DEPARTMENT OF THE AIR FORCE

SUPPORTING DATA FOR FISCAL YEARS 1998/1999

RESEARCH, DEVELOPMENT, TEST AND EVALUATION

DESCRIPTIVE SUMMARIES

FEBRUARY 1997

VOLUME I

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Threat Simulator Development	0604256F	1127
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BUDGET JUSTIFICATION FOR PROGRAM ELEMENTS OF THE DEPARTMENT OF THE AIR FORCE RESEARCH AND DEVELOPMENT PROGRAM FY 1998/1999 BIENNIAL BUDGET JUSTIFICATION BOOK FEBRUARY 1997

INTRODUCTION AND EXPLANATION OF CONTENTS

1. GENERAL: 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 hearings on the Fiscal Year 1998/1999 Budget Estimates. This information is in addition to the testimony given by DoD witnesses.

a. Contents: Volumes I and II contain all unclassified R-2 and R-3 exhibits. Volume III contains the following classified R-2 and R-2 classified exhibits. Volume IV contains the Facilities exhibit (DoD Form 1391) and the Combating Terrorism.

b. Exhibits R-2 and R-3 provide narrative information for all RDT&E program elements and projects within the USAF FY1998/1999 RDT&E program except those listed in Volume III. The formats and contents of this document are in accordance with the guidelines and requirement of the Congressional committees insofar as possible.

c. The "Other Program Funding Summary" portion of the R-2 includes, in addition to RDT&E funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DoE) costs.

d. There are three FY1998/1999 "Facilities Exhibits" that contain information on major improvement to and construction of government owned facilities funded by RDT&E located in section I of Volume IV.

e. There are three FY1998/1999 "Combating Terrorism Exhibits" that contain information on physical security or counterterrorism located in section II of Volume IV.

2: CLASSIFICATION: All R-2 and R-3 exhibits contained in Volumes I and II are UNCLASSIFIED. Classified R-2 and R-3 exhibits are now contained in Volume III. Classified pages bear the appropriate security classification and classified data is identified by use of brackets []. A list of R-2 and R-3 exhibits not included in this submission (due to the level of security classification and necessity of special security clearances) is located in Volume III.

3. COMPARISON OF FISCAL YEARS 1997 AND 1998/1999 DATA. A direct comparison of Fiscal Years 1997 and 1998/1999 data shown in this document with corresponding data in the Descriptive Summaries dated February 1996 will reveal differences. The table below highlights the relationship of the FY1998/1999 budget structure to the FY1997 Budget approved by Congress:

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BUDGET ACTIVITY 2: APPLIED RESEARCH DEVELOPMENT	
0602203F Aerospace Propulsion	Project 3012 terminates in FY98
0602204F Aerospace Avionics	Project 2000 and 7633 have been combined into Project 2000. Project 2001 and Project 2004 have been combined into Project 2001. Project 6095 and Project 7629 have been combined into Project 6095. Project 7622 and project 7662 have been combined into Project 7622.
0602602F Conventional Munitions	Project 2543 has been combined into Project 2502 beginning in FY98.
BUDGET ACTIVITY 3: ADVANCED TECHNOLOGY DEVELOPMENT	
0603205F Flight Vehicle Tech	Efforts previously conducted under PE 0603723F, Project 2104 have been consolidated with this PE in Project 4398
0603211F Aerospace Structures	Projects 486U and 69CW have been combined into Project 486U.

BUDGET ACTIVITY 3: ADVANCED TECHNOLOGY DEVELOPMENT (Continued)

0603216F Aerospace Propulsion and Power Technology	Project 2480 terminates in FY98, Project 2697 combined into Project 2480.
0603227F Personnel, Training and Simulation Tech	Projects 2743, 2922 and 2949 have been combined into Project 2743
0603231F Crew Systems & Personnel Protection	Projects 2829, 2830 and 2868 have been combined into Project 2830
0603238F Global Surveillance & Comm Tech	Funding transferred to 0603789F
0603270F Electronic Combat Tech	Projects 2754 and 2432 have been combined into Project 2432. Projects 691X radio countermeasures efforts are now reported in Project 431G. Project 2222 expendable countermeasures and the infrared missile warning efforts from the former Project 431G are now reported in Project 691X. Project 2432 precision location and identification efforts are now reported in Project 431G
0603311F Ballistic Missile Tech	Project 4091 terminates is FY97.
0603401F Advanced Spacecraft Tech	Project 4599 was previously called Project 0003, Reusable Launch Vehicle Technology. In FY96 this project was moved to PE 0603302F and renamed Launch Vehicle Technology. The only funds remaining in this project were added by Congress.
0603410F Space Systems Environmental Interactions	Projects 2822 and 2823 were combined into Project 2822.
0603601F Conventional Weapons Tech	Global Positioning System guidance and highly agile missile flight control will be developed in project 670B vice 670A.

PROGRAM ELEMENT COMPARISON SUMMARY

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BUDGET ACTIVITY 3: ADVANCED TECHNOLOGY DEVELOPMENT (Continued)

0603707F Weather Systems Tech	Projects 2688, 2781 and 4026 were combined into Project 2688.
0603723F Environmental Engineering Tech	Projects 2103 and 3037 have been combined into Project 2688.
0603726F C3 Subsystem Integration	Project 3192 combined with Project 2810.
0603789F C3 Advanced Development	PE 0603238F has been incorporated into this PE as Project 4216 beginning in FY98.

BUDGET ACTIVITY 4: DEMONSTRATION AND VALIDATION

0208030F WRM Ammunition	FY99 new start
0603319F Airborne Laser Technology	PE has transition from Budget Activity (BA) 3 to BA 4
0603790F NATO Research and Development	Funding transferred from DoD Account.
0603852F C-130J Em/Val	FY98 new start
0603855F DoD Space Architect (Space)	Funding transferred to PE 0305917F.
0604226F B-1B	Projects 1019, 1020, 1021 and 4143 were combined into Project 4596.
0604327F Harden Target Munitions	Funding adding in 0603311F in FY96. New PE established in FY97.

PROGRAM ELEMENT COMPARISON SUMMARY

INTRODUCTION AND EXPLANATION OF CONTENTS

BUDGET ACTIVITY 5: ENGINEERING AND MANUFACTURING DEV	
0207323F Conventional Air-Launched Cruise Missile	FY99 new start
0207414F Combat Intelligence System	PEs 0207431F, 0305158F, and 0604321F combined into single PE.
0305176F Combat Survivor Evader Locator (CSEL)	PE will transition from Budget Activity (BA) 3 to BA 5 in FY98.
0604226F B-1B	Projects 1019, 1020, 1021 and 4143 are combined into Project 4596.
0604321F Combat Intelligence System	Funds moved into PE 027414F beginning in FY98.
0604240F B-2	Project 3843 combined into Project 4609 beginning in FY98
0604770F JSTARS	Funds moved to new PE 0207581F.
0604851F ICBM EMD	Project 13C4 combined into PE 0303131F, Project 2832.
0604853F Evolved Exp Launch Veh -EMD	Project 0004 funding transferred from PE 0604853F.
BUDGET ACTIVITY 6: RDT&E MANAGEMENT SUPPORT	
0605704F Theater Air Defense BMC4I	Funding and efforts of this PE have been transferred to PE 0605126J beginning in FY98.
0605876F Non-Test Minor Construction (RPM)	Project 06MC was transferred from PE 0605807F, project 06MC starting in FY98.
0605878F Non-Test Maintenance and Repair	Project 06MR was transferred from PE 0605807F, project 06MR starting in FY98.

BUDGET ACTIVITY 6: RDT&E MANAGEMENT SUPPORT (Continued)

0605879F Non-Test Real Property Services	Project 06CE was transferred from PE 0605896F, projects 06CE and 06UT starting in FY98.
0605807F Test and Evaluation Support	Project 06TS FY98 content and funding increased for Test and Evaluation to reflect a transfer of test facility maintenance and repair and minor construction requirements formerly identified in projects 06MR and 06MC.
0605807F Test and Evaluation Support	Project 06AS requirements and funding moved to Project 06TS beginning in FY98.
0605807F Test and Evaluation Support	Approximately 50% of Project 06MC requirements and funding were transferred to PE 0605876F (Non-Test Minor Construction), Project 06MC, beginning in FY98. The remaining 50% was identified as test mission requirements and transferred to Project 06TS.
0605807F Test and Evaluation Support	Approximately 75% of Project 06MR requirements and funding were transferred to PE 0605878F (Non-Test Maintenance), Project 06MR beginning in FY98. The remaining 25% was identified as test facility maintenance and repair to Project 06TS.
1001004F International Activities	Project 00AH has been combined into Project 4645 beginning in FY98.

PROGRAM ELEMENT COMPARISON SUMMARY

INTRODUCTION AND EXPLANATION OF CONTENTS

BUDGET ACTIVITY 7 : OPERATIONAL SYSTEM DEVELOPMENT	
0101113F B-52 SQUADRONS	Project 4493 completes in FY97. Projects 4401 and 4402 complete is FY98.
0102325F Joint Surveillance System	Projects 2976 and 4559 have been transferred to PE 0102326F, Project 4592
0102326F Joint Surveillance System	Project 4592 transferred from PE 0102325F
0207131F A-10 Squadrons	Project 3861 FY99 new start
0207320F Sensor Fuzed Weapons	Project 1016 funding for FY97 moved from Budget Activity (BA) 5 to BA 7
0207323F AGM-86C Conventional ALCMS	Project 4608 new start in FY99
0207414F Combat Intelligence Systems	PEs 0604321F, 0207431F and 35158F were combined into this PE.
0207419F Tactical Airborne Cmd & Control Sys	Project 4133 completes in FY97
0207431F Combat Air Intelligence	FY98 and later are reported in PE 0207414F Project 1004 moved to PE 0207414F.
BUDGET ACTIVITY 7 : OPERATIONAL SYSTEM DEVELOPMENT (Continued)	
0207581F Joint Stars	Funds prior to FY98 are reported in PE 0604770F
0207601F USAF Modeling and Simulation	Projects 1008 and 4582 are completed in FY98. Project 2888 was transferred from PE 0208060F

PROGRAM ELEMENT COMPARISON SUMMARY

INTRODUCTION AND EXPLANATION OF CONTENTS

BUDGET ACTIVITY 7 : OPERATIONAL SYSTEM DEVELOPMENT (Continued)

0303131F Minimum Essential Emer Comm	Project 4610 is a FY99 new start
0303140F Information Systems Security Program	Project 4585 is a FY98 new start
0303141F Global Combat Support System	Project 4533 was transferred from the O&M appropriation, PE 0308610F
0305145F Arms Control Implementation	Funds transferred to DoD (DWSA) in FY98
0305154F Defense Airborne Reconnaissance	Project 4607 completes in FY97.
0305158F Constant Source	Project 4394 transferred to PE 0207414F in FY98.
0305910F Spacetrack (Space)	Project 4239 funds moved to O&M appropriation. Project 4279 funds moved from 06072295F.
0305911F Defense Support Program (Space)	Talon/Shield ALERT activities are funded in PE 0305911F Project 3615. Prior to FY95, Talon Shield/ALERT activities were funded in PE 0305911F, Project 3624.
0305917F Space Architect	Funds moved from PE 0603855F
0305953F Evolved Expendable Launch Veh	Project 624A is a new FY99 new start
0308610F Information Management Auto	FY98 and outyear funding for this PE has been combined into PE 0303141F.
0604240F B-2	Project 3843 combined into Project 4609.

BUDGET ACTIVITY 7 : OPERATIONAL SYSTEM DEVELOPMENT (Continued)

0303601F MILSATCOM Terminals	FY97 and on funding includes Milstar terminals, SHF terminals and UHF SATCOM. FY96 and prior funding is for Milstar terminals only. PE 0303606F includes FY96 and prior funding for UHF SATCOM, and PE 0303605F includes FY96 and prior funding for SHF terminals.
0401119F C-5 Airlift Squadrons	Project 4377 completes in FY97
0401214F Air Cargo Materiel Handling	Project 5120 completes in FY97.
0401218F KC-135S	Project 4494 is a FY98 new start and Project 4403 completes in FY97
0401318F CV-22	PE terminated.
0404102F Aerospace Rescue and Recovery	PE terminates in FY97
0604770F JSTARS	Funds moved to PE 0207581F beginning in FY98.
0708611F Support Systems Development	Project 3759 terminates in FY98.
1001004F International Activities	Funds moved from Project OOAH to Project 4645 beginning in FY98. Funding moved from Budget Activity (BA) 7 to BA 6.
1001018F NATO JSTARS	Funds have been reclassified from PE 0604770.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	216,348	210,763	226,832	230,210	236,039	240,510	247,112	254,969	Continuing	Continuing
2301 Physics	17,613	18,503	20,362	20,680	21,194	21,567	22,070	22,767	Continuing	Continuing
2302 Solid Mechanics and Structures	14,341	14,384	15,608	15,838	16,235	16,526	16,987	17,623	Continuing	Continuing
2303 Chemistry	28,539	30,560	31,096	31,764	32,576	33,072	34,019	35,112	Continuing	Continuing
2304 Mathematical and Computer Sciences	28,589	30,828	34,254	34,859	35,647	36,293	37,226	38,414	Continuing	Continuing
2305 Electronics	27,777	27,866	30,301	30,553	31,630	32,400	33,308	34,358	Continuing	Continuing
2306 Structural Materials	15,031	15,081	16,100	16,338	16,752	16,958	17,641	18,100	Continuing	Continuing
2307 Fluid Mechanics	11,071	11,107	13,294	13,489	13,827	14,076	14,471	14,927	Continuing	Continuing
2308 Propulsion	10,654	10,686	11,293	11,359	11,647	11,858	12,194	12,583	Continuing	Continuing
2309 Terrestrial Sciences	14,170	0	0	0	0	0	0	0	14,170	TBD
2310 Atmospheric Sciences	7,225	7,247	7,172	7,381	7,471	7,609	7,829	8,084	Continuing	Continuing
2311 Space Sciences	5,214	5,229	4,962	5,040	5,076	5,276	5,336	5,518	Continuing	Continuing
2312 Biological Sciences	15,344	15,391	15,986	16,119	16,525	16,923	17,300	17,847	Continuing	Continuing
2313 Human Performance	8,709	8,738	9,057	9,190	9,422	9,592	9,861	10,173	Continuing	Continuing
4113 Science and Engineering Education Programs	12,071	15,143	17,347	17,600	18,037	18,360	18,870	19,463	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences

(U) A. **Mission Description and Budget Item Justification:** This Basic Research program, managed by the Air Force Office of Scientific Research (AFOSR), supports Air Force research efforts comprised of in-house investigations in Air Force laboratories and extramural activities in academia and industry. The program element funds broad-based scientific and engineering basic research in technologies critical to the Air Force mission. These technologies include aerospace structures, aerodynamics, materials, propulsion, power, electronics, computer science, directed energy, conventional weapons, life sciences, and atmospheric and space sciences. All projects are coordinated through the Project Reliance process to harmonize efforts, eliminate duplication, and ensure the most effective use of funds. All technology areas are subject to long-range research planning and technical review by tri-Service scientific planning groups that interface and support the Defense Technology Area Planning process.

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	229,188	234,475	240,220	244,657	Cont
(U) Appropriated Value	239,978	219,475			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-4,677	-4,392			
b. SBIR	-3,761	-4,115			
c. Omnibus/Other Above Threshold Reprogrammings	-15,017	-205			
d. Below Threshold Reprogrammings	-175				
(U) Current Budget Submit/FY 1998 PB	216,348	210,763	226,832	230,210	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									DATE February 1997	
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences						PROJECT 2301
COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2301 Physics	17,613	18,503	20,362	20,680	21,194	21,567	22,070	22,767	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project provides the fundamental knowledge required to conceptualize and develop new Air Force weapons and also establishes the basis for many technologies critical to the Air Force. Research in physics has an impact on electromagnetic countermeasures, nuclear weapons effects, communications, and non-destructive and non-intrusive testing and analysis, as well as new materials development. Other technologies affected include avionics, laser technology, and propulsion research. The primary areas of research supported by this project are Photonic Physics, Optics, Plasma Physics, and Atomic and Molecular Physics.

