSC), and the 6906 Electronic Security Squadron (USAFESC).

RELATED ACTIVITIES: AMD related activities are Aerospace Biotechnology (Program Element 62202F), Personnel Utilization Technology (Program Element 62703F) Satellite Control Facility (Program Element (PE) 35110F), Other Health Activities (PE 87714F), and ACS Telecommunications and General Support (PE 65304F). PE 86761F, Education and Training - Health Care; PE 87711F Care in Regional Facilities; PE 87794 - Real Property Maintenance Activities - Health Care; PE 87795F - Communications Health Care; PE 89732F - Off Duty and Volunteer Education Programs; PE 27593F Chemical Biological Defense; PE 91515F - Official representation; PE 88716F - Other Personnel Activities, PE 87792F - Medical Clinics, PE 87715F - Dental Care Activities.

WORK PERFORMED BY: Aerospace Medical Division Brooks AFB, TX. Major contracts include: What-Mac Conractors Inc., San Antonio, TX; DIV Laundry Dry Cleaning, San Antonio, TX; and San Antonio Real Property Maintenance Agency (SARPMA), Service Masters Industries, Inc, Downers Grove, IL.

Project: N/A
Program Element: #65806F
DOD Mission Area: General Management Support, #471

Title: Aerospace Medical Division (AMD)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable

2. FY 1980 Program: This is an in-house effort by the organization cited above which supports many program elements and projects in the Research, Development, Test and Evaluation community.

3. FY 1981 Planned Program: This is a level of effort program. The main cost of which is for pay of personnel. 75 percent of the total is for pay of personnel.

4. FY 1982 Planned Program: No major changes are foreseen in the nature of this element at this time.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable

7. Resources: ($ in thousands)

		FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E:	Funds*	12,330	12,461	13,370	14,015	Continuing	N/A

*Excludes Reimbursements

Project: N/A
Program Element: #65806F
DOD Mission Area: General Management Support, #471

Title: Space Division (SD)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: SD plans, programs, and manages systems programs to acquire space and missile systems, aerospace ground equipment (AGE), and other subsystems and related hardware; provides for the activation and alteration of missile sites and ground launch facilities; performs the functions of launch, on-orbit tracking, data acquisition, and command and control of Department of Defense (DoD) satellites; and affects recovery of various space packages. Conducts and manages standardization programs, medical activities, bioenvironmental engineering, system safety engineering, electromagnetic compatibility, personnel subsystems, reliability and maintainability, configuration management, survivability and vulnerability, systems engineering, value engineering, and quality assurance programs related to space and missile systems, equipment and material. Acquires and manages industrial facilities. Prepares, completes, and coordinates program management plans, to include management arrangement with other elements of Air Force Systems Command (AFSC), United States Air Force (USAF), DoD agences, military departments, Government agencies, and industry. Supports and participates in Research and Development (R&D) and procurement and production programs established with North Altantic Treaty Organization (NATO), and other friendly international organizations or individual nations. Ensures efficient and effective logistic support of systems and equipment being developed for the operational inventory and manages all phases of material, transportation, transportability, supplies, maintenance, Aerospace Ground Equipment (AGE), and propellents, in support of all SD programs and projects. Furnishes staff medical support and operates a Class B Dispensary. Provides, in collaboration with the Aerospace Medical Division, medical surveillance of systems development to ensure that medical research and support requirements are determined concurrently with system development. Discharges USAF responsibilities as Manager of the DoD Space Test Program. Provides required functional assistance to the Director of Special Projects (SAFSP), Headquarters USAF. SD has responsibility for System Program Offices, including Space Boosters & Space Transportation Program, Defense Dissemination Program, Satellite Data Systems, and has project office responsibility for approximately 40 projects including executive responsibility for the Global Positioning Satellite Joint Program. Two major sub-elements of SD, the Air Force Satellite Control Facility and the Space and Missile Test Organization (SAMTO) are funded as independent program elements: Program Element 35110F, and Program Element 78032F, respectively.

RELATED ACTIVITIES: SD uses the capabilities of the Air Force laboratories, centers, ranges and other AFSC in-house capabilities to the maximum extent feasible in all phases of systems planning, development, acquisition, and test. SD provides assistance to AFSC lead laboratories in the review and evaluation of those industry Independent Research and Deveopment programs related to Air Force space and missile systems, subsystems, and equipment, and acts as lead AFSC organization for contractors assigned by Headquarters AFSC. Related Program Elements are: 35110F, Satellite Control Facility: 65304F, Acquisition and Command Support (ACS) Telecommunications and General Support; 78032F, SAMTEC-Western Test Range, and 78022F, Eastern Test Range.

Project: N/A
Program Element: #65806F
DOD Mission Area: General Management Support, #471

Title: Space Division (SD)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

WORK PERFORMED BY: Space Division Los Angeles Air Force Station, CA. Major contractors include: Trend Western Technical Corp, Los Angeles, Ca; SF&A Inc., Anaheim, CA; B&W Services Industries, Los Angeles, CA; Del-Jen, Los Angeles, CA., Burroughs Corp., Paoli, PA., Xerox, Torrance, CA; Ontel Corp., Plainview, NY; Proprietrary Computer Systems, Van Nuys, CA; Action Transfer Centers, Gardena, CA; Washington Patrol Services, Inc, Escondido, CA; Quintron Systems, Santa Maria, CA. There are no other major contracts at SD funded by this program element.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable

2. FY 1980 Program: This is an in-house effort by the organization cited above which supports many program elements and projects in the Research, Development, Test and Evaluation community.

3. FY 1981 Planned Program: This is a continuing program. The main cost of which is for pay of personnel. 75 percent of the total is for pay of personnel. FY 1981 program effort increases due to the Space Transportation System (STS) and Space Defense System (SDS).

4. FY 1982 Planned Program: No major changes are foreseen in the nature of this element at this time.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in thousands)

		FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E:	Funds*	36,712	31,208	34,892	36,043	Continuing	N/A

* Excludes Reimbursements.

Project: N/A
Program Element: #65806F
DOD Mission Area: General Management Support, #471

Title: Armament Division (AD)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The Deputy for Armament Systems at the Armament Division (AD), Eglin AFB FL, manages for the Air Force the validation, development and production of air armaments; is responsible for the development, test, evaluation, and logistic support of the Sidewinder (AIM-9L), Sparrow III (AIM-7F), SHRIKE (AGM-45B) and the Anti-Radiation Missile (ARM) (AGM-88, B/C/D), and Advanced Medium Range Air-to-Air Missile (AMRAAM) systems, on a joint service basis to satisfy Air Force needs; is responsible for the development, test, evaluation and logistics for dispensers, rockets, flares, fuzes and other nonnuclear munitions and related support equipment, range instrumentation and tactical training support equipment, improved capability for Operational Test and Evaluation (OT&E), Chemical/Biological (C/B) defense equipment, improved Air Combat Fighter (ACF) gun systems, and foreign weapons evaluation; provides armament system program technical direction to contractors; establishes systems program financial objectives and cost control management; manages the acquisition of all subsystems; and incorporates new or advanced technology through modification of system hardware. The Deputy for Development Plans manages all air armament systems conceptual phase programs; is responsible for the AFSC Program Plan, Nonnuclear Armament Plan (NAP) and prepares and updates the Air Force Nonnuclear Consumable Annual Analysis (NCAA) attrition data base. The Deputy is the International Systems Focal Point and manages the Foreign Weapons Evaluation Program. The Deputy has a key role in prioritizing PCM/BES inputs through NAP. Development Plans formulates the Product Division Workload Forecast, provides technology guidance to the Laboratories, establishes cadre SPOs as necessary, performs engineering and effectiveness studies and acts as Division manager for using command requirements documents.

RELATED ACTIVITIES: The Deputy for Armament Systems and the Deputy for Development plans use the capabilities of the Air Force Laboratories, test centers, ranges, and other Air Force Systems Command (AFSC) in-house capabilities to the maximum extent feasible in all phases of systems planning, development, acquisition and test. They also function as AD focal point on all actions cognizant to the Joint Conventional Ammunition Program (JCAP) Group and single manager for conventional munitions activities. Related program elements are PE 27162F - Tactical AGM Missiles; PE 35116F - Aerial Target Drones; PE 63232F - Advance Aerial Targets Technology; PE 64602F - Armament/Ordnance Development; PE 64610F - Air Delivered Land Mines; PE 64733F - Surface Defense Suppression; PE 27161F - Tactical AIM Missiles; PE 63741F - Defense Suppression; PE 27429F - Range Improvement Equipment; PE 27597F - Tactical Training Support Equipment; PE 64735F - Improved Capability for OT&E; PE 11897F - Training Support Equipment; PE 64601F - C/B Defense Equipment; PE 64603F - Improved ACF Gun Systems; PE 63316F - Advanced Air-to-Air Missile System; PE 64604F - Low Altitude Airfield Attack Systems; PE 64612 - Low Level Laser Guided Bomb (LLLGE); PE 63370F and PE 64314F - AMRAAM; PE 63609F Advanced Attack Weapons; PE 64607F - Wide Area Anti-Armor Munition (WAAM); PE 64211F - Advanced Aerial Targets and PE 28030F - War Reserve Materials (WRM) Munitions. Development Plan Office functions as AD focal point for systems requirements, Division Advisory Group and Scientific

Project: N/A
Program Element: #65806F
DOD Mission Area: General Management Support, #471

Title: Armament Division (AD)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

Advisory Board (SAB) activities and International Programs Focal Point. Related program elements are PE 63101F - Development Planning, PE 63306F - Defense Suppression Weapons Advanced Technology, PE 63380F - Advanced Short Range Air-to-Air Missile (ASRAAM), PE 64302F - Defense Suppression Weapons Engineering Development, PE 63609F - Advanced Attack Weapons, PE 64614F - Advanced Conventional Standoff Missile (ACSM) and PE 64615F - Guided Hard Structure Munitions.

WORK PERFORMED BY: The Deputy for Armament Systems, Deputy for Development Plans, and a part of the Deputy for Contract and Manufacturing, and the Deputy for Comptroller, Eglin AFB FL. There are no contracts funded in this project.

PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Discussed in individual RDT&E program elements managed by AD.

2. FY 1980 Program: Discussed individual Research Development Test & Evaluation (RDT&E) RDT&E program elements by AD. Man-years and funding are increased to accommodate personnel in the procurement and plans offices previously funded in PE 65807F, Test and Evaluation Support.

3. FY 1981 Planned Program: This is basically a continuing program.

4. FY 1982 Planned Program: This continues the FY 1981 level of effort.

5. Program to Completion: This is a continuing programs.

6. Milestones: Not applicable.

7. Resources: ($ in thousands)

		FY 1979	FY 1980	FY 1981	FY 1982	Addition to Completion	Total Estimated Cost
RDT&E:	Funds*	10,505	10,428	11,048	11,445	Continuing	N/A

* Excludes Reimbursements.

Project: N/A
Program Element: #65806F
DOD Mission Area: Other Management Support, #641

Title: Ballistic Missile Office (BMO)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: BMO plans, programs, and manages systems programs to acquire ballistic missile systems, Aerospace Ground Equipment (AGE), and other subsystems and related hardware; provides for the activation/alteration of missile sites and ground launch facilities. Conducts and manages standardization programs, medical activities, bioenvironmental engineering, system safety engineering, electromagnetic compatibility, personnel subsystems, reliability and maintainability, configuration management, survivability and vulnerability, systems engineering, value engineering, and quality assurance programs, related to missile systems, equipment and material. Acquires and manages industrial facilities. Prepares, completes, and coordinates program management plans, to include management arrangements with other elements of Air Force Systems Command (AFSC), United States Air Force (USAF), DoD agencies, military departments, Government agencies and industry. Supports and participates in Research and Development (R&D) and procurement and production programs established with North Atalantic Treaty Organization (NATO), and other friendly international organizations or individual nations. Ensures efficient and effective logistic support of systems and equipment being developed for the operational inventory and manages all phases of material, transportation, transportability, supplies, maintenance, Aerospace Ground Equipment (AGE), and propellents, in support of all BMO programs and projects. Discharges USAF responsibility as Manager of the DoD Advanced Ballistic Reentry Systems (ABRES) program. BMO has responsibility for the Minuteman and Missile X Program Offices.

RELATED ACTIVITIES: BMO uses the capabilities of the Air Force laboratories, centers, ranges, and other AFSC in-house capabilities to the maximum extent feasible in all phases of systems planning, development, acquisition, and test. Related Program Element is 65304F, Acquisition and Command Support (ACS) Telecommunications.

WORK PERFORMED BY: Ballistic Missile Office, Norton AFB, CA. There are no major contracts at BMO funded by this program element. Minor contractual effort is provided through host base support contract.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not applicable

2. FY 1980 Program: This is an in-house effort by the organization cited above which supports many program elements and projects in the Research, Development, Test and Evaluation community.

Project: N/A
Program Element: #65806F
DOD Mission Area: General Management Support, #641

Title: Ballistic Missile Office (BMO)
Title: Acquisition and Command Support (ACS)
Budget Activity: Defensewide Mission Support, #6

3. FY 1981 Planned Program: This is a continuing program, the main cost of which is for pay of personnel. 91 percent of the total is for pay of personnel. Increase effort will be on the Missile-X program.

4. FY 1982 Planned Program: No major changes are foreseen in the nature of this element at this time.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable

7. Resources: ($ in thousands)

		FY 1979	FY 1980	FY 1981	FY 1982	Addition to Completion	Total Estimated Cost
RDT&E:	Funds*	N/A	5,000	7,500	7,747	Continuing	N/A

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65807F
DOD Mission Area: Major Ranges and Test Facilities, #451

Title: Test and Evaluation Support
Budget Activity: Defense-wide Mission Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	284,752	292,875	315,200	339,800	Continuing	Not Applicable
2109	Arnold Engineering Development Center	87,348	93,775	105,050	111,080	Continuing	Not Applicable
2110	Western Space and Missile Test Center (formerly Space and Missile Test Center (SAMTEC)	1,950	900	1,500	1,500	Continuing	Not Applicable
2111	Armament Division	90,939	89,100	96,050	104,280	Continuing	Not Applicable
2112	Air Force Flight Test Center	70,116	71,600	71,140	78,430	Continuing	Not Applicable
2114	4950th Test Wing	34,399	37,500	41,460	44,510	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides resources for operating the above Air Force Systems Command test activities. Operation of the activities includes both technical and base support functions. These activities provide test and evaluation support to Air Force programs, those of other Services and Government agencies, and commercial companies. Many capabilities possessed by the test activities are unique and cannot be found elsewhere. The SAMTEC operating funds were transferred to Operations and Maintenance effective FY 1979, with only instrumentation development funds remaining with Project 2110.

BASIS FOR FY 1981 RDT&E REQUEST: The program supports the operation and maintenance of the RDT&E activities and includes pay and related costs of civilian personnel, travel, transportation, rents, communications, utilities, contractual services, supplies and equipment.