(U) FY 1996 ($ in Thousands):
- (U) $17,613 Boosted performance of high-powered microwave (HPM) systems. Found new approaches to small, laser-based ultra stable clocks for navigation and position finding. Found critical physics limitations when imaging through the atmosphere for surveillance or airborne laser applications. Extended enhanced imaging techniques to low light levels and high resolution. Established novel principles for stretched atoms and their application in energy storage.
- (U) $17,613 Total

(U) FY 1997 ($ in Thousands):
- (U) $18,503 Extend existing imaging techniques to the physical limits for monitoring space debris and space assets. Extend power efficiency and harmonic linearity in microwave and millimeter-wave vacuum tubes. Discover new laser media for the window from ultraviolet to the visible. Examine innovative laser-assisted processing techniques for micro-electromechanical devices to be used in microsatellites.
- (U) $18,503 Total

(U) FY 1998 ($ in Thousands):
- (U) $20,362 Redirect program toward physics issues in nonlethal kill and optical image resolution. Continue to support scientific approaches to providing design and performance options in optical countermeasures, high-power microwaves, and space surveillance and targeting precision, which are recognized as being foremost issues for physics research.
- (U) $20,362 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2301

(U) FY 1999 ($ in Thousands):

- (U) $20,680 Focus program on unconventional imaging techniques for mostly space-based surveillance applications. Study properties and technological opportunities in contaminated plasma physics and air plasmas. Investigate microelectromechanical devices for micro-satellite and unmanned aerial vehicle applications. Explore opportunities in physics for soft kill with emphasis on destruction of chemical and biological weapons.
- (U) $20,680 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	23,179	20,574	21,070	21,473	Cont
(U) Current Budget Submit/FY 1998 PB	17,613	18,503	20,362	20,680	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0602601F, Phillips Laboratory.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2302

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2302 Solid Mechanics and Structures	14,341	14,384	15,608	15,838	16,235	16,526	16,987	17,623	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project seeks to develop a fundamental understanding of the behavior of aerospace materials, structures, and supporting facilities, leading to cost-effective development and safe and reliable operation of superior weapons and defensive systems. Research includes such diverse topics as the micromechanical design of advanced materials, modeling and simulation of the dynamic behavior of aircraft, missiles, and large space structures, and technology integration for the performance and survivability enhancement of these systems. This research will result in expanding the fundamental knowledge base to better understand the mechanics of deformation and damage of aerospace materials and structures. Also, this research will lead to an improved understanding of the aeroelastic and acoustic behavior of airframe and engine structures, and the dynamic behavior of launch vehicles and space structures.

(U) FY 1996 ($ in Thousands):
- (U) $14,341 Studied the mechanics of metal and composite processing and manufacturing, such as chemical vapor infiltration and deformation forming, including the highly nonlinear and dissipative behavior of material systems undergoing change. Developed models for ceramic-matrix composites subjected to cyclic loading at various frequencies. Continued research into improved non-destructive evaluation techniques for the detection of corrosion and internal damage in aging aircraft structures.
- (U) $14,341 Total

(U) FY 1997 ($ in Thousands):
- (U) $14,384 Develop models for three-dimensionally reinforced composite materials. Continue research of the scaling issues in structural mechanics and develop necessary computational techniques for handling homogenization. Develop a first principles understanding of the behavior of particulate systems and their interaction with the surrounding environment. Begin investigation to understand the fundamental behavior of vibro/acoustic systems and aeroelastic structures.
- (U) $14,384 Total

(U) FY 1998 ($ in Thousands):
- (U) $15,608 Continue to investigate the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials. Obtain quantitative relationships to describe the fundamental mechanics governing the behavior of particulate systems. Examine issues related to dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems. Investigate the fundamental behavior of actuator/structure interaction for control of shell structures in vibro/acoustic environments. Develop a fundamental understanding of the behavior of aeroelastic structures.
- (U) $15,608 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2302

(U) FY 1999 ($ in Thousands):

- (U) $15,838 Continue to investigate the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials. Develop models for predicting the dynamic and material behavior of structures for micro-electromechanical systems. Continue to investigate quantitative relationships that describe the fundamental mechanics governing the behavior of particulate systems. Develop models to predict and control the response of shell structures in vibro/acoustic environments. Develop models to predict and control the response of aeroelastic structures.
- (U) $15,838 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	14,505	15,994	16,381	16,687	Cont
(U) Current Budget Submit/FY 1998 PB	14,341	14,384	15,608	15,838	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0602203F, Aerospace Propulsion.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2303

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2303 Chemistry	28,539	30,560	31,096	31,764	32,576	33,072	34,019	35,112	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: In the chemistry research program, knowledge and understanding is sought in chemical synthesis and reactivity, polymer chemistry, surface science, and molecular dynamics. The focus is on building the knowledge base required to develop new materials and to improve the synthesis of existing materials. Specific research focus areas include functional and structural materials, electronic and photonic materials, biomimetic materials, electromagnetic and conventional weaponry, propellants, and environmentally safer materials. This program conducts novel synthesis and characterization of higher performance and lower cost nonmetallic and biomimetic materials for application as infrared sensors, and safer, more efficient fire suppressants and deicer/anti-ice materials, and mechanistic studies of biological corrosion and semiconductor nanolithography. The chemistry program also investigates effects of chemical and morphological structures on functional and mechanical properties of polymeric materials. The program also explores atomic and molecular surface interactions that can limit performance of electronic devices, compact power sources, and lubricant materials, and investigates molecular energy release mechanisms and energy storage in metastable molecular systems to foster advances in laser weapons development and new chemical propellants.

(U) FY 1996 ($ in Thousands):
- (U) $28,539 Developed and demonstrated electrochromic polymers with improved switching speed and stability. Isolated and purified high-activity insect antifreeze protein for application in low-temperature fuels. Developed non-volatile precursor for fire protection agent. Developed new technique for growing large area nonlinear optic films of organic salts. Developed methodology for quantum molecular dynamics simulations. Demonstrated optically-assisted poling technique and materials for microwave modulation in radars.
- (U) $28,539 Total

(U) FY 1997 ($ in Thousands):
- (U) $30,560 Continue research on low-cost biomimetic approaches to improved materials for electronic and electro-optical applications. Expand research on photorefractive polymers. Initiate research on ceramic precursors covering synthesis, processing fundamentals, and precursor/ceramic property relationships. Initiate research in chemical corrosion of aluminum and aluminum alloys. Investigate the effects of solvation and condensed media effects on the chemical synthesis of energetic materials.
- (U) $30,560 Total

(U) FY 1998 ($ in Thousands):
- (U) $31,096 Perform research on biological transduction mechanisms and biomimetic materials for infrared sensors. Study partially compatible polymer blends for structural and functional applications. Explore surface growth and characterization processes of thin films. Investigate chemical processing methods for producing nanophase ceramics and laminated materials.
- (U) $31,096 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2303

(U) FY 1999 ($ in Thousands):

- (U) $31,764 Conduct studies on chemical and photochemical deterioration in organic coatings. Address research on long-term durability of polymers. Investigate novel materials for compact power sources for rechargeable systems. Develop and apply methods for simulating molecular energy transfer in extreme aerospace environments.
- (U) $31,764 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	30,959	34,112	34,964	35,616	Cont
(U) Current Budget Submit/FY 1998 PB	28,539	30,560	31,096	31,764	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE: February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences	PROJECT: 2304

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2304 Mathematical and Computer Sciences	28,589	30,828	34,254	34,859	35,647	36,293	37,226	38,414	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This research focuses on mathematical modeling, simulation, and control of complex systems and provides analytical and computational methods. Topics include: effective utilization of high-performance computers; control of aerospace systems; models and computational tools for the design of aircraft, missiles, or other weapons; efficient production of large-scale, well documented computer programs and software; communication and information theory; signal processing; artificial intelligence in surveillance systems or independent weapons; reliability and maintainability; and the allocation of resources in logistics or operational activities using ideas from optimization and linear programming theories.

(U) FY 1996 ($ in Thousands):
- (U) $28,589 Investigated the capacity for image enhancement and data storage manipulation to facilitate the transmission of information over limited bandwidths. Transitioned the theory of invariants in vision to efficient automatic object recognition technology. Developed optimal control methods that allow for effective pulse-shaping for high-power microwave. Studied combinations of Artificial Intelligence and Operations Research methods to provide real-time reactive planning strategies.
- (U) $28,589 Total

(U) FY 1997 ($ in Thousands):
- (U) $30,828 Transition theories of student models to efficient computer mediated training. Study methods for managing large amounts of dissimilar information for use on distributed heterogeneous processors to enable real-time battlefield collaboration. Develop evaluation methods that permit the simulation of combustion processes for conventional warhead design problems.
- (U) $30,828 Total

(U) FY 1998 ($ in Thousands):
- (U) $34,254 Pursue research necessary to design and use effectively vision-directed trackers and robust feedback controllers for environments with severely degraded image quality. This research will impact the design of improved trackers for actively illuminated objects through a turbulent atmosphere, as occurs in the airborne laser problem. Investigate computational frameworks enabling robust, efficient multidisciplinary design of complex aerospace systems. Nonlinear control design methods will be examined that permit the design of novel aerospace vehicles with multiple reduced signature effectors.
- (U) $34,254 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2304

(U) FY 1999 ($ in Thousands):

- (U) $34,859 Research on computational mathematics will address the development of numerically accurate algorithms to address important issues in drag and heat reduction for hypersonic vehicle technology. Develop algorithms incorporating active control procedures involving magnetohydrodynamics, shock shape modification, and shock shape manipulation.
- (U) $34,859 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	31,105	34,278	35,187	35,792	Cont
(U) Current Budget Submit/FY 1998 PB	28,589	30,828	34,254	34,859	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602702F, Command, Control, and Communications.
- (U) PE 0603728F, Advanced Computer Technology.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2305

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2305 Electronics	27,777	27,866	30,301	30,553	31,630	32,400	33,308	34,358	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Research in this project emphasizes electronic devices and systems that enable new Air Force capabilities such as battle information management systems, countermeasures, sensors, and the more electric aircraft concept. The goals are to increase the data and information processing speed of electronic systems, to firmly control their complexity and reliability, and to improve the security and reliability of information and data transmission. Research is conducted in electronic processes which will enable the engineer to model and predict performance of electronic materials, devices, and systems for high-speed digital and analog signal processing, microwave and millimeter wave signal and power generation, superconducting, optical signal processing, and radiation effects.

(U) FY 1996 ($ in Thousands):
- (U) $27,777 Found new materials and device configurations which tolerate electronic operation beyond current military specifications, up to 300°C. Established quantum effects limiting further down scaling of silicon devices. Demonstrated feasibility of active silicon-based opto-electronic devices. Demonstrated holographic approaches for high density optical information storage memories. Created entirely novel concepts for digital high data rate superconductive circuits. Improved superconductive quantum interference devices (SQUIDs) for reliable hidden corrosion detection.
- (U) $27,777 Total

(U) FY 1997 ($ in Thousands):
- (U) $27,866 Explore opportunities to tailor electronic and photonic properties in artificial three-dimensionally ordered structures. Investigate new device and circuit concepts based on three-dimensional integration. Continue to examine radiation hardened ultrafast electronic, photonic, and sensor technology.
- (U) $27,866 Total

(U) FY 1998 ($ in Thousands):
- (U) $30,301 Continue science support for strategically important technologies which promise substantial down stream performance and cost improvements. Special attention is given to innovative approaches to ultrafast, real-time avionics concepts, to advancing the state-of-the-art in optical computing storage, and to improving the precision of space surveillance and targeting.
- (U) $30,301 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2305

(U) FY 1999 ($ in Thousands):

- (U) $30,553 Focus program on interface control and stability in semiconductor quantum structures for improved laser and detector applications, including low photon count photo receivers. Emphasize growth and characterization of non-stoichiometric antimonide ternaries as most promising material for mid and long wavelength infrared (IR) detector arrays. Investigate novel methods to passivate compound semiconductors with the goal of obtaining complementary electron device structures for ultrahigh frequency logic.
- (U) $30,553 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	28,097	30,982	31,731	32,324	Cont
(U) Current Budget Submit/FY 1998 PB	27,777	27,866	30,301	30,553	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0602702F, Command, Control, and Communications.
- (U) PE 0603728F, Advanced Computer Technology.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE: February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences	PROJECT: 2306

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2306 Structural Materials	15,031	15,081	16,100	16,338	16,752	16,958	17,641	18,100	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Research focuses on metallic, polymeric, and ceramic and nonmetallic structural materials. Materials research provides the knowledge for improving the performance, cost, and reliability of structural materials. Structural materials research studies a broad range of material properties such as strength, toughness, fatigue resistance, and corrosion resistance of airframe, turbine engine, and spacecraft materials. Emphasis is on refractory alloys, intermetallics, polymer composites, metal and ceramic matrix composites, and advanced ceramics, such as alumina, silicon carbide, silicon nitride, and carbon/carbon. Research in new processing methods complements research on materials properties. Direct goals of this program are to increase the operating temperature of engine materials which will further increase thrust-to-weight ratio of engines, develop improved aerospace vehicle structural materials, and control or eliminate advance material reliability issues related to high temperature strength, toughness, fatigue, and environmental conditions.

(U) FY 1996 ($ in Thousands):

- (U) $15,031 Researched polymer composites bonding integrity and strength enhancement. Investigated processing approaches to the synthesis of functionally graded materials with emphasis on achieving balanced mechanical properties. Researched microstructural mechanisms controlling mechanical performance of nanocrystalline materials. Studied processing approaches to producing bulk metallic glass alloys. Expanded research on the oxidation resistance and phase stability of high temperature refractory alloys. Investigated high temperature fracture mechanics, static and dynamic fatigue, and mechanisms of surface strengthening of monolithic and composite ceramic materials. Continued fundamental studies, both theoretical and experimental, on structure and properties of ceramic/metal and ceramic/ceramic interfaces at high temperatures. Researched oxidation-resistant interfaces for composites and coatings for carbon/carbon materials and investigated the environmental effects of processing/property relationships of carbon/carbon composites.
- (U) $15,031 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2306

(U) FY 1997 ($ in Thousands):

- (U) $15,081 Investigate processing approaches to the synthesis of nanolaminated thin oxide films with emphasis on achieving balanced mechanical and thermal properties. Initiate research to examine microstructural relationships in metal alloys to their high cycle fatigue behavior. Study microstructural relationships and interfacial stability of the mechanical properties of metallic and intermetallic microlaminated materials. Expand research in bulk metallic glass alloys to include effect of reinforcing mechanisms on fracture and fatigue mechanisms. Continue to research microstructural mechanisms controlling mechanical performance of nanocrystalline materials. Elucidate microstructural aspects of high temperature fracture mechanics, static and dynamic fatigue, and mechanisms of surface strengthening of monolithic and composite ceramic materials. Continue studies on polymer composites chemical and physical behavior for improving aerospace structural strength. Continue fundamental studies, both theoretical and experimental, on structure and properties of ceramic/metal and ceramic/ceramic interfaces at high temperatures. Continue studies of new oxidation-resistant interfaces for composites and coatings for carbon/carbon materials. Study doping of carbon to improve oxidation resistance.
- (U) $15,081 Total

(U) FY 1998 ($ in Thousands):

- (U) $16,100 Continue research on metallic and intermetallic microlaminated materials to include studies on processing and thermal behavior. Examine the high temperature fatigue behavior of new refractory alloys and the effect of environmental sensitivity on properties. Explore the concept of ceramic and crystalline reinforcement of bulk metallic glass alloys to enhance mechanical performance. Continue work on the understanding of microstructural effects on the high cycle fatigue behavior of metallic alloys.
- (U) $16,100 Total

(U) FY 1999 ($ in Thousands):

- (U) $16,338 Investigate new, very high temperature intermetallic alloys that can provide sustained mechanical performance at temperatures over 2300°F. Continue research on ceramic and crystalline reinforcement of bulk metallic glass alloys as a means to enhance mechanical performance. Continue work in relating first principal theories to continuum level models to provide realistic predictors of bulk material behavior.
- (U) $16,338 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2306

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	15,203	16,767	17,172	17,492	Cont
(U) Current Budget Submit/FY 1998 PB	15,031	15,081	16,100	16,338	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0708011F, Manufacturing Technology.
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0602201F, Aerospace Flight Dynamics.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 2307

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2307 Fluid Mechanics	11,071	11,107	13,294	13,489	13,827	14,076	14,471	14,927	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Research involves turbulence prediction and control, unsteady and separated flows, hypersonics, and internal fluid dynamics. This research provides fundamental knowledge, tools, data, concepts, and methods for improving the efficiency, effectiveness, and reliability of aerospace vehicles. Research provides an understanding of key fluid flow phenomena, improves theoretical models for aerodynamic prediction and design, and originates flow control concepts and predictive methods to expand current flight performance boundaries. Research includes the development of computational methods for complex flows, prediction of real gas effects in high-speed flight, control and prediction of turbulence in flight vehicles, propulsion systems, aero-optic applications, the dynamics of unsteady and separated flows, thrust vectoring and high lift concepts associated with enhanced performance and maneuverability, heat transfer and compressor instabilities in gas turbine engines, flow-structure interactions in both external and internal flows, and transport phenomena in structural materials processing.

(U) FY 1996 ($ in Thousands):

- (U) $11,071 Investigated active heat transfer reduction concepts in wall jet flows. Continued the development of the theory of trailing edge receptivity and explored active control concepts for supersonic jet screech suppression. Investigated dynamic aerothermoelastic effects associated with supersonic and hypersonic maneuvering flight vehicle configurations. Researched unsteady aeroelasticity in gas turbine compressors emphasizing inlet-compressor interactions.
- (U) $11,071 Total

(U) FY 1997 ($ in Thousands):

- (U) $11,107 Develop computational techniques for airbreathing propulsion systems, including new turbulence models to predict unsteady, compressible, internal flow phenomena. Integrate micro-actuators, sensors, and nonlinear control algorithms to enable high-lift airfoil design concepts. Investigate actively bladed high-speed compressors to simultaneously suppress noise, flutter, and surge in gas turbine engines. Incorporate new Large Eddy Simulation computational techniques to predict unsteady three-dimensional flows around high-speed flight vehicle configurations.
- (U) $11,107 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2307

(U) FY 1998 ($ in Thousands):

- (U) $13,294 Continue research to develop computational techniques for airbreathing propulsion systems, including new turbulence models to predict unsteady, compressible, internal flow phenomena. Integrate micro-actuators, sensors, and nonlinear control algorithms to enable high-lift airfoil design concepts, drag reduction, and mixing control strategies. Investigate actively bladed high-speed compressors to simultaneously suppress noise, flutter, and surge in gas turbine engines. Continue studies of Large Eddy Simulation computational techniques to predict unsteady three-dimensional flows around high-speed flight vehicle configurations. Investigate unsteady aerodynamic forcing for high-cycle fatigue mitigation.
- (U) $13,294 Total

(U) FY 1999 ($ in Thousands):

- (U) $13,489 Continue research to develop computational techniques for airbreathing propulsion systems, including new turbulence models to predict unsteady, compressible, internal flow phenomena. Continue research to integrate micro-actuators, sensors, and nonlinear control algorithms to enable high-lift airfoil design concepts, drag reduction, and mixing control strategies. Investigate actively bladed high-speed compressors to simultaneously suppress noise, flutter, and surge in gas turbine engines. Continue studies of Large Eddy Simulation computational techniques to predict unsteady three-dimensional flows around high-speed flight vehicles configurations. Continue research on aerodynamic forcing for high-cycle fatigue mitigation.
- (U) $13,489 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2307

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	11,197	12,349	12,647	12,884	Cont
(U) Current Budget Submit/FY 1998 PB	11,071	11,107	13,294	13,489	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary;

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603211F, Aerospace Structures.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2308

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2308 Propulsion	10,654	10,686	11,293	11,359	11,647	11,858	12,194	12,583	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: Efforts include space power and propulsion, airbreathing propulsion, and propulsion diagnostics. Research is focused on the efficient utilization of energy in airbreathing engines and chemical and non-chemical rockets. Research is organized into the areas of chemically reacting flow, non-chemical energetics. Chemically reacting flows involve complex coupling between energy release through chemical reaction and the flow processes which transport chemical reactants, products, and energy. Non-chemical energetic systems include plasma and beamed energy propulsion for orbit raising space missions and efficient ultra-high energy techniques for space-based energy utilization. Thermal management of space-based power and propulsion systems will be addressed.

(U) FY 1996 ($ in Thousands):
- (U) $10,654 Meshed direct simulation Monte Carlo/particle-in-cell simulations. Successfully predicted Hall Thruster ionized plume effects on satellites. Decomposition studies of quadricyclane led to molecular level modification and a five-fold increase in decomposition rate, energy, and elimination of soot precursors. Discovered that alkali seeding doubles hydrogen arcjet efficiency. Demonstrated that for supercritical propellant injection in gas turbines, scramjets, and rockets, secondary atomization is the primary rate-controlling physical process. Research on amplified spontaneous emissions demonstrated that they were a potentially powerful new spectroscopic measurement technique for characterizing light atomic species in plasma spacecraft thrusters.
- (U) $10,654 Total

(U) FY 1997 ($ in Thousands):
- (U) $10,686 Continue combustion product formation studies and the investigation of supercritical fuel behavior. Conduct additional computational and experimental studies of turbulent combustion and droplet dispersion, vaporization, and combustion. Study combustion instability in liquid-fueled rockets and continue experimental and numerical investigation of plasma thrusters for orbit maneuvering and station keeping. Initiate research on hydrocarbon-fueled scramjet propulsion.
- (U) $10,686 Total

(U) FY 1998 ($ in Thousands):
- (U) $11,293 Continue the investigation of supercritical fuel behavior and perform research on hydrocarbon-fueled scramjet propulsion. Conduct additional computational and experimental studies of turbulent combustion and droplet dispersion, vaporization, and combustion and study storable propellant combustion instability in liquid-fueled rockets. Continue experimental and numerical investigation of plasma thrusters for orbit maneuvering and station keeping. Perform research on microsatellite propulsion.
- (U) $11,293 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2308

(U) FY 1999 ($ in Thousands):

- (U) $11,359 Continue research on hydrocarbon-fueled scramjet and microsatellite propulsion. Apply newly developed supercritical and transcritical models to computational and experimental studies of turbulent combustion and droplet dispersion, vaporization, and combustion.
- (U) $11,359 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	10,777	11,882	12,169	12,397	Cont
(U) Current Budget Submit/FY 1998 PB	10,654	10,686	11,293	11,359	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603211F, Aerospace Structures.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2309

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2309 Terrestrial Sciences	14,170	0	0	0	0	0	0	0	14,170	TBD

(U) A. **Mission Description and Budget Item Justification:** Provide fundamental research in seismology. Basic research in seismology is required to understand the propagation through the earth of seismic waves caused by underground explosions and to locate the source of such events. Research is required to identify seismic signatures which can be used to discriminate between natural events (for example, earthquakes), and explosions and other man-caused events. This research will provide an improved seismic monitoring capability required to effectively monitor compliance with nuclear test ban treaty agreements and will also help detect nuclear proliferation by improving the detection and identification of small nuclear tests. In FY 1997 and out, funding for Air Force seismic research efforts has been transferred to PE 0305145F, Arms Control Implementation.

(U) FY 1996 ($ in Thousands):
- (U) $14,170 Continued research relating to discriminating between nuclear underground tests and other types of underground and surface non-nuclear explosions. Continued location and depth of seismic events research. Continued support of the Global Seismic Network/Joint Seismic Program.
- (U) $14,170 Total

(U) FY 1997: Not Applicable.

(U) FY 1998: Not Applicable.

(U) FY 1999: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2309

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	12,007	0	0	0	Cont
(U) Current Budget Submit/FY 1998 PB	14,170	0	0	0	TBD

(U) Change Summary Explanation:

Funding: In FY 1997 and out, funding for Air Force seismic research efforts has been transferred to PE 0305145F, Arms Control Implementation.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2310

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2310 Atmospheric Sciences	7,225	7,247	7,172	7,381	7,471	7,609	7,829	8,084	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Areas of emphasis include ionospheric research and meteorology. This research includes the physics, dynamics, and chemistry of processes that determine the structure and variability of the earth's atmosphere. Atmospheric properties such as wind, density, clouds and precipitation, ionization, and optical/infrared (IR) transmission/emissivity all affect the performance of Air Force systems. Research includes new measurement techniques and the development of models for specifying and predicting weather and other atmospheric conditions. Emphasis is placed on understanding fundamental atmospheric processes and their impacts on optical and IR weapon systems, and on understanding the dynamics and structure of the ionosphere that affect communications and surveillance systems. Major research efforts focus on ionospheric dynamics, mesoscale meteorology, triggered and natural lightning, cloud prediction, and models which define the optical structure of the atmosphere.

(U) FY 1996 ($ in Thousands):
- (U) $7,225 Researched satellite data retrieval algorithms with emphasis on improved utilization of multispectral data. Studied atmospheric electrification with emphasis on tropospheric discharges which may extend into the stratosphere and the ionosphere. Improved our understanding of atmospheric structure within the mesosphere and thermosphere with emphasis on relationships to optical transmissivity of atmosphere.
- (U) $7,225 Total

(U) FY 1997 ($ in Thousands):
- (U) $7,247 Investigate improved atmospheric modeling capabilities with emphasis on improved four-dimensional data assimilation techniques for integrating multispectral satellite data utilization in model initialization schemes. Conduct studies related to WSR-88D Doppler radar to develop methodologies for improved identification of aliased signals, turbulence, and severe weather. Continue research on atmospheric electrification with emphasis on optical characteristics of upper atmospheric discharges.
- (U) $7,247 Total

(U) FY 1998 ($ in Thousands):
- (U) $7,172 Investigate improved atmospheric simulation capabilities with emphasis on initial development of spatially and temporally correlated fields of winds, clouds, relative humidity, visibility, etc. Conduct observational experiments which seek to expand knowledge about the characteristics of the tropical ionosphere and its highly variable density regimes. Research techniques for improved remote sensing of the three-dimensional structure of cloud fields for initialization of sophisticated prediction models.
- (U) $7,172 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2310

(U) FY 1999 ($ in Thousands):

- (U) $7,381 Utilize field experiment observations to develop improved theoretical models of ionospheric dynamics of neutral hydrogen loss processes and improved estimation of total electron concentrations. Develop improved atmospheric radiation models which more realistically estimate solar radiation impacts related to cloud field dynamics. Investigate improved soil moisture models, which account for critical hydrometeorological processes, to improve surface temperature, moisture, and cloud forecasts.
- (U) $7,381 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	7,309	8,058	8,307	8,410	Cont
(U) Current Budget Submit/FY 1998 PB	7,225	7,247	7,172	7,381	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603220C, Surveillance, Acquisition, Tracking, and Kill.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2311

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2311 Space Sciences	5,214	5,229	4,962	5,040	5,076	5,276	5,336	5,518	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: The objective of this project is to provide basic knowledge of the space environment and solar activity for the design and calibration of advanced Air Force systems relevant to operations in and through near-earth space. The project also supports the Air Weather Service (AWS) by improving observing and forecasting techniques that support operational military systems in space environments. Theoretical and empirical descriptions and models of the physics of the sun and the earth's magnetosphere, which are critical elements of future AWS prediction models and radiation belt codes, are being investigated.

(U) FY 1996 ($ in Thousands):

- (U) $5,214 Transitioned solar activity models to 6.2 for solar forecasting applications. Defined processes throughout the solar-terrestrial system using simultaneously measured solar, solar wind, and magnetosphere satellite data. These results will be used for the prediction of geomagnetic storms which affect ground and space assets. Completed models of radiation in plasmas, which are required to assess communications using electron beams or space borne antennas. Obtained data from a space shuttle experiment to validate electron beam propagation models, examine plasma effects on large space structures, and assess tethers in space as power generators.
- (U) $5,214 Total

(U) FY 1997 ($ in Thousands):

- (U) $5,229 Integrate solar activity and coronal mass ejection models with interplanetary, magnetosphere, ionosphere, and thermosphere models to generate a unified global space weather mode scheduled to be transitioned to the Air Force Space Forecast Center in FY 1998. Use space- and ground-based data to test the models and to examine the characteristics of space environment particles and fields during the minimum of solar cycle 22 and the rise of cycle 23. Evaluate secular variations of the geomagnetic field and their effect on radiation dosage over the past three solar cycles. Assess the utility of these variations as a tool for long-term planning of the lifetimes of Air Force and DoD spacecraft. Use high latitude satellite data to establish solar wind signatures for geomagnetic storm alerts. Study satellite degradation by the radiation belts to provide the basis for developing more survivable, robust, Air Force satellite systems.
- (U) $5,229 Total

(U) FY 1998 ($ in Thousands):

- (U) $4,962 Research will be undertaken to find the unknown trigger mechanism for geomagnetic substorms in the earth's magnetosphere. These substorms are the principal manifestation of disturbed space weather. Physical modeling and analysis will lead to the development of models which will be verified against observational data.
- (U) $4,962 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2311

(U) FY 1999 ($ in Thousands):

- (U) $5,040 Space weather at geosynchronous satellites will received increased emphasis to understand the dynamics and mitigate the effects of damage on communication satellites done by near-relativistic electron fluxes. The delayed reaction of two to three days between the onset of high gusts of solar wind and the storm of energetic electrons will be analyzed.
- (U) $5,040 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	5,273	5,814	5,955	6,066	Cont
(U) Current Budget Submit/FY 1998 PB	5,214	5,229	4,962	5,040	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0302101F, Geophysics.
- (U) PE 0602702F, Command, Control, and Communications.
- (U) PE 0603410F, Space System Environmental Interactions.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences		PROJECT: 2312

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2312 Biological Sciences	15,344	15,391	15,986	16,119	16,525	16,923	17,300	17,847	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project consists of two research areas: biodegradation and the toxicology of biohazards; and chronobiology and neural adaptation. Understanding how microbes degrade Air Force chemicals will enable the development of efficient and cost-effective strategies for cleaning up Air Force bases and preventing exposure to hazards due to Air Force operations. Likewise, knowledge of the mechanisms by which Air Force chemical and physical (lasers and microwaves) agents produce toxic effects will enable the development of safety assessment strategies and technologies to ensure the hazard-free development and use of future aerospace materials and systems. Basic research in neuroscience and chronobiology will result in new strategies to prevent G-induced loss of consciousness in pilots, impaired performance due to jet-lag and shift-work, night operations, and the loss of life and aircraft due to stress, inattention, or lack of vigilance.

(U) FY 1996 ($ in Thousands):

- (U) $15,344 Novel biochemistry was elucidated in the trinitrotoluene (TNT) degradation pathway of microorganisms, providing the scientific basis for the development of improved cleanup technology. Research findings on harmful laser-eye interactions led to the forwarding of recommendations to the Tri-Service Laser Safety Group for interim changes in the current national laser safety standards. Experimental data from toxicity studies on an Air Force ground water contaminant were incorporated into complex mathematical models that extrapolate toxicity findings in rodents to humans. Research has shown how adrenal steroids act on the brain center important for spatial learning, episodic memory and judgment, providing a biological explanation of why moderate levels of adrenal steroids facilitate cognition but high levels of steroids inhibit it. Acute caffeine doubles the time to G-loss of consciousness in rodents, but chronic caffeine ingestion has no effect.
- (U) $15,344 Total

(U) FY 1997 ($ in Thousands):

- (U) $15,391 Genes for novel degradative enzymes will continue to be cloned and sequenced. Research will expand to include ocular effects produced by infrared as well as visible laser pulses. Mechanistically based "test-tube" responses that are predictive of chemically induced effects in animals will continue to be explored. Priority will be given to investigations that examine the behavioral consequences of biochemical regulation of nervous system function to elucidate relationships between brain chemistry and performance.
- (U) $15,391 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2312

(U) FY 1998 ($ in Thousands):

- (U) $15,986 Research will continue on understanding the biomolecular reaction mechanisms of novel degradative enzymes. Research efforts will begin to switch from characterizing laser-induced lesions at the gross tissue level to the subcellular and molecular level. Computational methods for predicting chemical toxicity will be examined together with mechanistically based, cell/tissue-culture models of assessment. Research on the circadian timing system and the biology underlying fatigue will be augmented to include individual differences and performance prediction.
- (U) $15,986 Total

(U) FY 1999 ($ in Thousands):

- (U) $16,119 Molecular biology techniques will be used to expand the degradative capacity of newly discovered enzymes. Research will continue to investigate the biochemical mechanisms of cell killing by ultrashort laser pulses. Research will continue to explore the integration of short-term, cell culture techniques with computational methods for predicting chemical toxicity. Research will continue to examine biological mechanisms responsible for circadian rhythmicity and how these mechanisms influence skilled human performance.
- (U) $16,119 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences — PROJECT: 2312

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	15,521	17,113	17,527	17,854	Cont
(U) Current Budget Submit/FY 1998 PB	15,344	15,391	15,986	16,119	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602202F, Human Systems Technology.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 2313

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2313 Human Performance	8,709	8,738	9,057	9,190	9,422	9,592	9,861	10,173	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project provides fundamental knowledge of information processing in humans and other complex organisms needed to advance technologies for autonomous systems, command and control, human systems integration, and personnel selection and training. Research on sensory systems impacts technologies of computer image and speech processing, human interface, sensors and sensor fusion. Research on cognitive and perceptual processes impacts technologies of selection, education and training, command and control, and adaptive autonomous systems. Supported areas of research include Sensory Systems, with emphasis on vision and hearing, Cognition, Perception, Intelligent Tutors, and Team Situational Awareness.

(U) FY 1996 ($ in Thousands):

- (U) $8,709 Developed brain activation model to analyze scalp electrical recordings to monitor mental effort and learning. Developed techniques that permit more sensitive measurement of relations between individual abilities and rates of progress in various instructional modes. Developed model of visual search which was used to predict the time to locate visual targets in cluttered environments. Demonstrated feasibility of using three-dimensional sound localization to reduce pilot spatial disorientation.
- (U) $8,709 Total

(U) FY 1997 ($ in Thousands):

- (U) $8,738 Investigate novel sensory systems such as animal infrared sensors. Continue vision, hearing, cognition, perception, intelligent tutors, and team situational awareness research. Determine optimal image compression for human viewing. Determine mechanisms of human auditory localization. Evaluate models of advising in the context of intelligent tutoring. Determine the performance dimensions of human psychomotor abilities.
- (U) $8,738 Total

(U) FY 1998 ($ in Thousands):

- (U) $9,057 Begin research in sensory integration. Continue research on novel animal sensing systems. Model human decision-making in selected dynamic task environments. Experimentally evaluate models of motor performance in virtual environments. Extend models of spatial orientation to performance in naturalistic versions of laboratory tasks.
- (U) $9,057 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2313

(U) FY 1999 ($ in Thousands):

- (U) $9,190 Continue research in sensory integration and mechanisms of animal infrared sensing systems. Investigate sensory-motor integration processes. Explore confidence concepts related to use of virtual environments for tele-command of adaptive autonomous systems.
- (U) $9,190 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	8,812	9,715	9,950	10,136	Cont
(U) Current Budget Submit/FY 1998 PB	8,709	8,738	9,057	9,190	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0602702F, Command, Control, and Communication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 4113

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4113 Science and Engineering Education Programs	12,071	15,143	17,347	17,600	18,037	18,360	18,870	19,463	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project stimulates scientific and engineering education and increases the interaction between the broader research community (including the international research community) and the Air Force laboratories. Emphasis is placed on increasing the number of U.S. citizens, especially women and minorities, with advanced degrees in science and engineering. These programs include: the Summer Faculty Research Program under which selected university faculty members conduct research at Air Force labs; the Graduate Student Research Program where graduate students in areas of interest to the Air Force perform research at Air Force labs; the University Resident Research Program where faculty members spend one year at an Air Force lab contributing to Air Force research needs and operations; the U.S. Air Force National Research Council (NRC) Resident Research Associateship Program which provides outstanding post-doctoral and senior scientists and engineers opportunities to research problems of their own choice that are compatible with the research interests of selected Air Force labs; the Laboratory Graduate Fellowship Program which is designed to stimulate doctoral candidate interest in Air Force labs and the research programs of those labs; and the National Defense Science and Engineering Graduate Fellowship Program which is jointly sponsored by the Army, Navy, Air Force, the Defense Advanced Research Projects Agency for the purpose of increasing the number of U.S. citizens trained in science and engineering, and various international programs such as Windows on Science which provides insight and experience in international research.