OTHER APPROPRIATION FUNDS:

Military Construction (3300)	8,566	5,100	16,750	6,240	Continuing	Not Applicable

Program Element: #65807F
DoD Mission Area: Major Ranges and Test Facilities, #451

Title: Test and Evaluation Support
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: This Program Element resulted from the consolidation of three other Program Elements effective with the start of FY 1975. The old Program Elements were: 65301F - Space and Missile Test Center (SAMTEC); 65802F - Arnold Engineering Development Center (AEDC); and 65807F - Development and Test Support which included the Armament Development and Test center (now the Armament Division (AD)), the Air Force Flight Test Center (AFFTC), and the Air Force Special Weapons Center (AFSWC). Also effective in FY 1975, all test activities in this Program Element began to earn direct cost reimbursements from Test and Evaluation customers under the uniform funding policy established by Department of Defense Directive 3200.11. During FY 1977 an analysis was conducted on the SAMTEC workload which determined that the majority of programs supported were operational and that effective in FY 1979, SAMTEC operation should be funded in the operations and maintenance appropriation.

RELATED ACTIVITIES: The test activities provide test and evaluation support to Air Force programs and those of other Services and Government agencies. Examples include the Air Force Air Launched Cruise Missile, F-15, F-16, and National Aeronautics and Space Administration Space Shuttle. Additional related activities are covered under each project.

WORK PERFORMED BY: AEDC, Tullahoma, TN; AD, Eglin AFB, Fl, AFFTC, Edwards AFB, CA; 4950th Test Wing, Wright-Patterson AFB, OH. Major contractors performing work at the center, shown in parenthesis, include: Arnold Research Organization, Inc. (AEDC); VITRO Services (AD); RCA Missile and Service Division (AD); and Dynalectron Corp (Holloman AFB), NM.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: See attached project descriptions.

2. FY 1980 Program: See attached project descriptions.

3. FY 1981 Program: See attached project descriptions.

4. FY 1982 Program: See attached project descriptions.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: See attached project description.

Project: #2109

Title: Arnold Engineering Development Center (AEDC)

Program Element: #65807F

Title: Test and Evaluation Support

DoD Mission Area: Major Ranges and Test Facilities, #451

Budget Activity: Defensewide Mission Support, #6

BACKGROUND AND DESCRIPTION: AEDC provides ground environment test support for all Department of Defense aeronautical, missile, and space programs, such as Minuteman, M-X, F-15, F-16, Air Launched Cruise Missile Advanced Strategic Air Launched Missile, and Advanced Ballistic Re-Entry System, as well as for other Government agency programs. The center has three facility complexes encompassing wind tunnels, altitude rocket cells, aeroballistic ranges, altitude engine cells, space chambers, and required support and administrative facilities. The test facility complexes are: Von Karman Gas Dynamic Facility which performs aerodynamic testing of scale models of aircraft missile and space systems from Mach 1.5 to 10, testing of large and full-scale satellites, sensors and space vehicles in a simulated space environment, and tests of projectiles (both high performance and conventional gun) at various altitudes and re-entry conditions; Engine Test Facility which provides altitude environmental testing for aircraft, missile, and spacecraft propulsion systems including turbojets, turbofans, and both liquid and solid propellant rockets; and Propulsion Wind Tunnel Facility which provides tests of large-scale models, and in some cases, full-scale engine? inlet combinations, missiles, and space boosters together with their propulsion systems at Mach numbers from 0.5 to 4.5. This national test facility evaluates aerospace systems, hardware, concepts and prototypes in simulated operating environments to assist project managers and program directors in effective development and acquisition of their systems. These test complexes assist in obtaining an optimal design, evaluation and certification of performance and acceptance of hardware by providing accurate data at minimum cost.

RELATED ACTIVITIES: The Center also supports programs of the National Aeronautics and Space Administration such as Space Shuttle, the Army Ballistic Missile Division, and Navy standard missile development, as well as technology support to the Department of Energy. The Center's facilities are national assets that provide unique test capabilities not available elsewhere.

WORK PERFORMED BY: Under the direction of the Air Force Systems Command, the AEDC Commander and his staff provide the overall planning, programming, funding, and administration of AEDC. The operation of the test facilities and support activities at AEDC is performed by the operating contractor, Arnold Research Organization (ARO) Inc., (AEDC Division of Sverdrup Corporation) Arnold AFS, TN. Approximately 80 percent of the AEDC institutional budget is used in this operating contract. The current contract with ARO Inc was awarded competitively for the first time in FY 1978. The contract is for three years (FY 1978, FY 1979, and FY 1980) with two one-year priced options. The contr will be recompeted for the period FY 1981 - FY 1985. Other contractors include: Grumman Data Systems, Bethpage, NY; Westinghouse, Sunnyvale, CA; Daniel, Mann, Johnson & Mendenhall, Los Angeles, CA; Brown Boveri, Switzerland; Sulzer Brothers, Switzerland; Axel Johnson, San Fransisco, CA; Mosser, Bethleham, PA; Clow Corp, Chicago, IL; Rotoflow Corp, Los Angeles, CA; and Carrier, Syracuse, NY.

Project: #2109

Title: Arnold Engineering Development Center (AEDC)

Program Element: #65807

Title: Test and Evaluation Support

DoD Mission Area: Major Ranges and Test Facilities, #451

Budget Activity: Defensewide Mission Support, #6

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: AEDC has provided vital environmental test support to most of the national aerospace system development programs such as the F-15, F-16, B-1, A-10, F100/F101 Engine Model Derivative Program (EMDP), F-5E, Advanced Ballistic Re-Entry System (ABRES), F-111, Minuteman, Inertial Upper State, Titan 340, Air Launched Cruise Missile (ALCM), Advanced Strategic Air Launched Missile (ASALM), Air Force Flight Dynamics Laboratory (AFFDL), Global Positioning Satellite. Major direct support for environmental testing was provided for advanced surveillance devices, aerospace propulsion flight dynamics and munition development. Additional support was provided to Air Force Logistics Command (AFLC) for Engine Baseline performance and trending. Starting in FY 1975, a funding policy was implemented where the customers pay for the direct cost portion of their testing efforts. Congressional approval was issued in 1977 for construction of the Aeropropulsion Systems Test Facility. This facility, costing $437 million, will be a national test facility capable of simulating altitude flight conditions for integrated aerodynamic and propulsion tests of very large aircraft engines. Construction is progressing on schedule. Initial Operational Capability will be FY 1983.

2. FY 1980 Program: Major direct support for environmental testing is being provided for the F-15, ALCM, ASALM, ABRES, and Missile-Experimental (MX). Support will also be provided to the AFFDL, as well as to the Air Force Aeropropulsion Laboratory, the Air Force Rocket Propulsion Laboratory and the Air Force Armament Test Laboratory. Support to AFLC, Army, Navy, and National Aeronautics and Space Administration (NASA) wil continue. F100 Engine Component Improvement Program testing will be conducted as well as tests for F101 Derivative Fighter Engine development.

3. FY 1981 Planned Program: The Center will continue to be a prime contributor to the successful development of Department of Defense and NASA aeronautical, missile and space Systems Integration program, ABRES, Advanced Medium Range Air to Air Missile, Wide Area Anti-Armor Munition, ASALM, Space Shuttle, MX, F-16, Stores Separation testing, EMDP and ALCM. Major aerodynamic testing programs will be conducted for the Foreign Technology Division, Scientific and Technology Intelligence Programs, Aerospace performance testing. Additionally, AEDC will provide support for other Services, such as the Navy and Army, and commercial companies. Magnetohydrodynamic technology support will be provide to Department of Energy. In order to provide the best possible test data at minimum cost AEDC will maintain its continuing effort in developing technology and instrumentation to improve and modernize its existing capabilities.

4. FY 1982 Planned Program: The statements in paragraph 3 also apply in FY 1982.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

Project: #2109
Program Element: #65807F
DoD Mission Area: Major Ranges and Test Facilities, #451

Title: Arnold Engineering Development Center
Title: Test and Evaluation Support
Budget Activity: Defensewide Mission Support, #6

7. Resources: ($ in thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional To Completion	Total Estimated Cost
RDT&E Funds*	87,348	93,775	105,050	111,080	Continuing	Not Applicable

* Excludes Reimbursements

Project: #2110 Title: Western Space and Missile Center (WSMC)/Western Test Range (WTR)
Program Element: #65807F Title: Test and Evaluation Support
DoD Mission Area: Major Ranges and Test Facilities, #451 Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The WSMC operates the WTR which provides range tracking, data acquisition, and flight safety support for all aeronautical flights, and ballistic missile and space system launches from Vandenberg AFB, CA. The WSMC operates an integrated system of radars, optical tracking instruments, telemetry receivers, range safety command destruct transmitters, computers, and data transmission and display equipment. Operating sites include: Vandenberg AFB and Pillar Pt, CA and Wheeler AFB and Kaena Pt, HI. This program element provides for the research and development of new range instrumentation at a test facility whose funding is predominately operations and maintenance (O&M). The remainder of WSMC/WTR funding is in Program Element 78032F, O&M.

RELATED ACTIVITIES: The WSMC provides common range support for: Strategic Air Command (SAC) ballistic missile operational testing; Air Force Space Division polar orbit and Ballistic Missile Office ballistic re-entry vehicle launches; other Department of Defense sponsored range users; the National Aeronautics and Space Administration polar orbit launches; on-orbit tracking of satellites launched from the Eastern Test Range; and support to the Navy Pacific Missile Test Center. Funds for WSMC Defense Communications Services and other leased communication services are carried under Program Element 78034F. SAC provides host base services to WSMC at Vandenberg AFB. The majority of funding for WSMC/WTR is in Operations and Maintenance, PE 78032F. Only $1.5 million Research, Development, Test and Evaluation remains for developmental improvement expenditures.

WORK PERFORMED BY: Air Force management is under the Air Force Western Space and Missile Center, Vandenberg AFB, CA. Major contractors are: Federal Electric Corporation, Division of International Telephone and Telegraph, Paramus, NJ, provides operation and maintenance of range instrumentation; Aeronautronic-Ford Corporation, Fort Washington, PA, operates the Vandenberg AFB, Precision Measurements Equipment Laboratory; Computer Sciences Corporation. Los Angeles, CA, provides computer engineering technical services; and Logicon, Inc., Torrance, CA, provides verification and validation of flight safety computer programs. Other contractors include: Bionetics, Hampton, VA; Science Applications Inc., La Jolla, CA; Southern Pacific Transportation Company, San Francisco, CA; and Xerox Corp, Los Angeles, CA.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: WSMC assumed responsibility for intercontinental ballistic missile and space vehicle range support functions from the Navy on 1 February 1965. The FY 1966 program provided for the consolidation and integration of range operations and the establishment of a communications center at Wheeler AFB, HI. The FY 1969 program provided for the installation of new mid-course tracking radar in the Hawaiian Islands and centralization of telemetry and peripheral equipment and data handling, processing, and display. The 1970 through 1974 programs provided for development of a new terminal/re-entry support site in the Phoenix Islands for Strategic Air Command operational testing of the Minuteman III, instrumentation improvement modifications to range ships, a tracking accuracy improvement modification of the WSMC radar in Hawaii major upgrading of the WSMC telemetry capability, acquisition of instrumentation to support the Minuteman III Operational Base Launch program at Vandenberg AFB, CA;

Project: #2110 Title: Western Space and Missile Center (WSMC)/Western Test Range (WTR)
Program Element: #65807 Title: Test and Evaluation Support
DoD Mission Area: Major Ranges and Test Facilities, #451 Budget Activity: Defensewide Mission Support, #6

initiation of development of an unattached scoring system, new range safety Digital Instrumentation Radar (DIR), and continued minimum essential improvements to range instrumentation and communications. Support to the Airborne Warning and Control System and B-1 programs began in FY 1976-1977 which added to WSMC's increasing aeronautical Development Test and Evaluation (DT&E) workload. Minuteman III testing increased significantly in FY 1977 to support Improved Guidance, Missile Precision Measurement System and MK-12A Re-entry Vehicles DT&E requirements. Implementation of the Telemetry Integrated Processing System and Range Safety Display System began in FY 1978.

2. FY 1980 Program: The WSMC/WTR will continue to support significant space, ballistic and aeronautical programs in FY 1980. An estimated 10 aeronautical flights and 41 space and ballistic launches are scheduled in FY 1980. Development of the capability to support the Space Shuttle and follow-on ballistic missile is planned for FY 1980. $0.9 million of Research, Development, Test and Evaluation will be used to develop range instrumentation in FY 1980.

3. FY 1981 Planned Program: The $1.5 million RDT&E for FY 1981 will be used for design and software development for the Metric Data Processing System and development of data transmission and acquisition security.

4. FY 1982 Planned Program: The FY 1982 WSMC/WTR RDT&E totals $1.5 million and includes approximately $1.0 million for completion of the development of the Metric Data Processing System, and initial funding of the Midcourse Range Safety System to provide the capability to track and command destruct the high thrust Missile Experimental ballistic missile stages as they proceed downrange to the terminal area.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. RESOURCES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional To Completion	Total Estimated Cost
RDT&E Funds*	1,950	900	1,500	1,500	Continuing	Not Applicable

* Excludes Reimbursements

Project: #2111
Program Element: 765807F
DoD Mission Area: Major Ranges and Test Facilities, #451

Title: Armament Division (AD)
Title: Test and Evaluation Support
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The AD is the host organization at Eglin AFB, FL and is the prime Air Force organization charged with non-nuclear armament development. As of 1 Oct 79, AD (formerly Armament Development and Test Center) became a full product division. In this role, AD: accomplished engineering development, test, evaluation, and initial acquisition of Air Force non-nuclear munitions; acts as the focal point for munitions integration in aeronautical systems; conducts and supports Air Force Weapons Effectiveness Testing, electromagnetic warfare testing, electronics surveillance and control testing, aeronautical systems testing; and supports and participates in the United States Air Force, Department of Defense (DoD), and other governmental agencies test and evaluation programs as required. Eglin is the largest Air Force Base in the free world encompassing 734 square miles of land and a 44,000 square mile Gulf Test Range extending 400 miles south into the Gulf of Mexico. AD conducts more than 400 test projects per year with the emphasis in the field of conventional munitions. To carry out this program, AD utilizes 46 aircraft and over 50 instrumented test areas, sites, and ranges. The ranges are divided into four categories: The Armament Systems Test Environment, The Electromagnetic Test Environment, The Multi-purpose Resources (MPR), and the Water Test Areas.

RELATED ACTIVITIES: AD supports the Air Force non-nuclear munitions development programs managed by the Air Force programs concerning the advanced development, engineering development, and initial production of non-nuclear munitions until transition to the Air Force Logistics Command. Test support is also provided to other Services and Government agencies. The Air Force Climatic Laboratory at Eglin AFB provides environmental testing for weapon systems programs of DoD. Related and complementary work is accomplished at the Air Force Flight Test Center, 6585th Test Group at Holloman AFB, NM, Arnold Engineering Development Center, Space and Missile Test Organization, all in Program Element 65807F Test and Evaluation Support; and the Product Divisions of PE 65806F, Aquisition and Command Support.