(U) FY 1996 ($ in Thousands):

- (U) $12,071 The Summer Faculty Research Program supported 175 university faculty for up to 12 weeks at Air Force laboratories. The Graduate Student Research Program supported 125 students for up to 12 weeks at Air Force laboratories. Five percent of these Summer Research Program participants are members of a historically black or minority college. The University Resident Research Program supported 22 university researchers. The National Research Council Resident Research Associateship Program supported 70 fellows, two-thirds post-doctoral researchers and one-third senior researchers. The National Defense Science and Engineering Graduate Fellowship Program supported 75 fellowships with ten percent set aside for members of ethnic minority groups underrepresented in science and engineering. Also, under the minority institution program, a pioneering outreach effort to Native American institutions of higher education supported development of telecommunications capability for research efforts.
- (U) $12,071 Total

(U) FY 1997 ($ in Thousands):

- (U) $15,143 This program will continue to support scientific and engineering education.
- (U) $15,143 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 4113

(U) FY 1998 ($ in Thousands):
- (U) $17,347 This program will continue to support scientific and engineering education.
- (U) $17,347 Total

(U) FY 1999 ($ in Thousands):
- (U) $17,600 This program will continue to support scientific and engineering education.
- (U) $17,600 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	15,244	16,837	17,160	17,526	Cont
(U) Current Budget Submit/FY 1998 PB	12,071	15,143	17,347	17,600	Cont

(U) Change Summary Explanation:

Funding: Changes since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0601103D, University Research Initiative.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	71,142	77,877	70,224	74,503	76,618	83,506	82,674	85,189	Continuing	Continuing
4347 Materials for Structures, Propulsion, and Subsystems	43,832	50,600	42,214	45,311	46,328	50,730	50,269	51,917	Continuing	Continuing
4348 Materials for Electronics, Optics, and Survivability	13,222	13,007	12,981	13,698	14,223	15,259	15,279	15,676	Continuing	Continuing
4349 Materials Technology for Sustainment	14,088	14,270	15,029	15,494	16,067	17,517	17,126	17,596	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Applied Research program is the primary source of advanced materials and processes to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems. Structural, propulsion, and sub-systems materials and processes are developed for aircraft, missile, space, satellite, and launch systems applications. Electronic and optical, advanced electromagnetic, and laser protection materials and processes are developed for application in Air Force aircraft, missile, space, and personnel protection systems. Advanced nondestructive materials evaluation methods, materials design data, pollution prevention materials, materials failure analysis, and materials repair methods are developed to improve the sustainment of Air Force systems for the current and future warfighters. Note: In FY 1997, Congress added $7.5 million and $1 million for composite materials research and advanced paint systems, respectively, which explains the perceived decrease in FY 1998. In FYs 1999 and out, additional emphasis has been placed on improved materials, space systems, and aging aircraft.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	71,683	72,360	73,421	78,149	Cont
(U) Appropriated Value	74,534	80,860			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-1,444	-1,813			
b. SBIR	-972	-1,094			
c. Omnibus/Other Above Threshold Reprogrammings	-970	-76			
d. Below Threshold Reprogrammings	-6				
(U) Current Budget Submit/FY 1998 PB	71,142	77,877	70,224	74,503	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 4347

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4347 Materials for Structures, Propulsion, and Subsystems	43,832	50,600	42,214	45,311	46,328	50,730	50,269	51,917	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops materials technologies for aircraft, spacecraft, and missiles with improved affordability, maintainability, and enhanced performance of current and future Air Force systems. Advanced thermal protection and carbon-carbon (C-C) composites materials are developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet the requirements of aircraft, spacecraft, missiles, and ballistic reentry systems. A family of affordable lightweight materials are developed, including metals, metallic and nonmetallic composites, and ceramics which can provide upgraded capability for existing aircraft, spacecraft, missile, and propulsion systems to meet the requirements for new systems beyond the year 2000. Included are turbine engine materials with operating capabilities from 1700°F to 2800°F that will enable engine designs to double the thrust to weight of 1986 engine performance capabilities. Spacecraft material technologies are developed that are lightweight, dimensionally stable, noncontaminating, and resistant to the space environment. Alternative or replacement materials are developed to maintain the performance of aging operational reentry systems. Fluids, lubricants, seals, and other nonstructural material technologies are developed for the subsystems on aircraft, spacecraft, and missile systems as well as their propulsion systems

(U) FY 1996 ($ in Thousands):

- (U) $9,700 Developed C-C and thermal protection material technologies to improve operational capability of strategic and tactical systems. These materials offer significant benefits in weight savings, dimensional stability, and thermal conductivity as well as the historical benefit of very high temperature performance in extreme environments. These properties will lead to higher performance structures, and smaller more efficient heat removal systems on aerospace platforms resulting in lighter, cooler, and more reliable spacecraft and aircraft electronics packages.
  - (U) Evaluated and developed alternate/replacement heatshield and antenna window materials for fielded aging reentry vehicles.
  - (U) Validated advanced structural and thermal control composites and polymer-based protective coatings in space environments for C-C satellite and electronic thermal management.
- (U) $5,458 Developed nonstructural materials (such as fluids, lubricants, seals, greases, and wear coatings) for improved system performance, reduced toxicity, and reduced life cycle costs.
  - (U) Completed laboratory demonstration of fire resistant, low temperature hydraulic fluid for all Air Force aircraft.
  - (U) Evaluated and demonstrated low solvent content low-observable coatings for aircraft.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials PROJECT 4347

– (U) $10,256 Developed advanced nonmetallic composite structural materials for aircraft applications including lightweight airframes, control surfaces, aircraft canopies, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and bus structures. These materials technologies will offer significant benefits in weight savings compared with the use of traditional metallic counterparts.

- (U) Demonstrated a low-cost (30% part cost savings) organic matrix composite process for aircraft and turbine engine applications.
- (U) Completed laboratory demonstration of damage tolerant thermoplastic composite technology to secondary structural applications in advanced fighter aircraft.
- (U) Investigated in-flight material fatigue life modeling and prediction for composite aircraft structures.

– (U) $8,739 Developed affordable lightweight metallic materials that are considerably lighter than conventional aluminum and can withstand higher temperatures than currently available materials. Applications are in lighter aircraft and spacecraft structural components, more efficient space launch systems, and in high temperature, high performance engine components.

- (U) Evaluated initial design properties for gamma titanium aluminides for Integrated High Performance Turbine Engine Technology (IHPTET) demonstrator engines for 30% weight savings over superalloys.
- (U) Completed mechanical testing of conventional titanium-matrix metal matrix composites (MMC) for establishing a data base and developing an analytical model to be used in design of MMCs.

– (U) $9,679 Developed ceramic matrix composites and very high temperature metallics to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.

- (U) Evaluated the performance of a ceramic matrix composite for space launch applications.
- (U) Investigated potential for cerium oxide-based thermal barrier to improve temperature performance of turbine engine superalloy materials.
- (U) Demonstrated in situ control of ceramic fiber matrix interface coatings for improved composite strength, toughness, and durability for turbine engine applications.

– (U) $43,832 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials / PROJECT: 4347

(U) FY 1997 ($ in Thousands):

- (U) $9,284 Develop carbon-carbon (C-C) and thermal protection material technologies to improve operational capability of strategic and tactical systems.
  - (U) Conduct ground test validation of alternate/replacement heatshield and antenna window materials and deliver models for flight test demonstration for ballistic missile upgrades.
  - (U) Identify and evaluate a cost reducing one step C-C process for electronic packaging applications in aircraft and spacecraft.
- (U) $7,177 Develop nonstructural materials (such as fluids, lubricants, seals, greases, and wear coatings) for improved system performance, reduced toxicity, and reduced life cycle costs.
  - (U) Complete laboratory demonstration of polyalphaolefin (PAO)-based coolant with improved temperature stability and dielectric performance for Air Force airborne radar systems.
  - (U) Identify advanced lubricants and coating system technologies for application in aging aircraft and spacecraft.
- (U) $17,055 Develop advanced nonmetallic composite structural materials for aircraft applications including lightweight airframes, control surfaces, aircraft canopies, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and bus structures.
  - (U) Publish a composite patch design guide focusing on adhesively bonded materials and processing issues for the repair and life extension of aging aircraft.
  - (U) Demonstrate the viability of high modulus polymeric composites for lightweight spacecraft structural applications.
- (U) $8,596 Develop affordable lightweight metallic materials that are considerably lighter than conventional aluminum and can withstand higher temperatures than currently available materials.
  - (U) Complete material validation of titanium metal matrix composite (Ti MMC) actuator rods for use on thrust vectoring nozzles of advanced turbine engines.
  - (U) Identify and characterize the application potential of an advanced Ti MMC for use in next-generation gas turbine engines.
  - (U) Conduct initial high cycle fatigue (HCF) evaluations of titanium alloy to provide guidance on resolving HCF issues with existing and future Air Force turbine engines.
- (U) $8,488 Develop ceramic matrix composites and very high temperature metallics to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.
  - (U) Develop low-cost ceramic matrix processes that can reduce the cost of these composites by 40% of today's cost.
  - (U) Develop repair materials for low-observable and other ceramic composite structures.
- (U) $50,600 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials
	PROJECT: 4347

(U) FY 1998 ($ in Thousands):

- (U) $8,398 Develop carbon-carbon (C-C) and thermal protection material technologies to improve operational capability of strategic and tactical systems.
  - (U) Develop alternate/replacement nosetip and heatshield materials for ballistic missile flight test evaluation.
  - (U) Develop Global Positioning System antenna window material models with improved durability for ballistic missile flight test evaluation.
  - (U) Establish baseline criteria for assessment of the aging affects on materials from operational reentry vehicle heatshields which have been in service.
  - (U) Develop and test properties of a one step C-C process for aircraft and spacecraft electronic materials packaging applications.
- (U) $6,340 Develop nonstructural materials (such as fluids, lubricants, seals, greases, and wear coatings) for improved system performance, reduced toxicity, and reduced life cycle costs.
  - (U) Identify and evaluate materials for improved aircraft paint systems for reduced maintenance and demonstrate low glint, low-observable canopy transparency coating treatments for Air Force systems.
  - (U) Evaluate and develop and provide materials data to transition long life hydraulic fluid seals for aging aircraft systems.
  - (U) Develop advanced lubricants and coating system technologies for application in spacecraft moving mechanical assemblies.
- (U) $10,042 Develop advanced nonmetallic composite structural materials for aircraft applications including lightweight airframes, control surfaces, aircraft canopies, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and bus structures.
  - (U) Identify and evaluate processing techniques that will minimize residual stresses in organic matrix composites without adversely affecting mechanical or physical properties.
  - (U) Develop and demonstrate high modulus/thermally conductive polymeric composites for lightweight spacecraft structural applications.
  - (U) Develop three-dimensional (3-D) failure criteria for the prediction of the initial failure and progressive damage in bonded and bolted composite joints by coupling nondestructive damage observations with 3-D spline variation stress analysis.
- (U) $8,773 Develop affordable lightweight metallic materials that are considerably lighter than conventional aluminum or can withstand higher temperatures than currently available materials.
  - (U) Demonstrate titanium metal matrix composite (Ti MMC) actuator rods for advanced turbine engines.
  - (U) Evaluate usefulness of orthorhombic Metal Matrix Composites (MMCs) and gamma TiAl by engine testing a bladed ring (Bling) containing both materials.
  - (U) Continue detailed high cycle fatigue (HCF) evaluations of titanium alloy to provide guidance on resolving HCF issues with existing and future Air Force turbine engines.
  - (U) Demonstrate processing techniques for producing isotropic aluminum lithium thick plate products from 15,000 pound ingots for 10-20% weight reduction from replacement of aluminum in aircraft and develop welding techniques for space tankage.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials
	PROJECT 4347

- (U) $8,661 Develop ceramic matrix composites and very high temperature metallics to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.
  - (U) Develop ceramic matrix composite for space applications.
  - (U) Develop permanent mold thin wall casting processes that can reduce the cost of these high temperature components by 40% of today's cost.
  - (U) Develop repair materials and techniques for low-observable and other ceramic composite structures.
- (U) $42,214 Total

(U) FY 1999 ($ in Thousands):

- (U) $9,232 Develop carbon-carbon (C-C) and thermal protection material technologies to improve operational capability of strategic and tactical systems.
  - (U) Demonstrate alternate/replacement heatshield materials for ballistic missile flight test evaluation.
  - (U) Develop aging materials behavior, prediction, and phenomenology models for operational reentry vehicle heatshield materials.
  - (U) Demonstrate reduced processing time and cost of one step C-C process for electronic packaging applications in aircraft and spacecraft.
  - (U) Identify and evaluate concepts for replacement/qualification of aging materials for life management and life extension of operational reentry vehicles.
- (U) $6,764 Develop nonstructural materials (such as fluids, lubricants, seals, greases, and wear coatings) for improved system performance, reduced toxicity, and reduced life cycle costs.
  - (U) Develop materials for improved aircraft paint systems for reduced maintenance.
  - (U) Demonstrate advanced lubricants and coating system technologies for application in spacecraft moving mechanical assemblies.
  - (U) Demonstrate low glint, low-observable canopy transparency treatments for Air Force systems.
- (U) $10,722 Develop advanced nonmetallic composite structural materials for aircraft applications including lightweight airframes, control surfaces, aircraft canopies, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and bus structures.
  - (U) Develop processing techniques that will minimize residual stresses in organic matrix composites without adversely affecting mechanical or physical properties.
  - (U) Identify and evaluate highly efficient electroluminescent nanocomposite materials suitable for displays in aircraft crew stations eliminating backlighting components.
  - (U) Update the spline variational elastic laminate technology (SVELT) three-dimensional nonmetallic structural composites to include the impact of environmental effects in the prediction of the initial failure and progressive damage in bonded and bolted joints.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials / PROJECT: 4347

- (U) $9,356 Develop affordable lightweight metallic materials that are considerably lighter than conventional aluminum or can withstand higher temperatures than currently available materials.
  - (U) Identify requirements and material properties needed to develop hybrid metal laminates for future fighter skins (e.g., wing surfaces and covering for active flexible wing structures, etc.).
  - (U) Transition orthorhombic titanium Metal Matrix Composites (MMCs) and gamma TiAl for bladed ring (Bling) material to propulsion technology demonstrator programs and identify ways to optimize orthorhombic processing methods.
  - (U) Quantify mechanical properties of isotropic wrought 2% aluminum lithium that is weldable for space tankage.
  - (U) Complete assessment and develop damage tolerant life prediction methods for high cycle fatigue (HCF) design of titanium alloy turbine engine fan and compressor blades which will resolve HCF issues with existing and future engines.
- (U) $9,237 Develop ceramic matrix composites and very high temperature metallics to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.
  - (U) Demonstrate ceramic matrix composites for space applications.
  - (U) Demonstrate permanent mold thin wall casting processes to reduce the cost of high temperature components by 40% of today's cost.
  - (U) Demonstrate materials and techniques for repair of low-observable and other ceramic composite structures.
  - (U) Identify and develop computer simulation model and design tool for the prediction of the metal grain structures in superalloy turbine engine disks.
- (U) $45,311 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials
	PROJECT 4347

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	44,161	44,077	44,264	47,532	Cont
(U) Current Budget Submit/FY 1998 PB	43,832	50,600	42,214	45,311	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) PE 0603211F, Aerospace Systems.
- (U) PE 0603202F, Aeropropulsion Subsystem Integration.
- (U) PE 0603216F, Aeropropulsion and Power Technology.
- (U) DOD Metal Matrix Composite Steering Group.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 4348

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4348 Materials for Electronics, Optics, and Survivability	13,222	13,007	12,981	13,698	14,223	15,259	15,279	15,676	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops materials technologies for optical and electro-optical devices and subsystems for aircraft, missile, and space systems. This project also develops new materials for protection of aircrews, sensors, aircraft, and space systems from laser threats. Radar modules, microwave devices, infrared (IR) detectors, photonics, and optical processors are used in target detection, data processing, electronic warfare, and communications. The performance of these systems is constrained by the quality and physical characteristics of these materials. New materials are developed that improve the production quality and rates to develop advanced electronic and optical materials that offer higher operating speeds, greater bandwidth density, improved thermal management, greater sensitivity, and expanded dynamic range. Protection from lasers is dependent upon the power level and wavelength or color emanating from the laser device and the susceptibility of the material or system being lased. Additionally, protection schemes are dependent on other characteristics of the laser such as variability of the wavelength and mode of operation (continuous wave or pulsed). Materials are optimized to counter the most prominent threat wavelengths and new materials are developed to respond to emerging threat wavelengths and ultimately to reject laser energy independent of threat wavelengths.

(U) FY 1996 ($ in Thousands):

- (U) $9,975 Developed new electronic and electromagnetic materials for improved microwave and microelectronics technology for radar, communications, and optical signal processing systems. Developments will offer lower cost and higher performance systems capable of operating in more demanding thermal, atmospheric, and electromagnetic environments.
  - (U) Demonstrated a semiorganic frequency conversion crystal source for blue laser applications (double transfer rates or storage capabilities of red laser).
  - (U) Completed durable long wave infrared (LWIR) window materials effort.
  - (U) Demonstrated high temperature microwave electronic materials for uncooled radar and avionics applications.
- (U) $3,247 Developed materials to enhance the survivability of aircrews and sensor systems against laser threats. These materials will prevent costly systems losses or damage from laser irradiation.
  - (U) Demonstrated a low-energy threshold midwave infrared semiconductor nonlinear absorber for sensor protection.
  - (U) Completed laboratory demonstration of first generation switchable hologram materials for application into switchable filters used in visible and near-infrared sensor protection.
- (U) $13,222 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials
	PROJECT 4348

(U) FY 1997 ($ in Thousands):

- (U) $9,514 Develop new electronic and electromagnetic materials for improved microwave and microelectronics technology for radar, communications, and optical signal processing systems.
  - (U) Demonstrate a high temperature superconducting infrared detector material that would not require cryogenic cooling for specialized space applications.
  - (U) Demonstrate enhanced operability and resolution of long wavelength focal plane arrays for space imagery for space imagery and tracking through the development of very low defect detector materials.
  - (U) Develop electronic materials that couple digital and optical data transfer on a single chip.
- (U) $3,493 Develop materials to enhance the survivability of aircrews and sensor systems against laser threats.
  - (U) Develop candidate mid-infrared, nonlinear materials and evaluate for use in tunable filter technology for laser protection devices.
  - (U) Complete laboratory demonstration of first generation, nonlinear organic materials for application into optical power limiters used in visible and near-infrared personnel and sensor protection.
- (U) $13,007 Total

(U) FY 1998 ($ in Thousands):

- (U) $9,381 Develop new electronic and electromagnetic materials for improved microwave and microelectronics technology for radar, communications, and optical signal processing systems.
  - (U) Identify and evaluate optimum carbon dioxide laser second harmonic generation crystals for higher power applications.
  - (U) Develop bulk growth of three-inch diameter silicon carbide semiconductor materials with low defect densities and reproducible compositional uniformity for high temperature avionic applications.
  - (U) Demonstrate fabrication of electronic materials that couple digital and optical data transfer on a single chip and identify multi-function (optical and electronic) device structures on a single wafer.
- (U) $3,600 Develop materials to enhance the survivability of aircrews and sensor systems against laser threats
  - (U) Develop mid-infrared optical limiter and spatial light modulator materials for sensor protection.
  - (U) Identify and evaluate second generation nonlinear organic materials for visible and near-infrared personnel and sensor protection and develop liquid crystal tunable filter materials for laser protection.
- (U) $12,981 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials PROJECT 4348

(U) FY 1999 ($ in Thousands):

- (U) $9,898 Develop new electronic and electromagnetic materials for improved microwave and microelectronics technology for radar, communications, and optical signal processing systems.
  - (U) Develop and demonstrate optimum carbon dioxide laser second harmonic generation crystals for higher power applications.
  - (U) Demonstrate bulk processing of three-inch diameter silicon carbide semiconductor materials with low defect densities and reproducible compositional uniformity for high temperature electronics and identify materials for high power device operations above 550°C.
  - (U) Evaluate multi-function (optical and electronic) device structures on a single wafer.
  - (U) Identify and evaluate high yielding, cost-effective, high performance semiconductors that are responsive across the infrared spectrum for space sensors and identify materials requirements for enhanced spaced-based laser communication requirements.
- (U) $3,800 Develop materials to enhance the survivability of aircrews and sensor systems against laser threats.
  - (U) Demonstrate mid-infrared optical limiter and spatial light modulator materials for sensor protection.
  - (U) Develop second generation nonlinear organic materials for visible and near-infrared personnel and sensor protection and develop liquid crystal tunable filter materials for laser protection.
- (U) $13,698 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials
	PROJECT 4348

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	13,322	13,473	13,888	14,580	Cont
(U) Current Budget Submit/FY 1998 PB	13,222	13,007	12,981	13,698	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget restraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) PE 0602202F, Armstrong Laboratory Exploratory Development.
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0603211F, Aerospace Systems.
- (U) Tri-Service Laser Hardening Materials and Structures Group.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 4349

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4349 Materials Technology for Sustainment	14,088	14,270	15,029	15,494	16,067	17,517	17,126	17,596	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops materials to provide operational support to Air Force mission areas by providing technologies to inspect the quality of delivered systems, transitioning more reliable and maintainable materials, establishing capability to detect and characterize performance threatening defects, eliminating the dependency on hazardous and toxic materials in repair and maintenance, and providing quick reaction support to the operational commands and repair centers. Non-destructive inspection/evaluation (NDI/E) methods are essential to ensure optimum quality in the design and production of aircraft, spacecraft, propulsion, and missile systems. NDI/E methods are essential to monitor and detect the onset of any service-initiated damage and/or deterioration. This project develops techniques that increase the capability and reliability of currently used methods to detect and characterize performance threatening defects in metallic and nonmetallic composite structures.

(U) FY 1996 ($ in Thousands):

- (U) $4,930 Developed NDI/E technologies to evaluate and characterize damage in complex, low-observable materials and structures. Developed NDI/E technologies to inspect and maintain integrity of aging aircraft and missile structures and aeropropulsion systems. NDI/E capability improvements are essential to ensure optimum quality in design, production, and maintenance of Air Force aircraft and missile weapon systems.
  - (U) Demonstrated corrosion characterization technologies for the inspection of transport and refueling aircraft.
- (U) $9,158 Developed support capabilities, information, and processes to resolve problems in the use of materials or in conducting failure analysis of components. Developed a materials database for transition of materials to aerospace systems. Maintained a handbook and developed guidelines for materials repair of aircraft structures.
  - (U) Developed advanced surface cleaning and surface preparation for removal of aircraft paints.
  - (U) Developed advanced heat blanket repair concept for large area (greater than ten square feet) composite patches.
- (U) $14,088 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials / PROJECT: 4349

(U) FY 1997 ($ in Thousands):

- (U) $5,076 Develop non-destructive inspection/evaluation (NDI/E) technologies to evaluate and characterize damage in complex, low-observable materials and structures. Develop NDI/E technologies to inspect and maintain integrity of aging aircraft and missile structures and aeropropulsion systems.
  - (U) Identify and evaluate corrosion and crack detection characterization technologies for the inspection of airframe structures.
  - (U) Demonstrate NDI/E technologies for the characterization of fiber-reinforced composite materials and structures.
  - (U) Identify and evaluate NDI/E technologies for the characterization of low-observable materials and structures.
- (U) $9,194 Develop support capabilities, information, and processes to resolve problems in the use of materials or in conducting failure analysis of components. Develop a materials database for transition of materials to aerospace systems. Maintain a handbook and develop guidelines for materials repair of aircraft structures.
  - (U) Demonstrate an advanced non-chromate treatment for corrosion resistance and surface hardening in aircraft structural materials.
  - (U) Demonstrate technology for improved composite repairs and composite repairs on metals.
  - (U) Demonstrate improved non-hazardous cleaning techniques for liquid oxygen lines and solid state electronics.
  - (U) Evaluate technologies and material candidates for a biodegradable chaff.
  - (U) Develop alternative paint/depaint technologies to reduce or eliminate volatile organic compounds.
- (U) $14,270 Total

(U) FY 1998 ($ in Thousands):

- (U) $5,328 Develop NDI/E technologies to evaluate and characterize damage in complex, low-observable materials and structures. Develop NDI/E technologies to inspect and maintain integrity of aging aircraft and missile structures and aeropropulsion systems.
  - (U) Demonstrate NDI/E technologies for the semi-automated characterization of fiber-reinforced composite materials and structures and identify capability to develop remote inspection within complex structures.
  - (U) Develop corrosion and crack detection characterization technologies for the inspection of aging airframe structures.
  - (U) Develop NDI/E technologies for the structural and electromagnetic characterization of low-observable materials and structures.
- (U) $9,701 Develop support capabilities, information, and processes to resolve problems in the use of materials or in conducting failure analysis of components. Develop a materials database for transition of materials to aerospace systems. Maintain a handbook and develop guidelines for materials repair of aircraft structures. Develop technical understanding of corrosion to model and reduce corrosion in aircraft structures. Assess emerging structures joining technologies for application to new alloys not currently weldable.
  - (U) Develop corrosion models for assessment of aircraft structural integrity.
  - (U) Develop alternative paint/depaint technologies to reduce or eliminate volatile organic compounds and improved non-chromate coatings environmental durability for corrosion resistance and surface hardening in aircraft structural materials.
  - (U) Characterize field level repair needs of high temperature materials and identify field level high-temperature repair materials.
  - (U) Participate with aerospace industry to assess new joining technologies for application to Air Force systems.
- (U) $15,029 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials PROJECT 4349

(U) FY 1999 ($ in Thousands):

- (U) $5,500 Develop nondestructive inspection/evaluation (NDI/E) technologies to evaluate and characterize damage in complex, low-observable materials and structures. Develop NDI/E technologies to inspect and maintain integrity of aging aircraft and missile structures and aeropropulsion systems.
  - (U) Identify/evaluate NDI/E techniques to provide process characterization information for control of aerospace processing operations.
  - (U) Demonstrate corrosion and crack detection characterization technologies for the inspection of aging airframe structures and identify capability to develop automated methods for aircraft inspection.
  - (U) Demonstrate NDI/E technologies for the characterization of low-observable materials and structures.
- (U) $9,994 Develop support capabilities, information, and processes to resolve problems in the use of materials or in conducting failure analysis of components. Develop a materials database for transition of materials to aerospace systems. Maintain a handbook and develop guidelines for materials repair of aircraft structures. Develop technical understanding of corrosion to model and reduce corrosion in aircraft structures. Assess emerging joining structures technologies for application to new alloys not currently weldable.
  - (U) Demonstrate corrosion modeling to assess aircraft structural integrity.
  - (U) Demonstrate alternative paint/depaint technologies to reduce or eliminate volatile organic compounds and identify non-hazardous metal cleaning and surface treatments to apply paints with extended life.
  - (U) Evaluate and develop field level repair needs of high temperature materials.
  - (U) Assess and provide improvements for joining of new high performance alloys.
- (U) $15,494 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials
	PROJECT 4349

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	14,200	14,810	15,269	16,037	Cont
(U) Current Budget Submit/FY 1998 PB	14,088	14,270	15,029	15,494	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603112F, Advanced Materials for Weapons Systems.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603211F, Aerospace Systems.
- (U) Office of Science and Technology Committee Materials Working Group on Non-Destructive Materials.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	60,363	62,934	60,509	65,039	66,481	67,838	69,547	73,097	Continuing	Continuing
2401 Structures	15,252	15,698	16,604	17,999	18,469	18,966	19,075	19,610	Continuing	Continuing
2402 Vehicle Equipment	11,296	11,192	10,421	10,880	10,240	11,162	12,118	12,525	Continuing	Continuing
2403 Flight Controls and Pilot-Vehicle Interface	19,642	19,179	17,059	17,990	18,604	18,869	19,357	19,968	Continuing	Continuing
2404 Aeromechanics and Integration	12,034	14,997	15,925	16,676	17,159	17,238	17,805	18,355	Continuing	Continuing
4397 Air Base Technology	2,139	1,868	500	1,494	2,009	1,603	1,192	2,639	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Applied Research program determines the technical feasibility of air vehicle technologies in aeromechanics, structures, flight control, vehicle-pilot integration, vehicle subsystems, and air base operability to reduce life cycle costs and improve the performance of existing and future air vehicles, and the maintenance and survivability of air bases. The payoffs from these technology programs include: increased survivability, reliability, maintainability, and supportability for air vehicles and subsystems; improved air base operability; and safe air vehicle all-weather operations. Note: In FYs 1999 and out, additional emphasis has been placed on aerospace flight dynamics technologies that can be applied to prolonging the life of our aging aircraft fleet.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	60,947	65,080	67,212	70,085	Cont
(U) Appropriated Value	63,100	65,080			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-1,223	-1,424			
b. SBIR	-649	-661			
c. Omnibus/Other Above Threshold Reprogrammings	-865	-61			
(U) Current Budget Submit/FY 1998 PB	60,363	62,934	60,509	65,039	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:** Not Applicable.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE: February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics	PROJECT: 2401

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2401 Structures	15,252	15,698	16,604	17,999	18,469	18,966	19,075	19,610	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops advanced aircraft structures; investigates new structural concepts and design techniques which exploit new materials and fabrication processes to strengthen and extend the life of air vehicle structures while reducing weight and cost; and develops "smart" structures that will have embedded sensors to report stress, fatigue, and/or battle damage, leading to improved maintainability.

(U) FY 1996 ($ in Thousands):

- (U) $3,202 Develop advanced structural concepts and design techniques for performance enhancement through distributed vibration suppression, wing warping, and camber shaping for enhanced affordability and survivability of upgraded and derivative aircraft.
  - (U) Developed "smart stiffness" approaches and concepts to maneuver flight vehicles by means of wing warping without conventional separate control surfaces to reduce aircraft weight, drag, and radar signature, and to alleviate fighter aircraft vertical tail buffet and fatigue damage.
  - (U) Developed multidisciplinary structural design methodology to reduce fighter aircraft gross weight.
- (U) $12,050 Improve durability of existing stealth vehicles structures operating in extreme environments and extend usable structural lives of aging aircraft through proven techniques that account for life, risk repairs, and dynamic loads.
  - (U) Developed concepts for low-observable exhaust washed structures that significantly increase life and developed active/passive heat transfer techniques which increase durability and reduce infrared signature.
  - (U) Developed preliminary corrosion analysis metrics to assess corrosion fatigue effects on aircraft structural inspection and maintenance intervals.
  - (U) Developed analysis techniques for predicting structural component life accounting for widespread fatigue damage and developed methodologies for calculating stress intensities of cracked structural components.
  - (U) Developed advanced predictive methods to control flutter, avoid structural damage, and enable active aeroelastic wing for improved maneuverability.
- (U) $15,252 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 2401

(U) FY 1997 ($ in Thousands):

- (U) $542 Design, develop, and test advanced structures/concepts which incorporate distributed vibration suppression technologies for life extension and exploits wing warping, camber shaping, and adaptive structures technologies that enhance air vehicle performance.
  - (U) Conduct testing of embedded, distributed vibration suppression techniques for aircraft structures to enhance vehicle performance.
  - (U) Conduct testing of "smart stiffness" wing warping concepts to reduce aircraft weight, drag, and radar signature, and to alleviate fighter aircraft vertical tail buffet and fatigue damage.
  - (U) Develop scaling laws and procedures that incorporate "smart" structures techniques into full-scale aircraft structures which could lead to eliminating the need for discrete control surfaces.
- (U) $2,297 Develop advanced structural concepts and design methods that will enhance affordability and survivability of upgraded, derivative, and future aircraft.
  - (U) Design, fabricate, and assess advanced composite structures technologies which demonstrate the potential for 30% manufacturing and 20% support cost savings while providing improved battle damage tolerance over existing structures.
  - (U) Develop initial analytical aeroelastic techniques and methods to provide design guidance for structural flutter clearance for new weapons/store configurations on existing aircraft in lieu of expensive flight testing.
- (U) $11,475 Extend usable structural lives of aging aircraft through proven techniques that account for life, risk, repairs, and dynamic loads.
  - (U) Develop corrosion analysis metrics to assess corrosion fatigue effects on inspection and maintenance intervals.
  - (U) Develop crack growth analysis and preliminary probabilistic risk assessment techniques which incorporate widespread fatigue damage effects to better predict structural component service life.
  - (U) Develop techniques to analyze bonded-composite repairs of metallic structures which eliminate the need for riveted/bolted metal repair patches.
  - (U) Design and develop weapon bay acoustic suppression techniques to increase the performance of current and future air vehicles.
- (U) $1,384 Improve durability for existing stealth vehicles structures operating in extreme environments such as temperature, noise, and vibration caused by engine exhaust.
  - (U) Develop concepts for low-observable ceramic composite exhaust structures of stealth vehicles that significantly increase life and decrease costs.
  - (U) Develop passive structural temperature control concepts to reduce infrared signature of current fleet.
- (U) $15,698 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics PROJECT 2401