WORK PERFORMED BY: Under the direction of the Air Force Systems Command, the AD Commander and his staff provide the overall planning, programming, funding, and administration of Armament Division, Eglin AFB, FL. The operation of the range facilities is accomplished by a contract with VITRO Services, Division of Automation Industries, Inc., Ft. Walton Beach, FL. Other contractors include: Dynalectron, D.C.; Industrial Maintenance Services, Dothan, AL; Robbins Kirtland Incorp., Ft. Walton Beach, FL; Phillips Audio-Vidkeo, Mahwah, NJ: Bell Construction, Ft. Walton Beach, FL; Rivers Air Conditining Corp., Shalimar, FL; DBA Systems, Melbourne, FL.; NB Associates, San Ramon, CA; and Boeing Aerospace Corp., Seattle, WA. There are 106 additional contracts divided among 46 other contractors.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The primary testing mission of the AD is Development Test and Evaluation (DT&E). The objective of the AD testing programs is to provide data which satisfies the test objectives for armament development programs. In DT&E, AD has been primarily concerned with programs that fall within the categories of non-nuclear munitions and electromagnetic warfare. Under AD management, the 6585th Test Group

will continue to operate the Central Inertial Guidance Test Facility, the high speed test track, target drones, and the Radar Target Scatter (RATSCAT) Facility. In addition, AD support included: the collection of large quantities of precise and accurate data; reduction, analysis, and evaluation of these data; and the preparation of technical reports. Major weapon systems supported by AD during FY 1978 included the MAVERICK, A-10, F-15, Tactical Long Range Navigation, GBU-15, AIM-7F, AIM-9L, and Advanced Medium Range Air-to-Air Missile (AMRAAM).

2. FY 1980 Program. Fiscal year funds are used for the following purposes on a continuing basis: operate, maintain, and upgrade the highly instrumented 734 square mile test complex; conduct and support testing in the areas of Air Force non-nuclear munitions, electromagnetic warfare, and missiles and munitions/aeronautical systems integration; support United States Air Force, Office of the Secretary of Defense, and other Government agencies in test programs as required; provide administrative, logistical, and technical support to approximately 10,000 assigned tenant personnel.

3. FY 1981 Program: Many of the FY 1980 efforts will continue. Programs requiring support will be Advanced Locator Strike System, GPU-15, F-111, F-16, Advanced Ballistic Re-entry Systems and AIM-9M, AMRAAM and Wide Area Anti-Armor Munition.

4. FY 1982 Planned Program: Many of the FY 1981 efforts will be continued.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: ($ in thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E Funds*	90,939	89,100	96,050	104,280	Continuing	Not Applicable

*Excludes Reimbursements

Project: #2111
Program Element: #65807F
DOD Mission Area: Major Ranges and Test Facilities, #451

Title: Test and Evaluation Support
Budget Activity: Defensewide Mission Support, #6

8. Comparison with FY 1980 Budget Data:

FY 80 Budget - PE 65807F	FY 79	FY 80	FY 81
	280,000	292,875	323,175

The FY 1981 Budget reflects a net decrease from FY 1980 because FY 1981 Test and Evaluation Support funds were used as an offset for other DOD program increments. There has not been any overall increases in scope of the program. On the contrary, due to inflation exceeding increased Total Obligation Authority there will be some minor decreases in scope.

Project: #2112
Program Element: #65807F
DOD Mission Area: Major Ranges and Test Facilities, #451

Title Air Force Flight Test Center (AFFTC)
Title Test and Evaluation Support
Budget Activity Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The AFFTC conducts and supports tests of aircraft and aircraft systems, aerospace research vehicles, remotely piloted vehicles, cruise missiles, and parachute delivery and recovery systems. Major weapon systems undergoing testing at Edwards Air Force Base (AFB), CA, include the A-10, F-15, B-1 aircraft and Air Launched Cruise Missile (ALCM). The 6514th Test Squadron at Hill AFB, UT, conducts tests of RPV systems and the Ground Launched Cruise Missile using the Utah Test and Training Range to evaluate research, tactical and reconnaissance drone systems for military application. Air Force parachute testing is the responsibility of the 6510th Test Wing. The AFFTC also operates the United States Air Force Test Pilot School which annually trains 50 Department of Defense, allied, and contractor test pilots and flight test engineers.

RELATED ACTIVITIES: The AFFTC provides facilities and support as required to the National Aeronautics and Space Administration (NASA) Hugh L. Dryden Flight Research Center (DFRC) and to the United States Army Aviation Engineering Flight Activity, major tenants at Edwards AFB. The NASA DFRC programs include the Space Shuttle and Transonic Aircraft Technology. The Army programs includ tests of helicopter systems at Edwards AFB and at its high elevation test complex at Bishop, CA. The AFFTC also provides administrative and limited test support to the Air Force Rocket Propulsion Laboratory (AFRPL) located 15 miles east. The AFRPL programs include testing of rocket motors, nozzles, and propellants. Other Government agencies receive AFFTC test support as required. Nongovernment organizations not under Government contract may use AFFTC facilities, when available, to conduct independent testing, on a full cost reimbursement basis.

WORK PERFORMED BY: Most of the tests and supporting activities are done by Air Force military and civilian personnel. The AFFTC provides facility and limited administrative support to NASA DFRC, the Army, and to tenant contractor organizations. It also provides full administrative support to the Rocket Propulsion Laboratory. However, all tenant organizations provide for their own direct maintenance. Kentron International, Dallas, TX, is the major range contractor for the Edwards Flight Test Range.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The AFFTC has been the center of aircraft and research vehicle flight test for many years because of its unique features: excellent flying weather, large restricted airspace, and the availability of natural dry lakebed runways. Programs which have undergone development testing at Edwards AFB include the F-105, XB-70, F-4, YF-12, the F-111 and the C-5A. Jointly, with NASA, the Air Force has tested the high altitude hypersonic X-15 research vehicle and the X-24 A/B lifting bodies. During FY 1978, NASA efforts focused on Space Shuttle approach and landing tests. The Air Force continued its developement of the A-10, F-5E/F, F-15, F-16, and the B-1 aircraft. ALCM testing was begun in FY 1979.

Project: #2112
Program Element: # #65807F
DOD Mission Area: Major Ranges and Test Facilities, #451

Title Air Force Flight Test Center (AFFTC)
Title Test and Evaluation Support
Budget Activity Defensewide Mission Support, #6

2. FY 1980 Program: Testing is continuing on the A-10, F-15, F-16, and B-1 programs. The air and ground launched cruise missile (ALCM/GLCM) test organizations have been established. ALCM testing is scheduled to continue and GLCM testing will start this year. Parachute testing will continue on various parachute development programs. The Utah Test and raining Range was established in FY 2/1979 under AFFTC cognizance and is operated under a separate program element. The National Aeronautics and Space Administration (NASA) is beginning orbital flight tests of the Space Shuttle; the Hugh L. Dreyden Flight Research Center (DFRC) is scheduled to continue joint AF/NASA tests of the Highly Maneuverable Aircraft Technology vehicle.

3. FY 1981 Planned Program: The A-10, F-15, F-16, GLCM and other anticipated missile programs are scheduled for additional testing in FY 1981. The Advanced Fighter Technology Integration test program will be jointly conducted with DFRC. NASA will continue orbital flight tests of the Space Shuttle with landings scheduled for Edwards AFB. The AFFTC will continue to play a key role in the successful development of Department of Defense aerospace systems.

4. FY 1982 Planned Program: The program shown for FY 1981 will continue into FY 1982.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable

7. RESOURCES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E Funds*	70,116	71,600	71,140	78,430	Continuing	Not Applicable

* Excludes Reimbursements

Project: #2114
Program Element: # #65807F
DOD Mission Area: Major Ranges and Test Facilities, #451

Title 4950th Test Wing
Title Test and Evaluation Support
Budget Activity Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The 4950th Test Wing, Wright-Patterson Air Force Base (AFB), OH, performs flight tests of aircraft and airborne systems, supports space vehicle tracking for the Space and Missile Test Organization and other Government agenices, and operates the Air Force Systems Command (AFSC) aircraft Class II modification enter. Flight test activities have varied from evaluations of airborne side-firing cannon to investigations of state-of-the-art airborne laser systems and night attack sensors. The Wing has the test support facilities to conduct full-scale engineering evaluations. These facilities include a complete airborne instrumentation and data reduction capability, a central facility for major and minor aircraft modifications, and an extensive technical photo capability. Staging out of over 25 overseas bases, the Advanced Range Instrumentation Aircraft (ARIA) provide tracking support for National Aeronautics and Space Administration (NASA) and Department of Defense (DoD) missile launches out of Cape Canaveral, FL, and Vandenberg AFB, CA. The modification center does hardware and electronics modifications to AFSC aircraft, primarily to support the various flight test programs.

RELATED ACTIVITIES: The 4950th Test Wing supports DoD programs and those of other Government agencies.

WORK PERFORMED BY: Air Force personnel (55 percent civilian) accomplish about 94 percent of the workload of the 4950th. The remaining work is covered by contracts which total $2.4 million. Major contractors include Digital Equipment Corporation of Dayton, OH, which performs computer maintenance, Bendix Corporation of Columbia, MD, which provides ARIA instrumentation maintenance, E-Systems of Greenville, TX, Hayes International Inco. of Birmingham, AL, Technology Inc. of Dayton, OH, and Systems Research Laboratory of Dayton, OH which provide supplementary engineering design and aircraft modification. About 18 percent of the 4950th's 11,000 hours of annual flying are in support of ARIA missions. The rest are flown for test, support, and proficiency training. The research and development fabrication and Class II modification workload consumes about 350 man-years of direct labor effort annually.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The 4950th Test Wing was designated a Major Test Facility in November 1975 and was therefore placed within the purview of DoD Directive 3200.11, the directive which governs the use, management and operation of major DoD ranges and test facilities. As part of the reorganization, the ARIA aircraft were reassigned to the 4950th from the Eastern Test Range. In addition, the wing assumed the responsibility within AFSC for the major aircraft modification program. Some of the recent accomplishments in the flight test program are the development of the all-weather landing system, the air-cushion landing vehicle, the Infrared Warning Receiver, the Pulse Doppler Map Match Navigation System, and support to the Advanced Ballistic Re-entry System. The ARIA aircraft have supported such programs as Apollo and Venus Pioneer for NASA; Titan IIIC, Atlas Agena, and Minuteman for the Air Force; Poseidon and Trident for the Navy; and Pershing for the Army.

Project: #2114
Program Element: # #65807F
DOD Mission Area: Major Ranges and Test Facilities, #451

Title 4950th Test Wing
Title Test and Evaluation Support
Budget Activity Defensewide Mission Support, #6

2. FY 1980 Program: Some of the flight test programs currently being supported are Infrared Properties, Aerospace Radio Propgation, Defense Meteorological Satellite, Airborne Laser Laboratory Aircraft Navigation System Verification, NAVSTAR, T-Bird bi-static radar test, Advanced Strategic Air Launched Missile - Long Range Passive Location System, Joint Tactical Information Display System, Coherent Emitter Location Test Bed and laser communications. In addition the Advanced Range Instrumentation Aircraft (ARIA) are supporting various Air Force, National Aeronautics and Space Administration, Army, and Navy programs. A significant improvement and modernization program is underway to update the ARIA instrumentation systems, to include an upgrade of airborne receivers and the replacement of antenna control systems. The modification center will complete conversion of two EC-135B fan engine aircraft for ARIA support.

3. FY 1981 Planned Program: Planned for flight test in FY 1981 are continuing efforts on the existing programs. Also being supported are the Precision Location Strike System (PLSS), the Cross Eye ECM program, Adaptive Communications, and small Super High Frequency satellite communications. The ARIA will continue to support future launche

4. FY 1982 Planned Program: The 4950th Test Wing will continue to support programs as in FY 1981.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. RESOURCES: ($ in thousands)

	FY 1979	FY 1980	FY 1981	FY 1982	Additional to Completion	Total Estimated Cost
RDT&E Funds*	34,399	37,500	41,460	44,510	Continuing	Not Applicable

*Excludes Reimbursements

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65808F Title: Advanced Systems Engineering/Planning
DOD Mission Area: Technical Integration/Studies & Analyses #440 Budget Activity: Defense-wide Mission Support #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6,000	4,200	4,400	5,100	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force conducts development planning (mission area planning, systems architecture, and systems planning) to convert operational requirements into effective weapon systems. This Advanced System Engineering/Planning Program provides technical support for the development planning function at the Electronic Systems Division and the Space Division. This includes the definition of technology needs, the macro-system planning or architecture required to meet national objectives and the initial system definition necessary to satisfy operational requirements.

BASIS FOR FY 1981 RDT&E REQUEST: This request will provide technical support for the development planning function at the Electronic Systems Division and the Space Division. This effort will include the identification of new technology required for future systems; the future architectural plans for strategic and tactical systems; and initial engineering design for future systems required to satisfy operational requirements.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #65808F
DOD Mission Area: Technical Integration/Studies & Analyses #440

Title: Advanced Systems Engineering/Planning
Budget Activity: Defense-wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: Development planning is the initial step in the systems acquisition process. The overall objective is the conversion of operational requirements into effective military capabilities. The development planning function includes: (1) mission area planning that broadly examines Air Force capabilities and potential deficiencies, and establishes development goals; (2) systems architecture that will provide a time-phased plan for meeting the development goals; (3) systems planning that will define initial system characteristics for a future weapon or support system. This program provides technical support for the development planning function in the strategic and tactical areas of command, control, communications, and intelligence at the Electronic Systems Division and for space systems at the Space Division. In addition to the Air Force personnel assigned to support this functional area, the Aerospace Corporation and the MITRE Corporation are the principal technical support contractors for the program.

RELATED ACTIVITIES: The "technology needs" identified and published in the Technology Planning Guide provide the basic research and exploratory development planners and the associated 6.1 and 6.2 program elements with research area guidance. The Space Architecture and the Command, Control, Communications and Intelligence Architecture activities supported by this program element provide the advanced development planners with the time-phased capabilities needed. The development planning activities are discussed with the other military services to prevent duplication and enhance cooperation.

WORK PERFORMED BY: The primary technical support for this program is provided by the Aerospace Corporation, El Segundo, CA, and the MITRE Corporation, Bedford, MA. Other contractors may be selected to provide technical support in specific areas. The Aerospace and MITRE Corporations have been designated Federal Contract Research Centers (FCRCs) and, as such, may have access to contractor proprietary data and to sensitive Air Force procurement information. This capability allows these FCRCs to provide unique and necessary support to the Air Force development planning function.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: System architectural efforts have been emphasized to provide a basis for technology planning and future system acquisition. The Electronic Systems Division initiated the Command, Control, Communications and Intelligence Architecture Project for the Tactical Air Forces, identified technology needs and published a Technology Planning Guide for use by the basic research and exploratory development planners. A computer technology planning task was initiated to reduce the problems associated with software procurement. The Space and Missile Systems Organization program focused on space and missile architecture, support to a study on the utility of military crews in space, all aspects of space sensor data management, an in-depth examination of an advanced military launch capability for the 1990s, and initial planning for a stand-off ballistic missile system to enhance bomber survivability through increasing stand-off range.

Program Element: #65808F Title: Advanced Systems Engineering/Planning
DOD Mission Area: Technical Integration/Studies & Analyses #440 Budget Activity: Defense-wide Mission Support #

2. FY 1980 Program: The program activities at the Electronic Systems Division are emphasizing command, control communications and intelligence architectural efforts in support of the Tactical Air Forces Integrated Informatio System (TAFIIS) Master Plan. This architectural effort is providing a time-phased system acquisition plan. Th Technology Planning Guide is being updated. Computer software planning support is being continued to reduce softwar procurement problems. Advanced systems planning is continuing in the automatic data processing, communications ar aerospace defense areas. Space architecture efforts are being accomplished with emphasis on the ground interface with military satellites. This approach to ground control architecture is taking into consideration the developmen of the Consolidated Space Operations Center, transportable ground terminals, mobile ground terminals, mission groun stations and relay satellites. The objective is to provide specific recommendations and guidelines to improve spac system survivability. Advanced concepts currently being investigated include satellite clustering, atmospheric sur veillance and warning, and attempts to better understand how space systems can provide decisive support to militar forces. System feasibility investigations are being accomplished for a satellite control space system to bette manage data and an in-depth review is being accomplished in the military space flight capability area.

3. FY 1981 Planned Program: The Electronic Systems Division program will emphasize command, control communication and intelligence architecture for the Tactical Air Forces. Specific areas to be stressed are forward air surveillanc and identification concepts, ground target identification and strike capability and electronic warfare concepts. Th Technology Planning Guide will be updated to include the current "technology needs" information. Additional effor will be applied in the electronic warfare/electronic counter-countermeasures area primarily to provide a primary source of expertise to assist individual development programs. Space architecture efforts wi complete the ground contro architecture task. The advanced concepts investigations in the satellite clustering a tmospheric surveillance ar warning areas should be completed. The satellite data management methods and military space flight capability investi gations are planned to continue.

4. FY 1982 Planned Program: The emphasis on tactical and strategic architectural activities and advanced syste engineering efforts will be continued. The Electronic Systems Division will continue the advanced systems plannin tasks in the automatic data processing, communications and aerospace defense areas. The Space Division plans t investigate manned space applications such as on-orbit maintenance/servicing and retrieval of satellites as well as a investigation of functions that can best be performed in space.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

Program Element: #65808F Title: Advanced Systems Engineering/Planning
DOD Mission Area: Technical Integration/Studies & Analyses #440 Budget Activity: Defense-wide Mission Support #6

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5,300	6,000	4,200	4,500	Continuing	Not Applicable

FY 1981 funding decreased by $100,000 as a result of an Air Force accounting error during the FY 1980 Budget Estimate Submission Exercise.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65898F
DOD Mission Area: General Management Support, #471

Title Management Headquarters - Research and Development
Budget Activity: Defensewide Mission Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	19,030	17,751	21,312	23,199	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the resources to support the Commander, his staff, the technical mission and support functions for Headquarters Air Force Systems Command (HQ AFSC). Categories of cost include pay and the related costs of civilian personnel, travel, transportation, rents, contractual services, supplies, and equipment.

BASIS FOR FY 1981 RDT&E REQUEST: This is a continuing program which provides the resources to support the commander, his staff, the technical mission, and support functions for HQ AFSC.

OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #65898F
DOD Mission Area: General Management Support, #471

Title: Management Headquarters - Research and Development
Budget Activity: Defensewide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The mission of Air Force Systems Command (AFSC) is to advance aerospace science and technology, apply it to aerospace systems development and improvement, and acquire qualitatively superior aerospace systems and equipment needed to accomplish the Air Force mission. Specifically, the commander and his staff: manage the aerospace systems equipment acquisition programs; act as the primary Air Force agent for technical advocacy of development programs to provide the technology and capability to fulfill known or anticipated Air Force operational requirements; maintain in-house laboratories of superior quality to conduct research in selected scientific areas to provide Air Force competence; plan, develop, and manage - through a central authority - aerospace vehicle launch facilities, range communication-electronics and instrumentation, worldwide satellite control, and recovery facilities for assigned Department of Defense (DoD), National Aeronautics and Space Administration (NASA), and other United States Government agency programs; plan, conduct, and manage systems; systems support; research, exploratory development engineering, and advanced development programs in bioastronautics, research programs in support of the Air Force personnel systems, clinical and aerospace medicine requirements, and specialized aerospace medical education programs; conduct and manage foreign technology program to provide a current foreign aerospace technical threat assessment for use in systems planning and acquisition; perform development testing and evaluation to establish the technical adequacy, safety, environmental consequences, and qualitative characteristics of systems and equipment; conduct such research and development activities as necessary to insure that environmental and ecological considerations are reflected in the course of accomplishing the overall mission; and provide liaison between the Air Force and the scientific community in areas of potential Air Force interest. This program provides the resources for the commander to meet this mission.

RELATED ACTIVITIES: In addition to the above responsibilities, the AFSC provides technical assistance to other major commands in conducting their operational test and evaluation activities; supports the other Services in developing and procuring aerospace items according to current directives; provides-by agreement or on request - foreign aerospace technological data and support to Headquarters United States Air Force (HQ USAF), Major Commands, NASA, and agencies of the national intelligence community; manages the Electromagnetic Compatibility Analysis Center in support of DoD and other Government agencies; established appropriate precedence rating alignment of all units within the precedence categories; informs HQ USAF of areas of conflict owing to changing forces, mission, or emphasis, maintains close liaison with the Federal Aviation Administration (FAA) to insure the compatibility of Air Force aircraft with other elements of the National Airspace Systems (NAS) and the ability to operate in airspace under the administration of the International Civil Aviation Organization (ICAO). Related activities include all Air Force program elements.

WORK PERFORMED BY: Headquarters AFSC, Andrews AFB, MD, performs staff management for work which is performed by Aeronautical Systems Division, Electronic Systems Division, Aerospace Medical Division, Space Division, and the Armament System Program Offices at Armament Division within Program Element 65806F, Acquisition and Command Support, and laboratories, test centers and national ranges funded by other program elements. Major contracts include: Honeywell Corp., McLean, VA for automatic data processing equipment rental; Saxon Corp., Fairfax, VA; 3M, Springfield, VA; IBM, Rockville, MD; and Xerox Corp., Arlington, VA, for lease of reproduction equipment.

Program Element: #65898F
DOD Mission Area: General Management Support, #471

Title: Management Headquarters - Research and Development
Budget Activity: Defensewide Mission Support, #6

PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: This is a continuing program. Funds were used to support the Commander, his staff, the technical mission and support function for Headquarters Air Force Systems Command (HQ AFSC).

2. FY 1980 Program: This is a continuing program supporting the HQ AFSC Commander and staff.

3. FY 1981 Planned Program: The planned program will provide resources to continue operation of HQ AFSC.

4. FY 1982 Planned Program: The FY 1982 program continues the FY 1981 effort.

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable.

7. Resources: Not applicable.

8. Comparision with FY 1980 Budget Data:

FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Addition To Completion	Total Estimated Costs
17,935	16,800	19,751	20,551	Continuing	N/A

This PE was decreased for FY 1980 by Congressional action, necessitating a reprogramming request to allow continuation at the FY 1979 level. The FY 1981 planned program is in line with the FY 1979 budget. It reflects civilian pay raises and increased costs to support the Management Headquarters Research and Development effort. There has not been any increase in the scope of the program.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #35110F
DoD Mission Area: Space Launch and Orbit Support #410

Title: Satellite Control Facility
Budget Activity: Defensewide Mission Support #6

RESOURCES (PROJECT LISTING): ($ IN THOUSANDS)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		8,199	14,700	14,100	20,400	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program has as its main objective the maintenance of a highly reliable national satellite tracking, telemetry and commanding range tasked to support the RDT&E and operation of DoD satellite systems. The range consists of a global network which includes instrumentation systems, antennas, communications and data processing equipment required to support a growing inventory of increasingly complex space vehicles.

BASIS FOR FY 1981 RDT&E REQUEST: This program will provide a scientific and engineering capability to develop and maintain a network configuration capable of providing satellite system support to a variety of users and to insure system compatibility. The FY 1981 RDT&E funding represents the minimum amount required to carry on continuing project efforts and provides a program for essential data system development and upgrade.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimate Costs
Aircraft Procurement (3010)	1,140	1,018	1,117	1,240	Continuing	Not Applicable*
Military Construction (3300)		3,150			Continuing	Not Applicable
Other Procurement (3080)	3,506	9,629	19,223	34,607	Continuing	Not Applicable

*Spares only

Program Element: #35110F
DoD Mission Area: Space Launch and Orbit Support #410

Title: Satellite Control Facility
Budget Activity: Defensewide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: The Satellite Control Facility (SCF) is a world-wide network consisting of a Headquarters at Sunnyvale, CA, seven geographically dispersed tracking stations, a communications satellite calibration site at Camp Parks, CA, a control center (the Satellite Test Center (STC) at Sunnyvale), and a satellite recovery group at Hickam AFB, HI. The mission of the SCF is to provide tracking, real-time telemetry, commanding, (TT&C), and recovery of Department of Defense (DoD) space vehicles operating in a multi-satellite environment. The SCF supports satellites operating with various orbital parameters to accomplish diversified test and operational objectives. A complex instrumentation system consisting of antennas, communications, and data processing equipment provides the means of meeting the ground support requirements of the many space vehicles. This appropriation provides for the development and installation of operating equipment. The SCF provides on-orbit support to satellite programs of the Air Force, the Navy, the DoD, the National Aeronautics and Space Administration (NASA), and the North Atlantic Treaty Organization (NATO). Support commences prior to launch and in most cases, continues throughout the life of the satellite to include recovery, if required. Efforts accomplished under this program either correct system deficiencies or allow for increased program support.

RELATED ACTIVITIES: Both Defense Communications System (DCS) and non-DCS telecommunications program activities relating to the SCF are contained in Program Element 35151F (SCF Telecommunications). The Real Property Maintenance activities relating to the SCF are contained in Program Element 35894F (Real Property Maintenance, AFSC). The majority of DoD satellite programs rely to varying degrees on the SCF for TT&C support. The Consolidated Space Operations Center (CSOC) PE 35130F will provide increased capability by sharing the control functions of the STC.

WORK PERFORMED BY: Air Force management of this National Range is under the Space Division, Los Angeles, CA. Principal contractors are: Lockheed Missile and Space Company, Sunnyvale, CA, which provides study and development analysis for the STC; Ford Aerospace, Palo Alto, CA, which provides study and development analysis for the Remote Tracking Stations; and Systems Development Corporation, Santa Monica, CA, which provides computer system integration. Competitors in a parallel development effort for the Data System Modernization include Hughes Aircraft Corporation, Boeing Aerospace Corporation and IBM Corporation.

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: The SCF was initially configured during 1956-1957 to provide on-orbit support for the Discoverer Program. Since then, many new space programs have been added, with older programs being upgraded or deleted. This has resulted in a fluctuating satellite inventory. In FY 1979, the network supported an average of 46 satellites on-orbit simultaneously. This average is increasing annually as is the overall SCF workload which is expected to increase 15% by 1981. This trend toward longer on-orbit lifetimes and more complex spacecraft with multiple payloads has resulted in a growing demand for satellite control services.

Program Element: 35110F
DoD Mission Area: Space Launch and Orbit Support #410

Title: Satellite Control Facility
Budget Activity: Defensewide Mission Support #6

Since its inception, the Satellite Control Facility (SCF) has undergone significant evolution in order to provide the required satellite support services. In 1966 a standard integrated tracking, telemetry and commanding (TT&C) system was installed at all remote tracking stations (RTS) to provide a common system. Wideband communications capabilities have been achieved through installation of an interim system in 1973. The Defense Communication System/ SCF Interface System (DSIS) is now providing wideband communication. The first RTS/DSIS link was operational in 1979 and DSIS will service all RTSs by 1980. More capacity has been added to the network with the addition of a second antenna at Guam and Thule, Greenland in 1979 and with the SCF use of the British Telemetry and Commanding Station at Oakhanger, England starting in 1978. Additional satellite communications are provided between the Satellite Test Center and the RTSs using the Satellite Data System. The standard TT&C system has been augmented by installation of a Time Division Multiplex (TDM) system at the Indian Ocean Station for initial support of the Space Transportation System. For operational use of the STS, all RTSs will be equipped with TDM systems.

Parallel development contracts were let in June 1979 for the first phase of the SCF Data System Modernization. These competitive contracts will produce design concepts for a centralized data system that will replace the aging computer systems throughout the SCF. The modernized system will greatly increase the network capacity as well as significantly reduce operating cost by decreasing the manpower intensity of numerous satellite support functions.

2. FY 1980 PROGRAM: The Satellite Control Facility will continue the planning, development, acquisition, operation and maintenance of systems necessary to support the needs of current and planned space programs. Satellite recovery equipment and mission control center modifications dictated by satellite program requirements will continue. Facilities and equipment for SCF support of the Space Transportation, including both orbiter and inertial upper stage, will be developed and provided. Development effort for the Data System Modernization will continue.

3. FY 1981 PROGRAM: Ongoing efforts to meet evolving satellite program requirements will continue. The competition development phase of the Data System Modernization will be completed and detailed design/acquisition contractor will be selected.

4. FY 1982 PROGRAM: Ongoing efforts, including the design/software development work for the Data Systems Modernization, will continue.

5. PROGRAM TO COMPLETION: This is a continuing program.

6. MILESTONES: Not Applicable

7. RESOURCES: Not Applicable

Program Element: #35110F
DoD Mission Area: Space Launch and Orbit Support #410

Title: Satellite Control Facility
Budget Activity: Defensewide Mission Support #6

8. COMPARISON WITH FY 1980 BUDGET DATA:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENT		5,899	6,200	14,700	13,200	Continuing	Not Applicable

The increase of $2M from the FY80 Descriptive Summary projected FY79 budget included an OSD directed analysis of future Shuttle and satellite control capabilities. This work contributed to the decision to proceed with concept development of the Consolidated Space Operations Center (CSOC) Also included were additional funds to provide mission control center reconfiguration to meet near term requirements for Shuttle orbital flight tests and communications satellite support.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #35119F — Title: Space Boosters
DOD Mission Area: Space Launch and Orbital Support #410 — Budget Activity: Defense-wide Mission Support #6

RESOURCES (PROJECT LISTING): ($ IN THOUSANDS)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	32,600	29,700*	29,500	14,000	8,300	1,251,100

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides consolidated launch vehicle support of requirements common to Air Force satellite programs. The main program objective is to maintain and/or improve the reliability of DOD Atlas E/F and Titan III space launch vehicles as a part of the national launch vehicle family.