(U) FY 1998 ($ in Thousands):

- (U) $609 Design, develop, and test advanced structures/concepts which incorporate distributed vibration suppression technologies for life extension and exploits wing warping, camber shaping, and adaptive structures technologies that enhance air vehicle performance.
  - (U) Evaluate promising active distributed vibration suppression techniques using embedded actuator design concepts for aircraft structural applications.
  - (U) Conduct wind tunnel and ground assessment tests of wing warping, camber shaping, and "smart stiffness" structural concepts to reduce aircraft weight, drag, and radar signature, and to alleviate fighter aircraft vertical tail buffet and fatigue damage.
  - (U) Evaluate scaling laws and procedures needed to incorporate "smart" structures techniques into full-scale aircraft structures and, thus, eliminate the need for discrete control surfaces.
- (U) $2,309 Develop advanced structural concepts and design methods that will enhance affordability and survivability of upgraded, derivative, and future aircraft.
  - (U) Design, fabricate, and assess advanced composite structures technologies which demonstrate the potential for 30% manufacturing and 20% support cost savings while providing improved battle damage tolerance over existing structures. Complete evaluation and assessment of cost benefits from applying full-scale, primary, composite sandwich structure fabrication methods to air vehicles.
  - (U) Exercise analytical techniques needed to provide design guidance for future use of active aeroelastic wings.
  - (U) Demonstrate integration of advanced methods in aerodynamics, controls, signatures, testing, manufacturing, etc. with structural design methods to facilitate more efficient development of aircraft systems.
- (U) $12,102 Extend usable structural lives and/or reduce costs of aging aircraft through proven techniques that account for life, risk, repairs, and dynamic loads.
  - (U) Develop life prediction analysis techniques to assess corrosion fatigue effects on inspection and maintenance intervals.
  - (U) Develop mature probabilistic risk assessment techniques which incorporate widespread fatigue damage effects to better predict structural component service life.
  - (U) Further develop techniques to analyze bonded-composite repairs of metallic structures and to optimize repair design.
  - (U) Evaluate and assess weapon bay acoustic suppression techniques to increase the weapons delivery envelope of current and future air vehicles.
- (U) $1,584 Improve durability for existing stealth vehicles structures operating in extreme environments such as temperature, noise, and vibration caused by engine exhaust.
  - (U) Evaluate floating deck concepts for low-observable ceramic composite exhaust structures of stealth vehicles that significantly increase life and decrease costs.
  - (U) Complete assessment of passive high performance ceramic matrix composite technology/concepts for exhaust washed structures.
  - (U) Develop active structural temperature control concepts to reduce infrared signature of current fleet.
- (U) $16,604 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics — PROJECT: 2401

(U) FY 1999 ($ in Thousands):

- (U) $677 — Design, develop, and test advanced structures/concepts which incorporate distributed vibration suppression technologies for life extension and exploits wing warping, camber shaping, and adaptive structures technologies that enhance air vehicle performance.
  - (U) Complete the evaluation and assessment of active distributed vibration suppression techniques using embedded actuator design concepts. Develop scaling laws and procedures needed to transition this technology to full-scale aircraft structures.
  - (U) Complete the evaluation and assessment of wing warping, camber shaping, and "smart stiffness" structural concepts to reduce aircraft weight, drag, and radar signature, and to alleviate fighter aircraft vertical tail buffet and fatigue damage.
  - (U) Develop advanced structural design concepts based on the established scaling laws, procedures, and concept testing which incorporates "smart" structures and "smart stiffness" techniques into full-scale aircraft structures.
- (U) $2,500 — Develop advanced structural concepts and design methods that will enhance affordability and survivability of upgraded, derivative, and future aircraft.
  - (U) Correlate analytical methods with ground test data to provide guidance for future use of active aeroelastic wings.
  - (U) Design, fabricate, and assess advanced composite structures technologies which demonstrate the potential for 30% manufacturing and 20% support cost savings while providing improved battle damage tolerance over existing structures. Complete evaluation and assessment of cost benefits of incorporating a survivable, decoupled fuel cell design into air vehicle structures.
  - (U) Complete demonstration of integration of advanced methods in aerodynamics, controls, signatures, testing, manufacturing, etc. with structural design methods to facilitate more efficient development of aircraft systems.
- (U) $13,215 — Extend usable structural lives and/or reduce costs of aging aircraft through proven techniques that account for life, risk, repairs, and dynamic loads.
  - (U) Validate corrosion life analysis methodology and metrics to assess corrosion fatigue effects on inspection and maintenance intervals.
  - (U) Evaluate probabilistic risk assessment techniques that include widespread fatigue damage to predict structural component service life.
  - (U) Validate repair design tool for bonded-composite repairs of metallic structures, eliminating riveted/bolted metal repair patches.
  - (U) Demonstrate weapon bay preliminary active, acoustic suppression techniques to increase the performance envelope of current and future air vehicles.
- (U) $1,607 — Improve durability for existing stealth vehicles structures operating in extreme environments such as temperature, noise, and vibration caused by engine exhaust.
  - (U) Develop structurally integrated airframe nozzle design and ceramic matrix composite concepts for low-observable compatible exhaust structures of stealth vehicles that significantly increase life and decrease costs.
  - (U) Complete assessment of active structural temperature control concepts to reduce infrared signature of current fleet.
- (U) $17,999 — Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics — PROJECT: 2401

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	15,836	16,074	16,601	17,312	Cont
(U) Current Budget Submit/FY 1998 PB	15,252	15,698	16,604	17,999	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602269F, Hypersonic Technology Development.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics

PROJECT: 2402

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2402 Vehicle Equipment	11,296	11,192	10,421	10,880	10,240	11,162	12,118	12,525	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops technologies to reduce subsystem and component life cycle costs, improve vehicle/crew member survival in operational environments, and improve subsystem performance for current and future flight vehicles.

(U) FY 1996 ($ in Thousands):

- (U) $8,140 Demonstrate technologies that increase performance, supportability, and affordability of air vehicle subsystems.
  - (U) Designed, fabricated, and tested micro-scale heat transfer devices to reduce weight and improve performance of internal aircraft temperature control systems.
  - (U) Conducted studies on improving windshield resistance to electrostatic charge damage.
  - (U) Developed design criteria for next generation aircraft transparencies which yield improved protection and increased service life.
  - (U) Developed and assessed conceptual design methods to compute the optimum air release point for delivery of cargo from high altitude air drops.
- (U) $3,156 Develop technologies that increase air vehicle survivability and safety.
  - (U) Developed innovative concepts and design tools to evaluate aerodynamic performance during high-speed separation of integrated escape subsystems and vehicle airframes.
- (U) $11,296 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 2402

(U) FY 1997 ($ in Thousands):

- (U) $3,099 Design, develop, and assess component damage repair technologies that increase air vehicle survivability.
  - (U) Develop preliminary experimental techniques and analytical tools which define effects of various ballistic threats against a variety of structural components.
- (U) $2,881 Design, develop, and assess subsystem technologies to enhance air vehicle protection and survivability.
  - (U) Develop an abrasion-resistant coating for next generation injection molded transparencies to fabricate single-piece canopies for increased affordability and a factor of five reduction in life cycle costs.
  - (U) Develop the capability to conduct transparency tests that determine degradation of performance and supportability.
  - (U) Develop approaches that alleviate transparency electrostatic discharge and reduce component degradation and life cycle costs.
- (U) $2,655 Design, develop, and assess technologies for aircraft internal thermal energy management systems.
  - (U) Complete initial concept demonstrator for integrated subsystems design methodologies.
  - (U) Fabricate and test thermal system composite material components to achieve 50% reduction in weight and size.
  - (U) Design and test enhanced heat exchanger model to improve aircraft temperature control system performance.
- (U) $2,557 Design, develop, and assess advanced landing gear concepts for improving performance and supportability of air vehicle subsystems.
  - (U) Design, develop, and assess scientific methods for predicting and measuring landing gear stability.
  - (U) Develop lightweight landing gear technology to gain overall aircraft performance and efficiency.
- (U) $11,192 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics PROJECT 2402

(U) FY 1998 ($ in Thousands):

- (U) $3,849 Design, develop, and assess component damage repair technologies and fire suppression techniques that increase air vehicle survivability.
  - (U) Develop mature experimental techniques and analytical tools to define effects of various ballistic threats on a variety of structural components and vehicle fuel systems.
  - (U) Develop preliminary analytical models to predict air vehicle vulnerability.
- (U) $2,938 Design, develop, and assess subsystem technologies to enhance air vehicle protection and survivability.
  - (U) Establish the capability to conduct dust erosion tests for predicting transparency coating performance/durability degradation at speeds up to Mach 1.5.
  - (U) Demonstrate the methodology to verify the compliance of transparency designs with the electrostatic discharge damage protection criteria.
- (U) $3,634 Design, develop, and assess technologies for aircraft internal energy management systems.
  - (U) Define technologies and approaches which allow an assessment of aircraft subsystem energy interactions.
  - (U) Develop a detailed roadmap of modeling, methodologies, and technologies required for development of a capability for system-based design trade offs of air vehicle components, subsystems, and stores.
  - (U) Fabricate a full-scale advanced composite material heat exchanger; demonstrate 50% reduction in weight and size.
- (U) $10,421 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 2402

(U) FY 1999 ($ in Thousands):

- (U) $3,794 Design, develop, and assess component damage repair technologies and fire suppression techniques that increase air vehicle survivability.
  - (U) Complete development of experimental techniques and analytical tools to define effects of various ballistic threats on structural and fuel system components.
  - (U) Develop mature analytical models to predict air vehicle vulnerability.
- (U) $3,312 Design, develop, and assess subsystem technologies to enhance air vehicle protection and survivability.
  - (U) Develop a capability to combine birdstrike resistance and through-canopy aircrew ejection for low-cost injection molded canopies.
  - (U) Conduct flight test evaluation and assessment of injection molded transparency technology that will reduce parts count by 90%.
  - (U) Extend the capability to conduct dust erosion tests for predicting transparency coating performance/durability degradation at speeds up to Mach 2.5.
  - (U) Develop design concepts/approaches to prevent/minimize catastrophic birdstrikes during high speed, low altitude flight.
- (U) $3,774 Design, develop, and assess technologies for aircraft internal energy management systems.
  - (U) Develop breadboard for system-based design trade off of air vehicle components, subsystems, and stores.
  - (U) Validate high efficiency aircraft thermal energy management system components.
  - (U) Evaluate and assess advanced heat transfer techniques based on electrohydrodynamic principles.
  - (U) Demonstrate breadboard capability for system-based design trade offs of air vehicle components, subsystems, and stores.
- (U) $10,880 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics — PROJECT: 2402

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	11,296	11,458	11,827	12,332	Cont
(U) Current Budget Submit/FY 1998 PB	11,296	11,192	10,421	10,880	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603106F, Logistics System Technology.
- (U) PE 0603205F, Flight Vehicle Technology.
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) PE 0604212F, Aircraft Equipment Development.
- (U) PE 0604609F, Reliability and Maintainability Technology Insertion Program.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics		PROJECT: 2403

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2403 Flight Controls and Pilot-Vehicle Interface	19,642	19,179	17,059	17,990	18,604	18,869	19,357	19,968	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops technology to enable the pilot to obtain maximum performance from the aircraft under all conditions, provide the pilot with the display of information from on-board subsystems and off-board intelligence sources for increased situational awareness leading to enhanced mission performance and flight safety, provide robust capability to control aircraft after damage and failures, and network synthetic environments for evaluation of advanced concepts.

(U) FY 1996 ($ in Thousands):

- (U) $14,518 Develop advanced flight control concepts to provide a combat advantage for advanced aircraft by increasing performance and survivability while decreasing cost and supportability requirements.
  - (U) Conducted wind tunnel tests of innovative combinations of control effectors (e.g., pop-up controls, wing flexing controls, pneumatic controls) providing safe and effective control for air vehicles to realize signature, affordability, and controllability benefits.
  - (U) Developed aircraft evaluation techniques to support development of criteria for the design of flight control systems that prevent pilot-induced control problems.
  - (U) Developed and demonstrated promising actuator technology for flight critical control surfaces of advanced aircraft.
- (U) $5,124 Develop pilot-vehicle interface technologies for enhanced situational awareness and supportability of current and future aircraft cockpits.
  - (U) Developed and conducted pilot-in-the-loop tests of state-of-the-art information display formats and controls to enhance situational awareness and optimize workload.
  - (U) Developed initial concepts for cockpit information fusion of multiple data sources for increased mission effectiveness in future air battles.
  - (U) Developed and evaluated preliminary design of two-person large aircraft cockpit concepts to reduce crew size and life cycle costs.
- (U) $19,642 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 2403

(U) FY 1997 ($ in Thousands):

- (U) $5,761 Develop and demonstrate advanced flight control techniques to provide air combat advantage by increasing performance and survivability while decreasing cost and supportability requirements.
  - (U) Continue developing advanced control concepts such as advanced actuators and wing flexing.
  - (U) Develop central control system to support groups of manned and unmanned aircraft to increase mission effectiveness and attack options.
- (U) $4,985 Develop new flight control design methods and criteria that provide air combat advantage by increasing performance and survivability while decreasing cost.
  - (U) Select and evaluate reconfigurable flight control techniques which allow battle damaged, reduced signature aircraft to fly safely.
  - (U) Develop criteria and design standards for flight control systems that prevent pilot-induced control problems and improve handling qualities.
- (U) $3,831 Develop capabilities to evaluate ways to increase performance and survivability while decreasing cost and supportability requirements.
  - (U) Develop techniques incorporating long distance networking to support modeling of close-in and high angle-of-attack air combat.
- (U) $4,602 Develop enhanced vehicle-pilot integration technologies to improve overall weapon system performance and exploit real-time on-board/off-board data.
  - (U) Develop vehicle-pilot integration capabilities allowing two-person, mobility and special operations cockpits to access threat intelligence information in-flight.
  - (U) Develop vehicle-pilot integration technologies for single-seat fighter-bombers operating in high threat environments.
- (U) $19,179 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics PROJECT 2403

(U) FY 1998 ($ in Thousands):

- (U) $5,118 Develop and demonstrate advanced flight control techniques to provide air combat advantage by increasing performance and survivability while decreasing cost and supportability requirements.
  - (U) Continue developing advanced control concepts and advanced actuation development enabling reduced structural weight and cost while increasing survivability and decreasing logistical support.
  - (U) Develop control strategies that enable interactive and cooperative flights of manned and unmanned aircraft to increase mission effectiveness, attack options and all weather point-of-use delivery.
  - (U) Develop risk reduction strategies and global operational analyses for advanced optical air data sensor development.
  - (U) Develop open control system infrastructure that enables commercial processors and data busses in flight critical applications.
- (U) $4,436 Develop new flight control design methods and criteria that provide air combat advantage by increasing performance and survivability while decreasing cost.
  - (U) Continue to develop design criteria and standards for flight control systems that prevent pilot induced control problems.
  - (U) Start effort to update handling qualities handbook for use by the acquisition community.
  - (U) Continue development of reconfigurable flight control techniques that allow battle damaged, reduced signature aircraft to fly safely.
  - (U) Select and assess new methods that will improve prediction of non-linear aerodynamic modeling for use in design simulations.
  - (U) Develop control technologies for global range transport aircraft.
- (U) $2,217 Develop enhanced vehicle-pilot integration technologies to improve overall weapon system performance and exploit real-time on-board/off-board data.
  - (U) Develop display format requirements for integrating in-flight mission planning and automated low-level flight.
  - (U) Review operator mission requirements; assess availability/applicability of human-machine interface technologies.
- (U) $3,411 Develop pilot/operator control and display integration technologies for remotely operated, unmanned combat air vehicles.
  - (U) Initiate development of vehicle-pilot/operator integration techniques as they relate to unmanned combat air vehicles.
- (U) $1,877 Develop capabilities to evaluate ways to increase performance and survivability while decreasing cost and supportability requirements.
  - (U) Support the development of high angle-of-attack air combat and weapon targeting technology assessment tools.
- (U) $17,059 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics PROJECT 2403

(U) FY 1999 ($ in Thousands):

- (U) $5,397 Develop and demonstrate advanced flight control techniques to provide air combat advantage by increasing performance and survivability while decreasing cost and supportability requirements.
  - (U) Complete simulations and continue firmware development of advanced control concepts enabling reduced structural weight and cost.
  - (U) Complete demonstration of a low-cost alternative to conventional actuators and continue advanced actuation development increasing survivability while decreasing logistical support train.
  - (U) Continue developing control strategies that enable interactive and cooperative flights of manned and unmanned aircraft to increase mission effectiveness, attack options and all weather point-of-use delivery.
  - (U) Complete risk reduction assessment and global operational analyses for advanced optical air data sensor development.
  - (U) Complete evaluation of open control system infrastructure incorporating commercial processors and data busses in flight critical applications.
- (U) $4,677 Develop new flight control design methods and criteria that provide air combat advantage by increasing performance and survivability while decreasing cost.
  - (U) Validate reconfigurable flight control techniques which allow battle damaged, reduced signature aircraft to fly safely.
  - (U) Evaluate on-board techniques to detect and alleviate pilot-induced control problems.
  - (U) Validate design standards for flight control systems that prevent pilot-induced control problems.
  - (U) Evaluate methods for improving modeling of non-linear aerodynamics for use in design simulations.
  - (U) Evaluate control technologies for global range transport aircraft.
- (U) $2,339 Develop enhanced vehicle-pilot integration technologies to improve overall weapon system performance and exploit real-time on-board/off-board data.
  - (U) Continue development and evaluate vehicle-pilot integration technologies for in-flight mission planning and automated low-level flight.
  - (U) Develop advanced pilot decision aids to improve tactical landing approaches and air-to-air situational awareness.
- (U) $3,598 Develop capabilities to evaluate ways to increase performance and survivability while decreasing cost and supportability requirements.
  - (U) Perform comparison tests of combat aiding technologies through international network air combat simulation.
  - (U) Develop evaluation techniques for the assessment of mission effectiveness for uninhabited combat air vehicles
- (U) $1,979 Develop pilot/operator control and display integration technologies for remotely operated, unmanned combat aerial vehicles.
  - (U) Continue review of operator mission requirements; evaluate availability/applicability of human-machine interface technologies.
  - (U) Develop pilot/operator integration technologies for mission re-planning, task consent, and system status information.
- (U) $17,990 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics — PROJECT: 2403

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	19,642	19,979	20,635	21,517	Cont
(U) Current Budget Submit/FY 1998 PB	19,642	19,179	17,059	17,990	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603205F, Flight Vehicle Component and Subsystems Technology.
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics

PROJECT: 2404

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2404 Aeromechanics and Integration	12,034	14,997	15,925	16,676	17,159	17,238	17,805	18,355	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops aerodynamic design integration technologies for current and future flight vehicles, focusing on speed regimes ranging from low to high Mach. These technologies have potential to reduce costs, improve range to yield enhanced global force projection, improve maneuverability, and reduce observability. This project integrates technologies into air vehicle concepts and develops design assessment and analysis tools.