BASIS FOR FY 1981 RDT&E REQUEST: Continues engineering design and development program to integrate the Inertial Upper Stage (IUS) and its technology into the Titan III Space Launch Vehicle family, thus taking advantage of the investment in IUS reliability to correct current Titan III reliability deficiencies. The Titan III(34)D/IUS will improve the current Titan IIID and will replace the Titan IIIC. An FY 1981 Initial Launch Capability at Cape Canaveral Air Force Station, FL, is now scheduled for the Titan III(34)D/IUS. The Space Boosters program will also provide a continuing level of effort to assess Titan III and Atlas-E/F launch vehicle flight performance and correct deficiencies noted therein. This program will provide two Atlas-E/F launches for Air Force RDT&E satellites.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	TOTAL Estimated Costs
Procurement (3020)	11,500	44,000**	66,813			186,213
Quantities						
Payload Fairings	(2)					
Vehicles		(2)**				
Military Construction (3300)	1,983					1,983

*Includes planned FY 1980 reprogramming request to provide additional funds needed to support integration of the IUS into the Titan III family.

**Effort to be proposed in FY 1980 reprogramming to maintain critical Titan III(34)D production capability until Space Shuttle Initial Operational Capability by establishing an advance buy line in FY 1980 and fully funding in FY 1981 the remaining effort which would provide two backup Titan III(34)D boosters. Only if required by Shuttle schedules would these vehicles be completed. Phaseout of the Titan IIIC/D production lines will be initiated in FY 1981.

Program Element: #35119F
Title: Space Boosters
DOD Mission Area: Space Launch and Orbital Support #410
Budget Activity: Defense-wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: The DOD family of space boosters (Atlas, Thor, Titan III) was developed to provide a versatile capability (up to 29,200 pounds in low earth orbit-Titan IIIC) for meeting projected national launch requirements. While the family still includes two surplus ballistic missiles (the Atlas E/F and Thor SM-75 vehicles) the primary boosters are considerably improved standardized versions of the original missiles. This Program Element provided for development of the Titan IIIC Space Launch Vehicle and provides continuing support for the Atlas E/F and Titan III launch vehicles.

Atlas E/F - refurbished Atlas Intercontinental Ballistic Missile (ICBM), radio guided, liquid rocket engine, stage and one-half booster.

Titan IIIB - modified Titan II first and second stages with liquid rocket engines (core vehicle) flown with an Agena upper stage and either radio or inertial guidance.

Titan IIIC - core vehicle with a storable propellant upper stage (Transtage) plus two 5 segment 120" diameter strap-on solid rocket motors.

Titan IIID - core vehicle with two 5 segment 120" diameter strap-on solid rocket motors and radio guidance.

Titan III(34)D/IUS - Titan IIID modified for use with the Inertial Upper Stage (IUS) core vehicle with two 5-1/2 segment 120" strap-on solid rocket motors and which is guided by the IUS inertial guidance system; flown only at Cape Canaveral Air Force Station, Florida.

Titan III(34)D - radio guided version of the Titan III(34)D flown without the IUS at Vandenberg Air Force Base, CA.

The program includes post flight analysis of Research and Development (R&D) components; study, modification, redesign and test of components as a result of deficiencies identified during vehicle systems test and flight; evaluation and improvement (where warranted) of mission reliability; component reliability improvement to prevent launch vehicle failures; and analysis support and development planning for new missions. To take advantage of the investment in the IUS reliability, a program was initiated in FY 1977 to correct current Titan III reliability deficiencies through the integration of the IUS and its technology into the Titan III Space Launch Vehicle family. The Titan III(34)D/IUS will improve the current Titan IIID, replace the Titan IIIC Space Launch Vehicles and reduce the number of nonstandard Titan III components. In addition to increasing the Titan III launch reliability, the Titan III(34)D/IUS will reduce unit production costs, increase Space Shuttle transition flexibility and reduce the Space Shuttle backup launch capability cost.

Program Element: #35119F
DOD Mission Area: Space Launch and Orbital Support #410

Title: Space Boosters
Budget Activity: Defense-wide Mission Support #6

RELATED ACTIVITIES: Major DOD and National Aeronautics and Space Administration (NASA) space systems which employ the Atlas and Titan III boosters include: classified space programs; Defense Satellite Communications System, Program Element (PE) 33110F; Satellite Data System, PE 35158F; Defense Support Program, PE 12431F; NASA/National Oceanic and Atmospheric Administration (NOAA); and NAVSTAR Global Positioning System, PE 64778F. This program funds modifications to the Inertial Upper Stage (IUS), which is being developed by PE 63411F, to allow it to be flown as an upper stage on the Titan III.

WORK PERFORMED BY: Responsible Air Force agency is the Air Force Systems Command Space Division, Los Angeles, CA. Systems Engineering is provided by Aerospace Corporation, El Segundo, CA. Titan III contractors include: Martin Marietta Corporation, Denver, CO (integration, core vehicle, Transtage); Aerojet Liquid Rocket Company, Sacramento, CA (liquid propulsion system); United Technology Corporation-Chemical Systems Division, Sunnyvale, CA (solid rocket motors); Delco Electronics Division, Goleta, CA (inertial guidance); and Western Electric Company, Winston Salem, NC (radio guidance). Atlas contractors include: General Dynamics - Convair, San Diego, CA (integration and airframe); Rocketdyne, Canoga Park, CA (liquid propulsion systems); General Electric, Syracuse, NY (guidance). The upper stage contractors include: Boeing Space Division, Seattle, WA (Inertial Upper Stage); Fairchild Space and Electronic Division, Germantown, MD (Stage Vehicle System); McDonnell-Douglas Aircraft Company, Huntington Beach, CA (Improved Stage Vehicle System); and Lockheed Missile and Space Company, Sunnyvale, CA (Agena). There are eight additional contractors supplying Titan III and Atlas components.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Titan III program development go-ahead was received in December 1962. First launch of the Titan IIIA occurred on 1 September 1964. In 1965 the first Titan IIIC successfully placed a 21,000 pound simulated payload in orbit. The last development flight was on 23 May 1973. A reliability improvement program on the Titan III, Atlas, and Atlas E/F boosters was initiated in FY 1973. A new guidance system for the Titan IIIC was developed and first launched on 13 December 1973. Engineering analyses and reliability improvements have included corrective action for the April 1975 Atlas E/F failure, development of the Atlas replacement programmer, and initial development of a reliability improvement to the Atlas General Electric Radio Tracker System ground guidance hardware. In June 1977 a Congressional reprogramming authorized a program to correct reliability deficiencies in the current Titan III Space Launch Vehicle family through the use of the Inertial Upper Stage (IUS) and its technology. Through FY 1979, four NAVSTAR Global Positioning System satellites were successfully launched on Atlas-F vehicles. Also in FY 1979 the Space Test Program Gamma Ray Spectrometer satellite was successfully launched on an Atlas-F. The FY 1979 reliability maintenance efforts included efforts to correct reliability deficiencies in the Titan III Stage II Inadvertent Separation Destruct System and to relocate the Atlas-E/F guidance antenna.

Program Element: #35119F
DOD Mission Area: Space Launch and Orbital Support #410

Title: Space Boosters
Budget Activity: Defense-wide Mission Support #6

2. FY 1980 Program: The Titan III/Inertial Upper Stage (IUS) integration program and the basic Titan III and Atlas-E/F reliability maintenance program will continue. The effect of small launch vehicle procurements and production phase down/phase out will increase problems with retaining vendors of critical components of both the Titan III and Atlas E/F launch vehicles. This will require increased efforts to qualify new sources of existing materials/components or to redesign vehicle subsystems to incorporate replacement materials/components. Two Atlas-E/F launches for NAVSTAR Global Positioning System RDT&E missions are planned.

3. FY 1981 Planned Program: The Titan III/IUS integration effort will be completed to support an Initial Launch Capability at Cape Canaveral Air Force Station, FL, in FY 1981. First launch of the Titan III(34)D/IUS is scheduled for FY 1981 with two Defense Satellite Communications System satellites. The basic Titan III and Atlas-E/F reliability maintenance, flight assessment, vendor qualification, and component/subsystem replacement efforts will continue. Two Atlas-E/F launches for NAVSTAR Global Positioning System RDT&E missions are planned.

4. FY 1982 Planned Program: Initial Launch Capability for the Titan III(34)D configuration at Vandenberg Air Force Base, CA, is scheduled for December 1981. The basic Titan III and Atlas-E/F reliability maintenance, flight assessment, vendor qualification, and component/subsystem replacement efforts will continue. Two Atlas-E/F launches for NAVSTAR Global Positioning System RDT&E missions are planned.

5. Program to Completion: This program is planned to continue until the Air Force space payload transition to the Space Shuttle is completed in FY 1983.

6. Milestones:

		Date
Start Titan III(34)D/Inertial Upper Stage (IUS) Integration		Jun 1977
Space Shuttle backup launch vehicle procurement		Dec 1977
Titan III(34)D/IUS Initial Launch Capability at Cape Canaveral AFS	*(Jul 80)	Jul 1981
Initial Space Shuttle backup launch capability		Sep 1981
Titan III(34)D Initial Launch Capability at Vandenberg AFB		Dec 1981
Initiate Titan III production phase down	*(Oct 79)	Oct 1980

*Dates presented in FY80 Descriptive Summaries

Program Element: #35119F
DOD Mission Area: Space Launch and Orbital Support #410

Title: Space Boosters
Budget Activity: Defense-wide Mission Support #6

EXPLANATION OF MILESTONES CHANGES: Delays in completing Inertial Upper Stage (IUS) development have resulted in a delay in the Titan III(34)D/IUS Initial Launch Capability (ILC) at Cape Canaveral AFS until June 1981. No impact to payload programs will result from this delay. Space Shuttle development delays resulted in additional actions being taken in FY 1980 to maintain critical Titan III production capability. These actions have enabled the initiation of production phasedown to be delayed until October 1980.

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Acutal	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	25,000	32,600	23,700	12,300	19,800	1,225,400

Additional funding in FY 1980 and FY 1981 above that shown in the FY 1980 Descriptive Summary is required to complete the Titan III(34)D/IUS integration effort due to delays in completing the IUS development, which delays the Titan III(34)D/IUS ILC until FY 1981 rather than FY 1980, and due to cost increases in the IUS development program. These funding additions coupled with reduced booster support program requirements in FY 1982 and FY 1983 account for the difference in total estimated costs.

Budget Activity: Defense Wide Mission Support #6
Program Element: 35119F, Space Boosters

Test and Evaluation Data

1. Development Test and Evaluation: In June 1977, the Assistant Secretary of the Air Force for Research, Development and Logistics formally approved the initiation of a program to integrate the Inertial Upper Stage (IUS) into the Titan III family. This approval was based upon successful completion of an Air Force Systems Acquisition Review Council (AFSARC) of the integration program, the concurrence of the Deputy Secretary of Defense, and the prior approval by Congress of an FY77 reprogramming request to initiate the program. Benefits to be derived from the Titan III(34)D/IUS integration were: increased reliability, increased payload capability, reduction in launch vehicle configurations, mission model flexibility, and reduced total program cost. The Air Force Systems Command Space Division is responsible for management of the Titan III(34)D/IUS integration program. Participating contractors are: (1) Martin-Marietta Aerospace, Denver, Colorado; Boeing Aerospace Division, Seattle, Washington; Chemical Systems Division of United Technologies, Sunnyvale, California; Aerojet Liquid Rocket Company, Sacramento, California; and McDonnell-Douglas Astronautics, Huntington Beach, California. The Arnold Engineering Development Center (AEDC), Tullahoma, Tennessee, provides test support to this program.

Testing of Titan III changes required to integrate the IUS into the Titan III Space Launch Vehicle family consists of structural and electronic ground testing. Structural test provisions include testing of all new and modified hardware. Structural test items for this configuration include a modified Stage II equipment truss, a new design Stage II adapter skirt, an additional solid rocket motor half-segment, a new design Titan III(34)D to IUS support truss, and a modified payload fairing. Additional structural testing will also be required on the existing Stage I long core section. Tests of the IUS avionics/Titan III(34)D electronics interface will be required to insure system compatibility. IUS separation and shock testing will be provided to insure IUS compatibility with the Titan III interface. The Failure Modes and Effects Analysis (FMEA) for the Titan III will be updated to reflect all changes resulting from the Titan III(34)D/IUS integrtion.

IUS separation and shock testing was completed in November 1978 and demonstrated that the actual shock spectrum was less than predicted. The structural qualification testing was initiated in September 1979, and is expected to be completed in February 1980. In October 1979, the second and last full-scale static firing of the 5-1/2 segment, 120 inch diameter Solid Rocket Motor was successfully completed, demonstrating the flight-worthiness of the 5-1/2 segment motor and the new nozzle throat material. In April 1979, the Stage I fuel tank tests were successfully completed, thus verifying that the "stretched" Stage I fuel tank used on the Titan IIIB can withstand the Titan III(34)D/IUS flight environment. Successful completion of payload fairing (PLF) separation tests has verified proper separation of the modified payload fairing from the vehicle. Joint Titan III(34)D/IUS electronics interface testing is scheduled to occur in the period March-June 1980.

Development of the IUS under Program Element 63411F continues. However, technical problems during the development have resulted in a delay in the Initial Launch Capability for the Titan III(34)D/IUS from July 1980 to July 1981. Critical Design Review of the IUS was initiated in February 1979 and successfully completed in November 1979.

Qualification testing of the IUS avionics began in August 1979 and is currently estimated to be completed during 1980. The primary problem affecting the avionics system is the availability of high reliability, space qualified electronic piece parts. In the IUS software area, the prototype flight software has been designed, coded, and is now being tested with the avionics system with good results. The mission data load software has been designed and coded, and the support software is essentially complete. The primary problem now in the software development is in software timing. Development of the propulsion system is the pacing item in completing development of the IUS. Burst test of the solid rocket motor cases began in October 1978, and five successful case burst tests have been completed. The first full scale development motor firing was accomplished in March 1979 at AEDC with a total of four firings now completed. Eight additional firings at AEDC remain, which should be complete by September 1980. Thirteen qualification motor firings will also be performed. Primary problems in the propulsion development have not been in the technical area but rather in the manufacturing process control and quality control areas and have affected motor case fabrication and propellant processing. Actions are underway to correct these problems, including qualification of an alternate motor case manufacturer. For the total IUS vehicle, all component qualification is planned to complete in the last quarter of 1980 and vehicle qualification will complete in mid-1981.

2. Operational Test and Evaluation: Since the Titan III/Inertial Upper Stage (IUS) is not scheduled for operationa employment, no operational test and evaluation program is planned. Currently only twelve Titan III(34)D vehicles are planned for delivery (first delivery was in December 1979). Seven of these vehicles will be used for prime launches (four with IUS), and five will be Space Shuttle backups. Dependent on Space Shuttle development schedules, two additional backups may be delivered. Post-flight data from launches of these vehicles will be analyzed to determine if any modifications to the vehicle configuration are required to correct problems which may occur in flight.