(U) FY 1996 ($ in Thousands):

- (U) $9,977 Develop and demonstrate affordable technologies to increase aerodynamic performance and survivability through reduced drag, improved fuel fraction, enhanced maneuverability and control, and reduced signature.
  - (U) Developed advanced, low-cost, compact engine inlet designs to increase mission range of combat aircraft.
  - (U) Developed low-drag/low-observable aerodynamic concepts for external weapons carriage to increase air vehicle range, weapons payload, and survivability.
  - (U) Developed conceptual designs for advanced, fluidic, low-cost, reduced signature thrust-vectoring nozzles.
  - (U) Investigated high-payoff aerodynamic concepts that significantly extend combat aircraft mission range.
  - (U) Investigated concepts and design criteria for intermediate-range, fast reaction strike flight vehicles which minimize thermal protection system weight and total system cost.
  - (U) Developed concepts for high-lift devices to reduce landing/take-off distances of affordable, survivable transport aircraft.
- (U) $2,057 Develop and demonstrate numerical technologies to derive improved aircraft designs while increasing performance and reducing signature.
  - (U) Investigated and assessed the use of rapid, accurate algorithms to predict aerodynamic performance in order to evaluate advanced, affordable air vehicle designs.
  - (U) Investigated mathematical models of aerodynamic and structural interactions in aging aircraft and advanced flight vehicles.
  - (U) Developed and demonstrated new methods of aerodynamic design optimization for aircraft performance and survivability.
- (U) $12,034 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics PROJECT 2404

(U) FY 1997 ($ in Thousands):

- (U) $8,863 Develop and demonstrate affordable technologies to increase aerodynamic performance and survivability through reduced drag, improved fuel fraction, enhanced maneuverability and control, and reduced signature.
  - (U) Complete advanced, low-cost, compact engine inlet designs to increase mission range of combat aircraft.
  - (U) Complete advanced concept development for fluidic, low-cost, reduced signature, thrust-vectoring nozzles.
  - (U) Complete study of high-lift aerodynamic concepts to reduce landing take-off distances for affordable, survivable transport aircraft.
  - (U) Complete development of low-drag/low-observable aerodynamic weapons carriage concepts to increase weapons payload and air vehicle range and survivability.
  - (U) Develop concepts and design criteria for advanced, affordable, intermediate-range, manned and unmanned aircraft to provide fast reaction strike capability.
  - (U) Develop high-payoff aerodynamic concepts that significantly extend combat aircraft mission range.
  - (U) Investigate variable geometry, continuous moldline, external fuel tank concepts to extend fighter mission range.
  - (U) Investigate active flow control concepts for low-observable fighter take-off/landing and maneuver performance enhancement.
  - (U) Investigate methods for reducing aeroacoustic damage in aircraft twin nozzle installations to increase nozzle service life.
- (U) $2,946 Develop and demonstrate numerical technologies to derive advanced aircraft designs while increasing performance and reducing signature.
  - (U) Complete aerodynamic design optimization code for analysis of aircraft performance and survivability.
  - (U) Initiate development of mathematical models and preliminary assessment and evaluation of aerodynamic and structural interactions in aging aircraft and advanced flight vehicles.
  - (U) Initiate numerically based analysis capability to support weapons certification, crew escape, and safe paratrooper operation.
  - (U) Initiate development and assessment of rapid, accurate methods to predict aerodynamic performance and to evaluate advanced, affordable air vehicle designs.
- (U) $3,188 Develop integrated concepts, design, and analysis tools for fixed wing air vehicles.
  - (U) Develop architecture for integrating air vehicle design methods for Air Force, Navy, NASA, and industry.
  - (U) Develop designs for selected baseline aircraft concepts and identify relevant technologies.
- (U) $14,997 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 2404

(U) FY 1998 ($ in Thousands):

- (U) $9,394 Develop and demonstrate affordable technologies to increase aerodynamic performance and survivability through reducing drag, improving fuel fraction, enhancing maneuverability and control, and reducing signature.
  - (U) Investigate concepts for aero-structurally integrated compact inlet designs to decrease aircraft weight, cost, and radar detection.
  - (U) Investigate aerodynamic design, technology integration, and performance of survivable, multi-purpose transport aircraft configurations.
  - (U) Investigate rapid, low-cost aerodynamic assessment methods to reduce risk of weapon/aircraft integration, carriage, and separation.
  - (U) Develop aerodynamic configurations that significantly extend the range of unmanned combat aerial vehicles.
  - (U) Complete development of high-payoff aerodynamic concepts that significantly extend combat aircraft mission range.
  - (U) Investigate innovative vehicle/weapons aerodynamics that use emerging technologies to increase payload, survivability, and range.
  - (U) Continue development of concepts and design criteria for advanced, affordable, intermediate-range manned and unmanned aircraft to provide fast reaction strike capability.
  - (U) Develop variable geometry, continuous moldline, external fuel tank concepts to extend fighter mission range.
  - (U) Develop active flow control concepts for low-observable fighter take-off/landing and maneuver performance enhancement
  - (U) Investigate advanced active flow control devices for nozzle area control, mixing, and thrust vectoring for lightweight affordable flight vehicles.
  - (U) Assess aerodynamic and aerothermodynamic characteristics of high-speed air vehicle concepts.
- (U) $3,183 Develop and demonstrate numerical technologies to derive advanced aircraft designs while increasing performance and reducing signature.
  - (U) Initiate development of aerodynamic design optimization code for application to tailless aircraft geometry to maximize performance for multiple flight conditions, such as short field take-off and low drag cruise.
  - (U) Extend development of mathematical models of aerodynamic and structural interactions in aging aircraft and advanced flight vehicles.
  - (U) Extend development of numerically-based analysis capability to support weapons certification, crew escape, and safe paratrooper deployment with emphasis on cavity flows.
  - (U) Extend development and demonstration of rapid, accurate methods to predict and evaluate aerodynamic performance of advanced, affordable air vehicle designs and accelerate development of time-dependent analysis.
- (U) $3,348 Develop integrated concepts, design, and analysis tools for fixed wing air vehicles.
  - (U) Demonstrate modular architecture for integrating air vehicle design and analysis methods for Air Force, Navy, and NASA.
  - (U) Complete development of "families" of baseline aircraft designs; identify common characteristics needed to facilitate trade studies.
  - (U) Develop and demonstrate cost estimating tool to determine return on investment for broad range of technologies.
- (U) $15,925 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics PROJECT 2404

(U) FY 1999 ($ in Thousands):

- (U) $9,838 Develop and demonstrate affordable technologies to increase aerodynamic performance and survivability through reducing drag, improving fuel fraction, enhancing maneuverability and control, and reducing signature.
  - (U) Complete development of aero-structurally integrated compact inlet designs to decrease aircraft weight, cost, and radar detection.
  - (U) Develop critical aeromechanical components for survivable, multi-purpose transport aircraft configurations.
  - (U) Develop rapid, low-cost aerodynamic assessment methods to reduce risk of weapon/aircraft integration, carriage, and separation.
  - (U) Complete development of aerodynamic configurations that significantly extend the range of unmanned combat aerial vehicles.
  - (U) Develop innovative vehicle/weapons aerodynamic concepts that use emerging technologies to increase payload, survivability, and range.
  - (U) Complete development of concepts and design criteria for advanced, affordable, intermediate-range manned and unmanned aircraft to provide fast reaction strike capability.
  - (U) Complete design of variable geometry, continuous moldline, external fuel tank concepts to extend fighter mission range.
  - (U) Complete active flow control concept development for low-observable fighter take-off/landing and enhanced maneuvering.
  - (U) Develop advanced active-flow control devices for lightweight and affordable nozzle area control, mixing, and thrust vectoring in air vehicles.
  - (U) Investigate aerodynamic characteristics of a global range strike/reconnaissance air vehicle concept.
- (U) $3,332 Develop and demonstrate numerical technologies to derive advanced aircraft designs while increasing performance and reducing signature.
  - (U) Extend development of aerodynamic design optimization code for application to entire aircraft geometry to maximize performance for multiple flight conditions, such as short field take-off and low drag cruise.
  - (U) Complete mathematical model development of aerodynamic and structural interactions in aging aircraft and advanced air vehicles.
  - (U) Complete development of numerically-based analysis capability to support weapons certification, crew escape, and safe paratrooper deployment and assessment of acoustic effects.
  - (U) Complete development and assessment of rapid and accurate methods to predict aerodynamic performance and to evaluate advanced affordable air vehicle designs, including multidisciplinary analyses.
  - (U) Develop numerically-based method to analyze the performance of aircraft with active flight control surfaces.
- (U) $3,506 Develop integrated concepts, design, and analysis tools for fixed wing air vehicles.
  - (U) Complete development efforts and transition the integrated air vehicle design and analysis toolkit for Air Force, Navy, NASA, and industry air vehicle concepts to the user.
  - (U) Update designs for "families" of baseline aircraft concepts and identify relevant evolutionary technologies needed.
  - (U) Complete verification and validation of physics and technology based cost estimating tool to determine return on investment for broad range of aerodynamic technologies.
- (U) $16,676 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics PROJECT 2404

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	12,034	15,356	15,863	16,540	Cont
(U) Current Budget Submit/FY 1998 PB	12,034	14,997	15,925	16,676	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603205F, Flight Vehicle Technology.
- (U) PE 0603260F, Hypersonic Technology Development.
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics		PROJECT: 4397

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4397 Air Base Technology	2,139	1,868	500	1,494	2,009	1,603	1,192	2,639	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops technologies for fixed and bare base operations, including airfield pavements, energy systems, automation, air base survivability, air base recovery, protective systems, fire protection, and crash rescue.

(U) FY 1996 ($ in Thousands):

- (U) $1,291 Develop design criteria for improved bare base and fixed site applications (e.g., power and environmental utilities, survivable air base structures, and durable or repairable airfield surfaces).
  - (U) Studied new concepts for ground power generation such as high-efficiency solar cells, solid oxide, and commercially-available conversions for reduced size, weight, and cost and increased transportability.
  - (U) Developed deployable pavement evaluation methods and techniques for rapid evaluation of bare base and fixed site runway conditions.
  - (U) Studied the use of lightweight composite deployable shelters to reduce airlift and manpower requirements.
- (U) $848 Develop aircraft and air base fire fighting technologies (e.g., clean, environmentally safe, fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training subsystems).
  - (U) Completed development of an environmentally acceptable (biodegradable and non-toxic) Aqueous Film Forming Foam techniques for fire protection.
  - (U) Studied the impact of JP-8 fuel on aircraft hangar fire protection requirements.
- (U) $2,139 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics PROJECT 4397

(U) FY 1997 ($ in Thousands):

- (U) $1,059 Develop design criteria, methodology, and advanced technology concepts for improved bare base and fixed site applications (e.g., power and environmental utilities, survivable air base structures, and durable or repairable airfield surfaces).
  - (U) Develop applications using lightweight, composite, deployable structures to reduce airlift and manpower requirements.
  - (U) Develop advanced real-time pavement quality control and quality assurance tools.
  - (U) Complete the development of concepts for advanced ground power generators such as high-efficiency solar cells, solid oxide, and commercially-available conversions for reduced size, weight, and cost and increased transportability.
- (U) $809 Develop aircraft and air base fire fighting technologies (e.g., clean, environmentally safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training subsystems).
  - (U) Complete study of the impact of JP-8 fuel on aircraft hangar fire protection requirements.
- (U) $1,868 Total

(U) FY 1998 ($ in Thousands):

- (U) $500 Develop aircraft and air base fire fighting technologies (e.g., clean, environmentally safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, fire fighter training subsystems) and air base operations technologies.
  - (U) Analyze blended agents for three-dimensional fire fighting.
  - (U) Develop concepts, approaches, and tasks needed to identify the next generation non-halon fire suppressant.
  - (U) Develop concepts for advanced aircraft hanger fire protection; transition to Advanced Technology Development.
- (U) $500 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,494 Develop aircraft and air base fire fighting technologies (e.g., clean, environmentally safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, fire fighter training subsystems) and air base operations technologies.
  - (U) Complete analysis of blended agents for three-dimensional fire fighting.
  - (U) Develop methods for poor visibility emergency response.
  - (U) Complete applied research development effort to define concepts, approaches, and tasks needed to identify the next generation non-halon fire suppressant and transition to Advanced Technology Development.
- (U) $1,494 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics PROJECT 4397

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	2,139	2,213	2,286	2,384	Cont
(U) Current Budget Submit/FY 1998 PB	2,139	1,868	500	1,494	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603205F, Flight Vehicle Technology.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0603307F, Air Base Operability Advanced Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602202F Armstrong Lab Exploratory Development

COST ($ In Thousands)		FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	81,171	86,382	76,102	77,002	82,409	86,659	91,281	94,987	Continuing	Continuing
1123	Manpower, Personnel, and Training Technology	18,614	20,211	19,822	20,422	22,641	23,642	24,509	25,337	Continuing	Continuing
1710	Logistics Technology	6,061	5,882	5,308	5,539	6,266	6,574	6,690	6,975	Continuing	Continuing
1900	Environmental Quality Technology	9,866	9,661	4,534	5,827	5,036	5,475	8,155	8,425	Continuing	Continuing
7184	Crew Technology	25,800	30,204	26,970	26,181	28,895	30,865	30,836	32,146	Continuing	Continuing
7755	Aircrew Physiology Technology	7,231	6,488	4,717	4,590	3,547	3,750	3,987	4,284	Continuing	Continuing
7757	Toxicology/Radiation/Noise Hazards	13,599	13,936	14,751	14,443	16,024	16,353	17,104	17,820	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Applied Research program establishes technology feasibility and develops the technology base for Air Force human interface needs required for weapon systems, operational readiness, and environmental quality. The program addresses crew systems; manpower, personnel, training, and logistics; aerospace physiology investigation; occupational and environmental safety; and environmental compliance and site remediation. Crew systems technologies increase the performance of humans in weapon system operation by improving aircrew life support systems, man-machine integration (to include aircraft information display systems), and protection from biodynamic forces (ejection/escape). Manpower, personnel, training, and logistics technologies focus on reducing the manpower required to operate and support weapon systems by: providing more effective methods to select, classify, train, and retain personnel; increasing weapon systems supportability; and improving wartime logistics planning. Occupational and environmental health and safety technologies support deployment, operation, and maintenance of Air Force weapon systems by developing: occupational and operational exposure safety guidelines for militarily relevant electromagnetic radiations and toxicants; detection, control, reduction, and disposal of pollutants from Air Force operations; and cleaning up contaminated Air Force sites. Payoff from these technology development efforts is to improve combat effectiveness by expanding all parameters defining operational performance limits. Note: Congressional add of $2 million in FY 1997 for Helmet Mounted Display technologies (Project 7184) explains part of the decrease from FY 1997 to FY 1998. The remaining decrease in FY 1998 and FY1999 is due to elimination of Force Management Tools (Project 1123) and Aircrew Physiology (Project 7755).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	82,420	87,103	87,276	90,423	Cont
(U) Appropriated Value	86,911	89,103			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reduction	-1,684	-1,921			
b. SBIR	-747	-719			
c. Omnibus/Other Above Threshold Reprogrammings	-3,031	-82			
d. Below Threshold Reprogrammings	-278				
(U) Current Budget Submit / FY 1998 PB	81,171	86,382	76,102	77,002	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602202F Armstrong Lab Exploratory Development

PROJECT: 1123

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1123 Manpower, Personnel, and Training Technology	18,614	20,211	19,822	20,422	22,641	23,642	24,509	25,337	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops and evaluates new methods and technologies in support of Air Force training and education requirements in a variety of specific areas, including aircrew training, technical training, medical reserve training, logistics training, training in support of complex decision making, space training, information warfare training, and warfare readiness training. It investigates the spectrum of new and advanced training and education technologies for optimal ways to determine needs and deficiencies, design and implement training, and to evaluate training effectiveness. It develops and evaluates specific training systems, desk-top tutors, courseware development tools and technologies, assessment methodologies, and simulation-based systems to determine how to achieve maximum learning effectiveness for specific needs at minimum cost. This project will contribute to a more highly trained and flexible cadre of personnel and reduce the cost of maintaining crew, aircraft, and support personnel readiness. This Applied Research program develops technologies to increase operational readiness by: providing more effective methods and approaches to classify, assign, train, assess, and retain personnel. This program focuses on reducing the manpower required to operate and support weapon systems and on improving the effectiveness of the operators, maintainers, and other support personnel for those systems.