3. System Characteristics:

	Objectives	Demonstrated (DT&E)
Low Earth Orbit Missions (No IUS)		
Payload Capability (lbs.)		
100 n mi (east) 10 ft. Payload Fairing (PLF) Cape Canaveral AFS, FL	32,900	
100 n mi (polar) 10 ft. PLF Vandenberg AFB, CA	27,600	
Synchronous equatorial orbit missions		
Payload Capability (lbs.)		
10 ft. PLF Cape Canaveral AFS, FL	4,000	
Reliability	97%	

NOTE: Due to the development of the Titan III(34)D from the existing Titan III family and the small number of systems, availability and maintainability objectives have not been specified for the Titan III(34)D.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #35130F
Title: Consolidated Space Operations Center
DOD Mission Area: Space Launch and Orbit Control #410
Budget Activity: Defensewide Mission Support #6

RESOURCES (PROJECT LISTING): ($ IN THOUSANDS)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
TOTAL FOR PROGRAM ELEMENTS				13,700	6,400	45,700	65,800

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Consolidated Space Operations Center (CSOC) includes two elements: the Satellite Operations Center (SOC) and the Shuttle Operations and Planning Center (SOPC). The need for the SOC is based on the vulnerability of the Satellite Test Center (STC) in Sunnyvale, CA, a single critical node in the Satellite Control Facility network which provides tracking, telemetry, and commanding functions to support national security missions. The STC is vulnerable to both environmental (earthquake) and man made threats and has limited growth potential. The need for the SOPC stems from the planned increase in use of the Space Shuttle for DOD missions. The Air Force program for the mid 1980s includes a number of important DOD Shuttle missions, most requiring close coordination with the satellite control network. The DOD Shuttle control capability at Johnson Space Center (JSC) does not meet all DOD requirements for planning and conducting DOD missions in the post 1985 timeframe. JSC does not provide an adequate level of security protection; it is located in a region susceptible to environmental and man made threats; it is limited in capacity; and it does not provide direct and continuing control over military operations for full exploitation of the Shuttle.

BASIS FOR FY 1981 RDT&E REQUIRMENT: The FY 1981 effort will include system requirements definition of specific functional areas, implementation/integration contract activity to perform system engineering tasks, system upgrade analyses to adopt existing National Aeronautics and Space Administration (NASA) equipment to meet CSOC requirements and refinement of facility design criteria.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Other Procurement (3080)				89,836	138,467	228,303
Military Construction (3300)				109,000		109,000

Program Element: #35130F
DOD Mission Area: Space Launch and Orbit Control #410

Title: Consolidated Space Operations Center
Budget Activity: Defensewide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: The Consolidated Space Operations Center (CSOC) concept has evolved from examination of present satellite control capabilities at the Satellite Control Facility's Satellite Test Center (STC) and investigation of future military Shuttle control requirements. Studies clearly indicate a need to augment and backup the STC as well as a future need for a dedicated Department of Defense Shuttle control capability. Combining these capabilities into a CSOC will result in substantial cost avoidance through shared use of common facilities such as security, logistic support and communication antennas. The CSOC will eliminate single critical nodes for both satellite control at the STC and Shuttle control at Johnson Space Center and provide the management and control needed for manned military space operations in the post 1985 timeframe. The Satellite Operations Center (SOC) element of the CSOC will contribute to the ongoing mission of the Satellite Control Facility; the Shuttle Operations and Planning Center (SOPC) will develop as required over time to take advantage of Shuttle operations experience and expand Shuttle utility.

RELATED ACTIVITIES: The SOC element of the CSOC will become an integral part of the Satellite Control Facility (SCF) network funded under Program Element (PE) 35110F and will utilize the modernized data systems now being deveoped for the SCF. The SOPC element will expand the overall DOD Shuttle operations capabilities now being established as the Controlled Mode at JSC under PE 63411F and 64411F, allowing JSC and CSOC to provide mutual backup.

WORK PERFORMED BY: Air Force management of the CSOC development and acquisition effort is under the Space Division, Los Angeles AFS, CA. No major CSOC contracts have yet been awarded.

1. FY 1979 AND PRIOR ACCOMPLISHMENTS: The FY 1979 CSOC efforts dealt principally with requirements validation and concept development. A joint DOD/NASA study of various Satellite Operations Center/Shuttle Operations Planning Center configurations was done for Office of Management and Budget. Mission Element Need Statement for SOC and SOPC were validated by the Secretary of Defense in September 1979. CSOC site surveys were conducted by Air Force Systems Command and HQ USAF to identify preferred sites. The Peterson AFB/Colorado Spings area was tentatively selected pending completion of the environmental impact analysis process.

2. FY 1980 PROGRAM: CSOC work during FY 1980 will include development of detailed requirements, facilities design criteria, initiation of facilities design, and environmental impact assessment. Design tradeoff investigations will assess use of NASA like systems for the SOPC versus integration of the Shuttle mission into the SOC technical systems.

3. FY 1981 PROGRAM: The work started in FY 1980 will continue during FY 1981. Requirements development/definition for each of the functional areas will be concluded. Implementation planning and integration work will address such items as acquisition planning, engineering trade studies, life cycle cost analyses, schedule planning, and interface control documentation. Also planned are studies to determine how best to adopt existing NASA and Air Force systems to CSOC applications. Facility design work will be completed.

Program Element: #35130F
DOD Mission Area: Space Launch and Orbit Control #410

Title: Consolidated Space Operations Center
Budget Activity: Defensewide Mission Support #6

4. FY 1982 PROGRAM: The facility construction will begin in FY 1982. During FY 1982 the acquisition of long lead elements of the technical equipment will begin.

5. PROGRAM TO COMPLETION: FY 1983 and FY 1984 will continue hardware acquisition and software development for technical systems and communications. Initial Operating Capability is planned for mid-FY 1985.

6. Milestones:

A.	Mission Element Need Statements Validated	September 1979
B.	Military Construction Program Submission	January 1981
C.	Military Construction Program Approval	October 1981
D.	Start Construction	April 1982
E.	Initial Operating Capability (IOC)	June 1985
	- Satellite Operations Center (SOC)	
	- Shuttle Operations and Planning Center (SOPC)	

7. RESOURCES: Not Applicable

8. COMPARISON WITH FY80 BUDGET DATA: Not Applicable.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #35160F Title Defense Meteorological Satellite Program
DOD Mission Area: Global Military Environmental Support #420 Budget Activity Defense Wide Mission Support #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	12,500	15,900	19,000	62,300	Continuing	Not Applicable

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Defense Meteorological Satellite Program (DMSP) is the DOD advanced weather satellite system which provides visual and infrared cloud cover data and other meteorological information over the entire surface of the earth in support of strategic and tactical missions. Two satellites are maintained in polar orbit at all times; one providing data in the early morning and early evening, the other at noon and midnight.

BASIS FOR FY 1981 RDT&E REQUEST: The program provides for the development of a Shuttle compatible satellite design with improved survivability. It also provides for development of the Block 5D flight simulation facilities and command and control system. Development of advanced sensors and the satellite data handling system will be continued.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Missile Procurement	29,100	21,600	42,719	21,301	Continuing	Not Applicable
Quantity (Satellite)	Ø	Ø	1	Ø		
Other Procurement	5,754	3,459	4,056	9,448	Continuing	Not Applicable

Program Element: #35160F Title Defense Meteorological Satellite Program
DOD Mission Area: Global Military Environmental Support #420 Budget Activity Defense Wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: The Defense Meteorological Satellite Program (DMSP) is a weather satellite system started by the Air Force in to provide daily cloud cover data from the to support special strategic missions. The first successful launch was in and the system has been continuously operational since that time. In 1965, weather support to tactical operations was initiated when a mobile van which could receive direct, real-time weather data was deployed to South Vietnam. A requirement exists for two DMSP satellites in orbit at all times, one providing data in the early morning and early evening and the other providing data near noon and midnight (local time) for all points on the globe. The orbits are circular, sun-synchronous, near-polar, at 450 nautical miles altitude, with a period of 101.6 minutes. Launch is from Vandenberg AFB, CA, using a Thor launch vehicle. Stored data are recorded on the satellites and later sent to one of the data receiving stations at either Fairchild AFB, WA, Loring AFB, ME, or Kaena Point, HI, and simultaneously relayed from that station via commercial satellite to the Air Force Global Weather Central (AFGWC) at Offutt AFB, NE, for use in strategic and tactical weather forecasting. Real-time data are also transmitted to tactical receiving terminals located worldwide. A fixed tactical terminal at Hickam AFB, HI, receives real-time weather pictures of the eastern and central Pacific for monitoring typhoons and planning classified operations. Tactical mobile receiving terminals are currently located in Korea, Guam, Alaska, Panama, Spain, the Philippines, and Germany. mobile contingency terminal at McClellan AFB, CA, is available for instant deployment to any crisis area. Direct links have been installed from AFGWC to Headquarters Tactical Air Command (TAC) and the Pentagon to provide DMSP data on a timely basis to the commander, TAC and the Joint Chiefs of Staff. The current generation Block 5D satellites provide satellite imagery data of heretofore unequalled quality. Vertical temperature and moisture profiles are also collected along with data on the state of the ionosphere and data for

RELATED ACTIVITIES: The DMSP is a joint service program in accordance with the Memorandum of Agreement on the Joint Service Management and Operations of the DMSP, dated 15 December 1976. The program provides support to all military services. Based on the successful operation of an experimental receiving terminal aboard the U.S.S. Constellation, the Navy is equipping all large carriers to receive DMSP data and is operating two shore based terminals to DMSP data. The Air Force began procurement of new low cost tactical terminals in FY 1978, and the other services are contemplating procurements in following years. Navy personnel have been integrated into the Program Office to insure compatibility between the Air Force satellites and the receiving and data processing equipment of the Navy. Personnel from the Army's Atmospheric Sciences Lab are coordinating Army matters with the DMSP Program Office. Close coordination is also maintained with the civilian weather satellite program, operated by the Department of Commerce (DOC). The two systems are complementary, with DMSP satisfying many unique DOD requirements which the civilian satellites cannot support. Interchange of technology has been continuous, with special emphasis on avoiding duplication of effort. Pursuant to a study directed by the Office of Management and Budget, the DOC decided in January 1974, to adopt the DMSP spacecraft, the Block 5D, as a basic spacecraft bus for the civil system. Launch of DMSP satellites is performed by the Strategic Air Command in the Space Support Program, PE 35170F.

Program Element: #35160F Title Defense Meteorological Satellite Program
DOD Mission Area: Global Military Environmental Support #420 Budget Activity Defense Wide Mission Support #6

WORK PERFORMED BY: Development and procurement is managed by the Space Division, Los Angeles, CA. The Air Force Geophysics Laboratory, Bedford, MA, the Wright Aeronautical Development Laboratories, Wright-Patterson AFB, OH, Air Force Weapons Laboratory, Kirtland AFB, NM, the Aerospace Corporation, El Segundo, CA, and the Navy's Environmental Prediction Research Facility, Monterey, CA, all contribute to the DMSP satellite meteorology development program. Contractors include: RCA, Princeton, NJ - spacecraft; Westinghouse Electric Corporation, Baltimore, MD - sensor and ground display equipment; Barnes Engineering Company, Stamford, CT, and Aerojet Electro Systems, Azusa, CA - special sensors; Harris Corp., Melbourne, FL - ground terminals; McDonnell-Douglas, Huntington Beach, CA - launch vehicle.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: In addition to continuous support of the special strategic missions, DMSP provided emergency support during the Pueblo crisis (1968), all of the Apollo and Skylab recoveries (1969-1974), and the Mayaguez ship recovery operation (1975). Use of the real-time tactical data in Southeast Asia was so successful that all routine area weather reconnaissance flights were cancelled in October 1965, enabling a large reduction in RF-4 aircraft losses and operating costs. Currently, DMSP provides the U.S. Armed Forces with visual and infrared weather data of unmatched quality, timeliness, usability, and flexibility. Since 1966, the program has achieved 22 successful launches in 23 attempts, using refurbished surplus Thor boosters. All receiving stations are fully operational. In 1972, the Air Force began the development of a more reliable and producible system, designated the Block 5D integrated spacecraft. This effort continued during FY 1973-1977 and the first Block 5D satellite was launched on 11 September 1976. Development of a microwave temperature sounder was completed in 1978. This sensor was designed to measure the vertical temperature profile of the atmosphere in the presence of clouds. The first microwave temperature sounder was flown on the fourth Block 5D satellite which was launched in June 1979. A sensor to measure upper atmospheric density was also flown on the fourth Block 5D. A joint Air Force/Navy effort was initiated in 1978 to develop a microwave imager for collection of precipitation, soil moisture and ocean/ atmospheric data. Efforts to extend the on-orbit life of DMSP satellites from two to three years were completed in 1978. The lifetime extension program resulted in a change in the number of satellites to be procured (starting in 1977), from three every two years to less than one each year. Conceptual design activities associated with optimizing the DMSP satellite for launch on the Space Shuttle were completed in 1979.

2. FY 1980 PROGRAM: Development of a microwave imager will be continued during FY 1980, along with the development of the improved ionospheric sensor which was initiated in FY 1979. The ground system upgrade, initiated in 1978, will also be continued. Systems engineering and analysis efforts will be continued. One satellite is scheduled to be launched in FY 1980.

Program Element: #35160F Title Defense Meteorological Satellite Program
DOL Mission Area: Global Military Environmental Support #420 Budget Activity Defense Wide Mission Support #6

3. FY 1981 PROGRAM: Satellite development necessary for Shuttle transition in 1986 will continue. This effort was initiated in FY 79. Development of a Block 5D flight simulation facility will continue and the Block 5D-2 command and control development will be completed. Development of the microwave imager and the improved ionospheric sensor will continue and one satellite is scheduled for launch in 1981.

4. FY 1982 PROGRAM: Demonstration and validation of the design of the Shuttle compatible satellite will begin during this year. Development efforts for a microwave imager and ionospheric sensor will be continued. System engineering and systems analysis efforts will be pursued and one satellite is currently scheduled for launch.

5. PROGRAM TO COMPLETION: RDT&E funding will allow evolutionary development of spacecraft and sensors as necessary to support new requirements of the special strategic missions, the Joint-Service mission, and the Joint Chiefs of Staff. This is a continuing program.

6. MILESTONES:

		Date
A.	Program Initiation	
B.	Contract Award for Block 5D Satellite	Feb 72
C.	Deliver First Block 5D with Sensor Complement	3Q FY 76
D.	First Launch of Block 5D Satellite	11 Sep 76
E.	Second Launch of Block 5D Satellite	4 Jun 77
F.	Third Launch of Block 5D Satellite	30 Apr 78
G.	Fourth Launch of Block 5D Satellite	6 Jun 79
H.	Contract for Shuttle Optimized Design Studies	Jun 79
I.	Contract for Validation & Demonstration* (Sep 80)	Dec 81
J.	Transition of Space Shuttle* (Dec 1984)	Mar 86

*FY 79 Descriptive Summary Date

7. RESOURCES: N/A

8. COMPARISON WITH FY 1980 BUDGET DATA:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7,700	12,500	15,900	46,300	Continuing	Not Applicable

Program Element: #35160F
Title Defense Meteorological Satellite Program
DOD Mission Area: Global Military Environmental Support #420
Budget Activity Defense Wide Mission Support #6

The FY 1981 RDT&E budget is $27.3 million less than last years RDT&E budget request. This reduction is due to a delay in the Shuttle satellite development program which slipped start of the demonstration and validation phase from FY 1981 to FY 1982. This program was delayed because of revised analyses which indicated that Block 5D hardware would satisfy missions requirements up through March 1986. Prior to this revised analysis, Shuttle transition was required by Dec 1984.

Budget Activity: Defense Wide Mission Support #6
Program Element: 35160F, Defense Meteorological Satellite Program

Test and Evaluation Data

1. Development Test and Evaluation: RCA Corporation is the prime development contractor for the Defense Meteorological Satellite Program (DMSP). All Development, Test and Evaluation (DT&E) on the baseline design has been completed. System DT&E included static loads testing, acoustic and vibration testing, temperature cycling and thermal vacuum testing, orbit simulation testing in the vacuum chamber, simulated launch functional testing, and numerous detailed electrical tests both before and after environmental test events. Prior to system level testing, all components and subsystems underwent detailed functional and environmental tests. The hardware used for DT&E was designed and built as flight equipment. As a result of DT&E, design changes were made to the sensor mounting platform structural members, the solar array deployment mechanism, the satellite thermal control system, and the central computer internal design.

2. Operational Test and Evaluation: The Defense Meteorological Satellite Program (DMSP) is an operational meteorological satellite system whose mission is to provide timely global visual and infrared cloud cover, and other specialized meteorological data to Air Force Global Weather Central and Fleet Numerical Weather Central in support of strategic missions. DMSP provides realtime direct readout of local area weather data to receiving terminals at key locations throughout the world to support tactical operations. It also serves to continue the advancement of meteorologic satellite technology to meet changing DOD requirements. Current planning calls for acquisition and deployment of five Block 5D-1 satellites for use through 1980. Satellite F-1 was launched on 11 Sep 76 after extensive compatibility testing at the RCA factory and Vandenberg AFB by a joint contractor/Air Force Systems Command/Air Weather Service/Strategic Air Command/ Aerospace Defense Command/Air Force Logistics Command test team.

All spacecraft systems capable of being ground tested prior to launch were successfully checked prior to launch of F-2 on 2 June 1977, F-3 on 30 April 1978, and F-4 on 6 June 1979. After launch, all satellites went through three weeks of early orbit checkout. Upon successful completion of this testing, the satellites were declared operational and capable of supporting the User, Air Force Global Weather Central.

The Block 5D-2 series of satellites is currently in the development phase. SAC is involved with the System Program Office (SPO) in the design and development of the 5D-2 spacecraft and changes to the ground system required to support this spacecraft.

The SPO awarded contracts to five companies to perform tradeoff studies among various system and subsystem design concepts for the DMSP Shuttle era satellite. This effort was completed in late September 1979. The SPO is currently planning to transition to the Shuttle using a modified Block 5D satellite.

3. System Characteristics:

	Objectives	Demonstrated (DT&E)	Demonstrated (OT&E)
Orbit	450 9 NM Circular		450 5 NM
Data Storage Capacity	400 Minutes	400 Minutes	400 Minutes
Imagery Resolution	.3 & 1.5 NM Visual + Infrared	.25 & 1.5 NM Visual + Infrared	.25 & 1.5 NM Visual + Infrared

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #35171F
Title: Space Launch Support
DOD Mission Area: Space Launch and Orbital Support #410
Budget Activity: Defense Wide Mission Support #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT			3,433	35,035	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEEDS: This program provides the Space Transportation System (STS) resources/capability needed to transport Air Force space payloads into their mission orbits. The main program objective is to provide consolidated management, programming, and execution of the operational phase USAF Space Shuttle/Inertial Upper Stage (IUS) activities that are common to the Department of the Air Force research and development and operational satellite programs.

BASIS FOR FY 1981 RDT&E REQUEST: An effort will be initiated to define methods and criteria for efficient mixing of Air Force (and other defense) payloads, not requiring dedicated Shuttle launches, to optimize DOD Shuttle cargo manifesting and to define other means of more effectively using the Space Shuttle.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
Procurement (3020)	17,000	25,905	709	29,502	Continuing	N/A*
Quantities						
Inertial Upper Stages	(1)	(1)		(1)		

*Includes initial spares.

Program Element: #35171F Title: Space Launch Support

DOD Mission Area: Space Launch and Orbital Support #410 Budget Activity: Defense Wide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: This program element provides the Space Shuttle/Inertial Upper Stage (IUS) support that is common to the Department of the Air Force Research, Development, Test and Evaluation (RDT&E) and operational satellite programs. This support includes production IUS's, IUS launch services, Space Shuttle flight charges, Mission Control operations, and operation of the national Space Shuttle Launch Site at Vandenberg AFB (VAFB), CA. The RDT&E satellite programs supported include the Space Test Program (STP), Program Element (PE) 63402F; and the first Space Shuttle mission of each of the following programs: NAVSTAR Global Positioning System (GPS), PE 64778F; Space Based Surveillance System (SBSS), PE 63428F; and the Defense Meteorological Satellite Program (DMSP), PE 35160F. The operational satellite programs supported are the DMSP, PE 35160F; the Defense Satellite Communications System (DSCS), PE 33110F; the Defense Support Program (DSP), PE 12431F; the NAVSTAR GPS, PE 35165F; the Satellite Data System (SDS), PE 35158F; and the SBSS, PE 12424F.

RELATED ACTIVITIES: The IUS development, DOD Space Shuttle integration, and the acquisition of the VAFB launch site are being accomplished in PE 63411F and PE 12449F. The individual USAF programs will provide resources for program unique launch hardware and/or services. The resources for support to other DOD programs are included in the appropriate Special Activity and Department of the Navy Program Elements.

WORK PERFORMED BY: The responsible Air Force agency is the Air Force Systems Command Space Division (SD), Los Angeles, CA. The USAF Space Shuttle/IUS operations will be supported by the Space and Missile Test Organization (SAMTO) at Vandenberg AFB (VAFB), CA, and the 6555th Aerospace Test Group at Cape Canaveral AFS (CCAFS), FL. Systems Engineering is provided by the Aerospace Corporation, El Segundo, CA. The IUS contractor is the Boeing Aerospace Division, Seattle, WA. The payload integration contractor is Martin Marietta Corporation, Denver, CO. The VAFB Shuttle operations contractor has not been selected. The National Aeronautics and Space Administration (NASA) is the Space Transportation System (STS) manager and operates the national Space Shuttle Eastern Launch Site at Kennedy Space Center (KSC), FL.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Not Applicable

2. FY 1980 Program: Not Applicable

3. FY 1981 Planned Program: Initiation of an effort to define methods and criteria for efficient mixing of Air Force (and other defense) payloads to optimize DOD Shuttle cargo manifesting and to define other means of effectively using the Space Shuttle.

Program Element: #35171F Title: Space Launch Support
DOD Mission Area: Space Launch and Orbital Support #410 Budget Activity: Defense Wide Mission Support #6

4. FY 1982 Planned Program: Payment of the Space Shuttle flight charge for a Space Test Program (STP) sortie mode flight will be made. Adjustments to the total FY 82 column will be made in the FY 82 budget submittal to reflect changed launch requirements for payload programs supported by this program element.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable.

7. Resources: Not Applicable.

8. Comparison with FY 1980 Budget Data:

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT			5,700	3,400	Continuing	N/A

The funds requested in FY 1980 in the FY 1980 Descriptive Summary were to pay the Space Shuttle flight charge for the STP Teal Ruby mission, which was scheduled for launch in 1981. The Teal Ruby launch has been delayed until FY 1983, and funds for its Space Shuttle flight charge are not required until FY 1982. The FY 1980 funds were not released to this program element by DOD.

Funds requested in FY 1981 in the FY 1980 Descriptive Summary supported initiation of procurement of an IUS for the STP Mosaic Sensor/Mini-HALO mission. Based upon revised launch schedules, that IUS is not required at this time. A need has been identified and an effort will be initiated to define methods and criteria to efficiently mix Air Force (and other defense) payloads in the Space Shuttle to optimize cargo mixing and to define other means of more effectively using the Space Shuttle.

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #78019F
DoD Mission Area: Major Ranges and Test Facilities, #451

Title: Hill/Wendover/Dugway Range
Budget Activity: Defensewide Mission Support #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	N/A	1,700	1,800	1,900	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides resources for the development of new instrumentation, the procurement of off the shelf equipment and instrumentation, and the operations and maintenance of the Utah Test and Training Range. The range supports development testing of cruise missiles, unmanned vehicles, and airborne parachute recovery systems. It also supports airborne tactical training for active and reserve units, and provides scenarios for large scale operational exercises.

BASIS FOR FY 1981 RDT&E REQUEST: The program includes funds for equipment and instrumentation necessary to support the RDT&E mission, such as tracking devices and data links.

OTHER APPROPRIATION FUNDS:

	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
Other Procurement (3080)	1,500	800	3,285	2,739	Continuing	N/A
Military Construction	N/A	740			Continuing	N/A

Program Element: #78019F
DoD Mission Area: Major Ranges and Test Facilities, #451

Title: Hill/Wendover/Dugway Range
Budget Activity: Defensewide Mission Support #6

DETAILED BACKGROUND AND DESCRIPTION: The Utah Test and Training Range (UTTR) is located in western Utah and consists of 2.9 million acres of controlled airspace. The range supports test and evaluation of Air/Ground Launched Cruise Missiles (ALCM/GLCM), Remotely Piloted Vehicles (RPV), and parachute recovery systems; Tactical Air Command combat crew training; Air Force Logistics Command aircraft and munitions tests; Air Force Test and Evaluation Center (AFTEC) operational test and evaluation; and training for the Air Force Reserves. The RDT&E funds are used to improve and modernize the range instrumentation used for gathering telemetry, optical and metric data for range users. Other Procurement funds are used for the procurement of off the shelf equipment and instrumentation. Range operation and maintenance is funded from the Operations and Maintenance appropriation.

RELATED ACTIVITIES: The Utah Test and Training Range supports DoD programs and those of other government agencies. The majority of the workload is performed under contract (60 percent). The funding source for this contract is the Operations and Maintenance appropriation.

WORK PERFORMED BY: The Utah Test and Training Range is managed and operated by the Air Force Systems Command's 6501st Range Squadron at Hill AFB, UT. Procurement and contract management support is provided by the Air Force Systems Command's Air Force Flight Test Center at Edwards AFB, CA. The RDT&E appropriation will be used to fund 9 technical equipment improvement contracts in FY 81, the largest of which is anticipated to be less than $700,000. The contracts will be released for bid in late FY 80.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: On January 1, 1979 Air Force Systems Command became the single range manager. Funding for range operation is through Operations and Maintenance appropriations. RDT&E funds (in PE 65807F, for FY 1979) were used to upgrade capabilities of range instrumentation, data transmission and communications.

2. FY 1980 Program: Effective 1 October 1979, the UTTR was placed within the purview of Department of Defense Directive 3200.11, the directive which governs the use, management and operation of major DoD ranges and test facilities. RDT&E funds will be used to continue the upgrade of the range mission control center, the microwave system and the fixed telemetry system.

3. FY 1981 Planned Program: RDT&E funds will be used to continue the upgrade of the range mission control center and microwave system. Additional range capability upgrades using RDT&E funds will include mobile C-band radar systems, flight test television modernization, and intercept tracking system.

4. FY 1982 Planned Program: RDT&E funds will be used to continue the range upgrade into FY 1982. FY 1982 upgrades include the modernization of the communication system and the continuation of the intercept tracking system.

Program Element: #78019F
DoD Mission Area: Major Ranges and Test Facilities, #451

Title: Hill/Wendover/Dugway Range
Budget Activity: Defensewide Mission Support #6

5. Program to Completion: This is a continuing program.

6. Milestones: Not applicable

7. Comparison with FY 1980 Budget Data: No change in RDT&E funds. Other Procurement funds for FY 81 have increased from $300,00 shown in the FY 1980 President's Budget to $3,285,000. As the Utah Test and Training Range was not formed until 1 January 1979 the identification of Other Procurement funds requirements was incomplete prior to the submission of the FY 1980 President's Budget, and were not included until The FY 81 President's Budget.

FY 1981 RDT&E Descriptive Summary

Program Element: #78026F
DoD Mission Area: Defense System Cost Effectiveness/Improvements, #473

Title: Productivity, Reliability, Availability, and Maintainability (PRAM)
Budget Activity: Defense Wide Mission Support, #6

RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3,028	5,900	8,592	9,145	Continuing	N/A

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force has an urgent need to reduce the rising cost of ownership and improve productivity, reliability, availability and maintainability of its operational systems. The office of the Secretary of Defense (OSD) FY81-85 Consolidated Guidance stated, "we have learned that is is virtually impossible to anticipate and solve all reliability problems in a complex weapon system before it is fielded. In order to realize the intended performance from a system, one must plan to improve the design with reliability and maintainability modifications throughout most of its service life." PRAM has continued to respond forcefully to full this major gap for programs, since its inception in 1975 fy the Air Force Chief of Staff, through judicious and timely investments in projects leading to lower life cycle costs and improved operational readiness. The need for continuing this vital program has been documented over the years by commanders of both Air Force Systems Command and Logistics Command, and has been underscored by the Assistant Secretary of the Air Force for Research, Development and Logistics as well as the Under Secretary of Defense for Research and Engineering.

BASIS FOR FY 1981 RDT&E REQUEST: This program provides investment funds for projects leading to reduced cost of ownership in the areas of airframes, avionics, propulsion (non-Component Improvement Program applications affecting logistics support, repair technology and test methods that impact more than one engine model), missiles, depot maintenance and other support areas. Specific projects to be funded will be formulated by the PRAM Program Office and its affiliated field offices. Selection of projects will be based on such criteria as risk, projected cost, return on investment, net savings, amortization period, and implementation period. Projects selected for investment will continue to stand audit during the amortization period.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #78026F
DoD Mission Area: Defense System Cost Effectiveness/Improvements, #473

Title: Productivity, Reliability, Availability, and Maintainability (PRAM)
Budget Activity: Defense Wide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The Department of Defense (DoD) Consolidated Guidance for FY81-85 highlights the fact that "our tactical Air Forces represent the most expensive investment among our general purpose forces. Procurement and operating costs continue to rise steadily, more rapidly than defense spending as a whole, even after adjusting for inflation." The guidance further expresses "deep concern about the future impact of these trends on the size, age, and readiness of the force." The guidance calls for "major initiatives to reverse these disturbing trends and to provide an effective combat capability commensurate with our increasing commitment of resources." The PRAM program is filling this urgent requirement to reduce the rising cost of ownership while improving the operational readiness of our in-service weapon systems. PRAM's judicious and timely investment in projects lead to lower life cycle costs. These improvement projects drive the very same parameters (e.g., productivity, reliability, availability and maintainability) that lead also to improved operational readiness.

This program attacks the high cost of doing business by focusing management attention and funds in a concentrated effort to reduce operational and support costs without sacrificing systems effectiveness. The program objective is pursued through investments in cost reduction projects. These projects are to: (1) improve the reliability and maintainability of weapon systems through modifications and parts substitution, (2) improve the efficiency and producibility of maintenance and logistic support organizations at all levels through improved procedures and documentation, (3) exploit lower life cycle cost alternatives in systems configurations through component commonality and use of current technology lower cost components, and (4) develop new Research Development Test and Evaluation (RDT&E) approaches that better accommodate life cycle cost considerations in system development (improved specifications, standards, test methods and techniques). Implementation of these projects leads to: (1) reduced support manpower requirements, (2) lower spares consumption, stock levels and storage/transportation costs, and (3) improved ability to determine support requirements prior to the introduction of new weapon systems into the operational inventory. The need for PRAM projects on older in-production and deployed systems stems from the fact that technology advances through several cycles during the single lifetime of many of our systems. Completed hardware projects are not implemented by PRAM, but rather are implemented by procedural changes, or through the Air Force Mod Program or insertion in the inventory as a Preferred Spare. A valuable by-product is improved operational readiness of weapon systems.

To manage this program, an office has been established which is manned by personnel experienced in the research and development, acquisition, and logistic support disciplines. This is a joint Logistics Command and Systems Command office, equally responsible and responsive to the two commanders. As such, the program office is able to cut accross traditional lines to accomplish its goals. This office operates as a leadership organization, achieving its objectives primarily through interaction with Air Force Laboratories, System Program Offices, Air Logistics Centers and industry.

Program Element: #78026F
DoD Mission Area: Defense System Cost Effectiveness/Improvements, #473

Title: Productivity, Reliability, Availability, and Maintainability (PRAM)
Budget Activity: Defense Wide Mission Support, #6

PRAM provides the front-end risk reduction, investigation, development and evaluation of improvement projects geared toward in-service weapon systems. These projects lead to improved specifications, standards, test methods, and other development hardware, as well as modification test of commercially available items to lower in-service weapon system/sub-system life cycle costs. PRAM funds will not be used to develop new systems or to augment the funding of other development programs. Completed projects are subjected to audit during the amortization period to verify savings.

RELATED ACTIVITIES: This program is related to Program Element (PE) 64212F, Aircraft Equipment Development (AED), which has as one of its goals, the reduction of weapon systems ownership costs through development of aircraft equipment with minimum life cycle cost. The PRAM and AED programs are complementary with AED basically funding development of end items of equipment and PRAM primarily funding adaptation of: (1) high reliability, current technology or older systems, (2) adaptation of commercial items and procedures to military applications, and (3) improvements in development and acquisition techniques, methods and specifications. The component Improvement Program (CIP) is concerned with filling a void in our current engine development process by demonstration of growth potential in specific, current operational engine makes. The complimentary role played by PRAM in the propulsion area is of lessor focus in comparison to CIP, in that each PRAM propulsion project must be applicable to several operational engine makes and must also lead to a reduction in life cycle costs. To insure their complimentary operation, PRAM propulsion projects are closely coordinated with the Air Force Propulsion Lab and the Aeronatical Systems Division's Propulsion Program Office. A dialogue has been established with the Army and Navy through which program activities and accomplishments are being exchanged.

WORK PERFORMED BY: The PRAM Program Office is located at Wright-Patterson AFB, OH. Satellite PRAM offices have been established at each of the five Air Force Air Logistics Centers and at the Aerospace Guidance and Metrology Center in Newark, OH. The Air Force Flight Dynamics, Avionics, Materials and Propulsion Laboratories, as well as the Air Force Flight Test Center, Aeronautical Systems Division, and the Space and Missile Systems Organization, have been participants in PRAM projects.

The ten largest PRAM contractors were: Hughes Aircraft, Culver City, CA; Emerson Electric, St Louis, MO; International Automatics Div, Anaheim, CA; General Dynamics, Fort Worth, TX; Mechanical Technology Inc., Dayton, OH; TRW, Los Angeles, CA; Honeywell, Minneapolis, MN; McDonnell Douglass, St Louis, MO; Air Research, Phoenix, AZ; and University of Dayton Research Institute, Dayton, OH. In FY 1979 there were 94 additional contractors and a total of 126 separate contracts.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: The PRAM Program Office was formed in August 1975. As of September 1979, PRAM had initiated 425 projects representing a cumulative PRAM investment of 45.4 million for an estimated Program

net savings, five years after implementation, of $852.6 million. These projects were in the areas of airframes, avionics, propulsion, missiles and space, depot maintenance, and other support areas. Two hundred fifty-three projects have been completed with a combined five year net savings of $300.3 million for a PRAM investment of $11.8 million As an illustration of an effort to both cut ownership costs as well as improve operational readiness, the ammo feed unit on the F-4E gun is incurring excessively high support costs due to damage. The primary causes of jams are failures of the timing sprocket shaft and/or gate assembly on the ammo feed unit. This PRAM project will prototype and test an improved sprocket shaft and gate assembly to reduce feed jams which, in turn, have been causing other gun damage. The PRAM investment cost is $71.4 thousand for the ammo feed unit for a projected net savings five years after completion of $1.1 million. In the avionics area, many of the problems stem from our accelerating technology which goes through several cycles during the single life cycle of most of our original avionics suites. For example, there is the case of the AN/AAR-34 Tail Warning System (TWS) on the F/FB-111 aircraft, which detects missile threats approaching from the rear. Integrated circuit chips are used in 20 modules within the TWS. These circuit chips are of Resistor-Capacitior-Transistor-Logic (RCTL) design. A product of the mid-sixties technology, the RCTL chips have become virtually obsolete and procurement has become extremely difficult. In 1966 the prime contractor for the TWS completely stopped manufacturing RCTL ships. The PRAM program has successfully adapted state-of-the art,procurable Complmentary Metal Oxide Semiconductor (CMOS) chips to replace the RCTL chips. The new cmos chips have been designed and qualified to be form-fit-function replaceable for the RCTL chips, and is being implemented on a preferred spare basis. The PRAM TWS investment was 466 thousand dollars for a five year net savings of $3 million. PRAM also is active in the area of missiles. The F-106 aircraft uses a Weapons System Evaluation Missile (WSEM) to record and evaluate performance of the fire control system. The WSEM is a special AIM-4F missile which has been modified by replacing the rocket motor and warhead with fire control system evaluation circuitry. Low WSEM reliability (15.8 hours mean time between failure) results in annual support costs of $5.7 million. Moreover, WSEM attrition has resulted in a requirement to purchase additional units at a cost of $31.2 million over the next five years. To avoid these high costs, PRAM is prototyping and testing a more reliable system, using an existing qualified recorder. Total PRAM investment is $3 million for a projected net savings five years after completion of $44 million. Completed projects will continue to stand audit during the amortization period to verify savings.

2. FY 1980 Program: The $5.9 million program represents a healthy trend to restore this vital program funding level of 8 million dollars per year. In the functional areas addressed by PRAM (i.e., airframes, avionics, missiles and space, propulsion, depot and other areas), runaway technology has been accelerating through several cycles during the single cycle of most of our older weapon systems. PRAM provides the focused management attention required to harness that technology, and apply it to our older in-service systems to lower our cost of ownership. Since the parameters altered by PRAM to reduce life cycle cost (i.e., productivity, reliability, availability and maintainability) in many cases also improve readiness, a major FY 1980 initiative will be to increase operational readiness of in-service weapon systems. One example project is a reliability improvements to the LN-12 and LN-14 Inertial Naviga-

tion Platform for the F-4 and F-111 aircraft. The PRAM investment cost of $7.5 thousand for prototype and evaluation of this reliability improvement promises a five year net savings of 256 thousand dollars. Another example of PRAM's effort to improve the F-4 sortie regeneration and operational readiness by improving the reliability of the GSM-133. The GSM-133 Automatic Test Equipment is the only means to perform functional tests on most of the F-4 avionics. This equipment, first introduced operationally in the mid-sixties, is now outdated and badly worn. The 494 thousand dollar GSM-133 PRAM investment will not only lead directly to reduced aircraft turn around time and therefore improved sortie regeneration, but also return a projected five year net savings of $4.98 million.

3. FY 1981 Planned Program: In our efforts to restore PRAM to at least a fraction of its' 1977 31.5 million dollar funding level, the FY 1981 $8.5 million dollar request represents a minimum viable funding level for a truly effective PRAM program. Senior military and civilian Air Force executives continue to stress the need for this vital program. Accordingly, PRAM will apply maximum management attention to improve the operational readiness and to lower our cost of ownership of our older in-service systems. Candidate PRAM projects exceeding the budget request have been compiled. As in the past, projects actually pursued will be those offering the best potential return on investment.

4. FY 1982 Planned Program: Specific investments will be similar to and in some cases continuations of those initiated in the previous year. The planned $9 million request underscores the Air Force commitment to focus management attention and funds in a concentrated effort to reduce life cycle costs and improve operational readiness of in-service systems.

5. Program to Completion: This is a continuing program.

6. Milestones: Not Applicable

7. Resources: Not Applicable

8. Comparison with FY 1980 Budget Data ($ in thousands): Reprogrammed $1,028 thousand for operational readiness improvement projects in FY 1979.

	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
Total for Program Element	2,100	3,028	5,900	8,500	Continuing	N/A

FY 1981 RDT&E DESCRIPTIVE SUMMARY

Program Element: #01004F
Title: International Military Headquarters and Agencies
DoD Mission Area: International Cooperative RDT&E, #460
Budget Activity: Defense-Wide Mission Support, #6

RESOURCES (PROJECT LISTING) ($ in thousands)

Project Number	Title	FY 1979 Actual	FY 1980 Estimate	FY 1981 Estimate	FY 1982 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,275	1,900	1,978	1,982	Continuing	Not Applicable
2447	SHAPE Technical Center/ AGARD/Co-op R&D		1,640	1,718	1,722		
2446	Von Karman Institute		260	260	260		

BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program satisfies DoD administrative agent responsibilities for the North Atlantic Treaty Organization (NATO) Advisory Group for Aerospace Research and Development in Paris, France and for the Supreme Headquarters Allied Powers Europe (SHAPE) Technical Center (STC) in The Hague, Netherlands; pays for US scientists at STC; supports USAF participation in NATO cooperative research and development agencies and groups; and pays the US share (12%) of NATO support for the Von Karman Institute in Brussels, Belgium.

BASIS FOR FY 1981 RDT&E REQUEST: Support of this program is a continuing international commitment under the auspices of NATO.

OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #01004F Title: International Military Headquarters and Agencies
DoD Mission Area: International Cooperative RDT&E,#460 Budget Activity: Defense-Wide Mission Support, #6

DETAILED BACKGROUND AND DESCRIPTION: The Supreme Headquarters Allied Powers Europe (SHAPE) Technical Center (STC) is a multinational North Atlantic Treaty Organization (NATO) military organization responsible directly to the Supreme Allied Commander, Europe. The Center provides scientific and technical advice on military problems with emphasis on Command, Control and Communications. The US, thru the USAF as administrative agent, supports 21 of 106 international scientist and engineer positions at STC. These salary expenses are reimbursed at NATO rates thru credits to our NATO account. (Since the US pays less than NATO for an equivalent position, the US receives more credit than is actually spent.) The Advisory Group for Aerospace Research and Development (AGARD) provides technical advice and assistance to the NATO Military Committee, promotes advances and cooperation in the aerospace sciences, and provides assistance to requesting NATO member nations to help increase their aerospace scientific and technical potential. The USAF is administrative agent for AGARD and pays for all non government as well as USAF participation in the AGARD scientific and technical meetings. Included is contracting for special services such as language translation for meetings in the US. Also when the Director of AGARD is a US citizen this program pays the salary. In addition to AGARD-sponsored cooperative R&D efforts, this program pays for USAF participation in bilateral data exchange and engineer exchange agreements with free world countries, and participation in those NATO agencies and groups in which USAF membership and participation is directed by treaty or other agreement. Examples of the latter include the NATO Air Force Armaments Group, eight subordinate study groups and the Tri-Service Group on Air Defense. The remaining international responsibility is for the US share (12%) of NATO support to the Von Karman Institute for Fluid Dynamics in Brussels, Belgium. This world class international research facility is instrumental in advancing the state of the art in fluid dynamics and related diciplines. Thru research contracts and publications it is partially self sufficient; the additional budget requirements ($1.8M) are contributed by the NATO nations.

RELATED ACTIVITIES: Supports international cooperative Research and Development (R&D) agreements under NATO; the US Mutual Weapons Development Data Exchange Program; the Technical Cooperation Program with the United Kingdom, Canada, Australia, and New Zealand; and the US Air Senior National Representative to the Under Secretary of Defense for Research and Engineering.

WORK PERFORMED BY: Leading scientists, engineers,and administrators from the NATO countries including US military and civilians.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1979 and Prior Accomplishments: Examples from the programs of work at the STC and at AGARD include a European evaluation of the US Airborne Warning and Control System; a US DoD requested evaluation of the Joint Tactical Information Distribution System; initiation and completion of phase one of Project 2000, a NATO military committee-directed technology forecast of the military capability of NATO in the year 2000;and trials of an information display system for command and control installed at SHAPE for evaluation. Examples of exchanges which have resulted in cooperative R&D include establishment of a joint US/Federal Republic of Germany active flutter suppression program (fifty-fifty cost sharing); implementation of a plan for greater R&D/production cooperation with Korea; a cost sharing R&D program with Canada for a thrust computing system for the J-79 jet engine; and scientist exchange programs with Germany, Korea and Israel. While some of the data exchange and cooperative R&D

initiations do not produce expected results, the small investment and the growing technical capabilities of our allies make this program one of the most highly leveraged in the RDT&E Appropriation.

2. FY 1980 Program: Emphasis on Electronic Warfare and Command and Control systems by the Supreme Headquarters Allied Powers Europe (SHAPE) Technical Center including testing of the North Atlantic Treaty Organization III satellites, monitoring of the Allied Command Europe automatic data processing architecture design contract, and negotiation of a data exchange and engineer exchange between the US and Spain. Continued support for the NATO Advisory Group for Aerospace Research and Development and the Von Karman Institute (VKI). Meeting US treaty obligations through participation in NATO working groups and conferences.

3. FY 1981 Planned Program: The US funds for VKI will increase if the overseas value of the dollar declines. Participation in NATO working groups will continue as will cooperative research and development efforts.

4. FY 1982 Planned Program: The efforts described above will continue.

5. Program to Completion: This is a continuing program.

6. MILESTONES: Not Applicable

7. RESOURCES: Not Applicable

8. Comparison with FY 1980 Budget Data: The funds for FY-81 and beyond reflect an increase of $78K over last year's submission due to legislated civilian pay increases.

Project Number	Title	FY 1978 Actual	FY 1979 Estimate	FY 1980 Estimate	FY 1981 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1,103	1,200	1,900	1,900	Continuing	Not Applicable
2447	SHAPE Technical Center/ AGARD/Co-op R&D		1,000	1,640	1,640		
2446	Von Karman Institute		200	260	260		