(U) FY 1996 ($ in Thousands):

- (U) $2,624 Developed intelligent/adaptive training technologies for improved automated training.
  - (U) Demonstrated the effectiveness of instructional strategies for automated, intelligent instruction in operational tasks and settings.
  - (U) Continued large-scale evaluation of an intelligent tutor for fundamental science literacy skills, and of a licensed reading/writing tutor for commercial sale.
- (U) $2,825 Developed intelligent, instructional design technologies to reduce cost and time of automated training system design.
  - (U) Developed and evaluated desktop training technology to improve decision-making skills in military applications such as logistics planning and resource allocation.
  - (U) Completed formative evaluation of an experimental tool for providing intelligent tutor performance support to novice instructional designers.
  - (U) Developed interactive, multi-media distance learning technologies.
- (U) $1,665 Developed assessment and evaluation technologies for adaptive training.
  - (U) Developed preliminary education and training assessment guidelines.
  - (U) Conducted preliminary development of mission readiness and warfighting capability assessment methods for evaluating training.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 1123

- (U) $1,110 Continued to develop concepts, trainers/simulators, and associated technologies to improve Air Force aircrew training.
  - (U) Developed functional specifications for electronic classroom technology for aircrew training.
  - (U) Continued development of training guidelines for situational awareness training.
  - (U) Developed model for use of advanced simulation tools for mission planning and rehearsal for MH-53J helicopter training.
- (U) $2,120 Developed guidelines for fidelity specifications for visual technologies used to improve aircrew training simulators.
  - (U) Developed and evaluated eye position monitor for use in training aircrews.
  - (U) Determined effects of display viewing distance on perception of target size.
- (U) $1,815 Developed and transitioned technologies to select and classify Air Force personnel and structure DoD jobs to maximize performance and mission accomplishment.
  - (U) Delivered a computer-based job structuring decision aid.
  - (U) Provided analysis of each Services' job structures process to support joint job structuring design (Air Force responsibility under Project Reliance).
- (U) $6,455 Developed technologies to improve assessment of abilities of Air Force personnel.
  - (U) Developed data base of specific mental capabilities required for complex, high-technology jobs.
  - (U) Developed techniques to conduct on-the-job performance assessment.
  - (U) Collected technical school performance data to evaluate selection test accuracy.
  - (U) Developed techniques to measure personality and motivation.
  - (U) Collected test data to evaluate minority performance on pilot ability measurements.
  - (U) Measured effects of practice on test performance to develop re-test policy.
  - (U) Identified ability demands of revised pilot training curricula.
  - (U) Conducted cost benefit study of aircrew personnel selection tests.
  - (U) Conducted research into pilot selection board policies.
  - (U) Developed crew resource management (CRM) tests for selecting Air National Guard and Air Force Reserve pilots.
- (U) $18,614 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602202F Armstrong Lab Exploratory Development**
	PROJECT **1123**

(U) FY 1997 ($ in Thousands):

- (U) $3,547 Develop intelligent/adaptive training and instructional design technologies.
  - (U) Field demonstrate the effectiveness of instructional strategies for automated, intelligent instruction in operational tasks and settings.
  - (U) Demonstrate effectiveness of automatically generated instructional questions for Air Force Reserve training.
  - (U) Demonstrate effectiveness of automatically generated courseware for Air Force Reserve training.
  - (U) Complete evaluation of a tool for providing intelligent performance support to novice instructional
  - (U) Continue to develop and evaluate interactive, multi-media distance learning technologies
  - (U) Complete development of adaptive tutor for Undergraduate Navigator Training.
  - (U) Continue large-scale evaluation of commercially licensed intelligent tutoring systems for fundamental math, English, and science literacy skills.
  - (U) Complete development and evaluation of desktop training technology for logistics command and control.
- (U) $755 Develop intelligent training assessment technologies.
  - (U) Develop and validate criteria to assess the effectiveness and efficiency of intelligent training technologies in operational settings.
  - (U) Conduct preliminary validation of an integrated education and training assessment framework.
  - (U) Develop individual and team measures of training effectiveness, retention, and decay.
- (U) $8,949 Develop concepts, trainers/simulators, and associated technologies to improve Air Force aircrew training.
  - (U) Develop advanced visualization tools for classroom instruction of basic fighter maneuvers.
  - (U) Develop metrics of team oriented situational awareness.
  - (U) Develop joint-Service team training guidelines for Special Operations Forces aircrew.
  - (U) Evaluate virtual debrief system for basic fighter maneuver training.
  - (U) Assess training value of variable time simulator training on acquisition of combat tasks.
  - (U) Develop training techniques for Blue Flag Battlestaff exercises.
- (U) $1,566 Develop guidelines for fidelity specifications for visual technologies used to improve aircrew training simulators.
  - (U) Determine training value of eye-position monitoring as visual feedback tool for combat mission training.
  - (U) Determine effect of field of view of helmet mounted displays on eye-head movements during a search task.
  - (U) Develop Model of color perception for mesopic luminance displays.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development
	PROJECT 1123

- (U) $2,175 Develop and transition technologies to select and classify Air Force personnel and structure DoD jobs to maximize performance and mission accomplishment.
  - (U) Determine the relationship of individual aptitude and experience to training time and equipment repair time.
  - (U) Deliver technology to support analysis of force retention and compensation policy issues.
  - (U) Develop an automated technology for collection of individual and organizational productivity measures.
  - (U) Evaluate demographic trends to support Air Staff strategic recruiting plan.
  - (U) Develop Air Force Office of Personnel Management and Air Force-Army occupational crosswalks.
- (U) $3,219 Develop technologies to improve assessment of abilities of Air Force personnel.
  - (U) Develop adaptive and generative tests of abilities to improve precision while decreasing test administration time.
  - (U) Continue development of data base of specific mental capabilities required for complex, high-technology jobs.
  - (U) Continue to develop techniques to conduct on-the-job performance assessment.
  - (U) Complete techniques to measure personality and motivation.
  - (U) Continue to collect test data to evaluate minority group performance on aircrew selection tests.
  - (U) Validate crew resource management skills test for selection of C-130 pilots.
  - (U) Identify ability demands of Joint Primary Aircraft Trainer (JPAT) and Specialized Undergraduate Pilot Training (SUPT).
  - (U) Develop test battery for unmanned Combat Air Vehicle controller selection.
  - (U) Develop screening systems for selecting weapons directors, navigators, and air traffic controllers.
- (U) $20,211 Total

(U) FY 1998 ($ in Thousands):

- (U) $3,464 Develop intelligent/adaptive training and instructional design technologies.
  - (U) Continue demonstration of the effectiveness of instructional strategies for automated, intelligent instruction in operational Air Force tasks and settings.
  - (U) Demonstrate a proof-of-concept authoring system for automated, intelligent, knowledge-based tutoring systems.
  - (U) Continue to develop and evaluate interactive, multi-media distance learning technologies.
- (U) $722 Continue development of assessment and evaluation technologies for adaptive training.
  - (U) Demonstrate preliminary individual and team retention training and transfer methods.
  - (U) Develop method for linking individual and team training performance effectiveness to readiness and warfighting capability.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 1123

- (U) $10,350 Develop concepts, trainers/simulators, and associated technologies to improve Air Force aircrew training.
  - (U) Conduct simulation-based mission preparation and rehearsal effectiveness assessments.
  - (U) Determine effects of display disparities on perception of slant and motion.
  - (U) Develop surface threat visualization trainer.
  - (U) Demonstrate electronic classroom technology for Specialized Undergraduate Pilot Training (SUPT).
  - (U) Develop guidelines for information management in a fighter squadron environment.
  - (U) Use eye tracking technology to assess the impact of alternative training strategies on visual workload for combat mission training.
- (U) $2,171 (U) Continue to develop technologies to improve assessment of abilities of Air Force personnel.
  - (U) Continue development of database of specific mental abilities required for complex, high technology jobs (Advanced Personnel Test validation).
  - (U) Continue development of adaptive and generative tests of abilities to improve precision while decreasing test administration time.
  - (U) Develop and evaluate alternative concepts for measuring ability to perform complex jobs (e.g., unmanned air vehicle crew positions) under realistic stresses.
- (U) $3,115 Continue to develop and transition technologies to select and classify Air Force personnel and structure DoD jobs to maximize performance and mission accomplishment.
  - (U) Determine entry and career progression job classification standards based on a life cycle approach to job eligibility.
  - (U) Complete cost/benefit analysis of selected recruiting strategies to meet future demographic trends.
  - (U) Field test an automated technology to collect individual and organizational productivity data.
  - (U) Deliver crew resource management test to Air National Guard and United States Air Force Reserve.
- (U) $19,822 Total

(U) FY 1999 ($ in Thousands):

-(U) $3,556 Continue development of intelligent/adaptive training and instructional design technologies.
  - (U) Transition automated, intelligent instruction to operational Air Force tasks and settings.
  - (U) Demonstrate the implementation of an authoring system for automated, intelligent, knowledge-based tutoring systems in an education and/or technical training domain.
- (U) $768 Continue development and integration of assessment and evaluation for adaptive training.
  - (U) Develop specifications for integrating individual assessment, learning strategies, and performance effectiveness outcomes for training.
  - (U) Conduct field tests to validate assessment and evaluation technologies and methods.
  - (U) Validate linkage of individual and team training performance to readiness and warfighting capability.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 1123

- (U) $10,668 Develop concepts, trainers/simulators, and associated technologies to improve Air Force aircrew training.
  - (U) Conduct four ship training utility evaluation.
  - (U) Develop instructional syllabi for use of four ship training elements in distributed mission training environment.
  - (U) Evaluate advanced tools for information management in the squadron environment.
  - (U) Develop guidelines for Special Operations Forces simulation-based mission preparation and rehearsal strategies.
  - (U) Assess multi-place visual display alternatives.
- (U) $5,430 Continue to develop technologies to improve assessment of abilities of Air Force personnel.
  - (U) Implement the Advanced Personnel Test for Air Force classification.
  - (U) Evaluate capability of adaptive and generative tests of abilities to improve precision while decreasing test administration time.
  - (U) Continue development and evaluation of alternative concepts for measuring ability to perform complex jobs (e.g., unmanned air vehicle crew positions) under realistic stresses.
- (U) $20,422 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development
	PROJECT 1123

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	21,301	20,830	21,061	22,380	Cont
(U) Current Budget Submit / FY 1998 PB	18,614	20,211	19,822	20,422	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602233N, Mission Support Technology: Personnel, Training, and Simulation Technology Area.
- (U) PE 0602716A, Human Factors Engineering Technology Development.
- (U) PE 0602727A, Non-System Training Devices Technology.
- (U) PE 0602785A, Manpower, Personnel, and Training Technology.
- (U) PE 0603106F, Logistics Systems Technology.
- (U) PE 0603227F, Personnel, Training, and Simulation Technology.
- (U) PE 0604227F, Flight Simulator Development.
- (U) PE 0604243F, Manpower, Personnel, and Training Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602202F Armstrong Lab Exploratory Development

PROJECT: 1710

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1710 Logistics Technology	6,061	5,882	5,308	5,539	6,266	6,574	6,690	6,975	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops technologies to: improve logistics support for both combat and peacetime operations; enhance logistics planning and assessment models for realistic wartime and contingency operations; improve logistics support requirements trade off and design methods to reduce manpower and equipment needed to support logistics operations in dispersed locations; and develop software tools for use in designing improved reliability, maintainability, supportability, and man-machine interfaces to reduce life cycle costs and increase system affordability of aging aircraft and new weapon systems.

(U) FY 1996 ($ in Thousands):

- (U) $6,061 Developed technology for improved logistics planning, support equipment upgrades, and more effective software maintenance.
  - (U) Continued to develop needs assessment methods and technology to improve wing-level contingency logistical planning control, and support.
  - (U) Continued to develop improved logistics deployment and contingency planning and assessment tools.
- (U) $6,061 Total

(U) FY 1997 ($ in Thousands):

- (U) $5,882 Continue development of technology for improved contingency logistics planning, deployment, support equipment functional upgrades; evaluate alternatives for visual display and assessment of complex logistics control and planning data.
  - (U) Complete preliminary software tools to support wing-level contingency logistics planning, replanning, and support.
  - (U) Develop computer-based design tools to minimize weapon systems deployment footprint and increase supportability.
- (U) $5,882 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 1710

(U) FY 1998 ($ in Thousands):

- (U) $5,308 Develop and compare technologies to support more flexible and less costly deployment and maintenance of airlift, combat aircraft, and support equipment; continue development of portable "wearable" logistics visualization devices and logistics information integration, command and control systems.
  - (U) Develop analysis tools and collect field data to identify specific supportability shortfalls of current sortie generation support equipment.
  - (U) Evaluate technical development risk/feasibility and application implications of providing weapon system software diagnostics and remediation tools for deployed flight line application.
  - (U) Develop advanced visualization, option generation, and logistics command and control tools for deployment planning and execution.
- (U) $5,308 Total

(U) FY 1999 ($ in Thousands):

- (U) $5,539 Continue development of technologies to reduce the cost and improve the performance of aircraft maintenance and increase flexibility/reduce costs of sustainment, deployment, and operations; evaluate and compare visualization technologies for improving supportability assessment and logistics command and control.
  - (U) Continue to develop methods to reduce the cost of aircraft hardware and operational software maintenance.
  - (U) Conduct initial in-house demonstrations and preliminary user assessments of correlated (real world, simulated, and virtual reality) multi-media simulation, displays, and cueing techniques for assessing logistics deployment readiness.
  - (U) Define functional requirements for automated reliability, maintainability, and supportability analysis tools using "intelligent agent" software techniques.
  - (U) Define and evaluate advanced knowledge representation software schemes for weapon system design data to support automation of electronic maintenance manuals.
- (U) $5,539 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 1710

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	6,061	6,058	6,102	6,671	Cont
(U) Current Budget Submit / FY 1998 PB	6,061	5,882	5,308	5,539	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602233N, Mission Support Technology: Personnel, Training, and Simulation Technology Area.
- (U) PE 0602716A, Human Factors Engineering Technology Development.
- (U) PE 0603106F, Logistics Systems Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 1900

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1900 Environmental Quality Technology	9,866	9,661	4,534	5,827	5,036	5,475	8,155	8,425	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops technologies to characterize the chemistry of Air Force-generated pollutants and toxic materials, assesses their interaction with the environment, and develops reduction/destruction and control techniques. Efforts are conducted to reduce the cost and increase the effectiveness of technologies that protect the environment. New Air Force fuels and chemicals are analyzed to identify and prevent possible environmental problems. Materials are investigated and new processes explored to assess and reduce environmental risks. Novel monitoring and modeling technologies are also explored.

(U) FY 1996 ($ in Thousands):

- (U) $3,565 Developed technologies and design criteria for improved monitoring, characterization, and assessment of risks to the environment posed by Air Force activities.
  - (U) Continued characterizing the fate and transport of Dense Nonaqueous Phase Liquids (DNAPLs) in soils and groundwater using physical studies to validate and develop models for optimizing effects of physical, chemical, and biological processes on contaminants.
  - (U) Identified and began resolving environmental safety and health issues specific to Large-Scale Chemical Laser (LSCL) Systems.
  - (U) Developed in-place sensors and geophysical technologies to locate, identify, and monitor DNAPL sources and plumes; initiated development of technology to improve sensor placement.
  - (U) Continued evaluation of atmospheric chemistry of candidate and new Air Force fuels and chemicals, including Halon replacements and depainting solvents; conducted atmospheric research to enhance risk assessment and model verification for Air Force space launch operations.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 1900

- (U) $6,301 Developed technologies to reduce/destroy wastes and contamination of the environment by Air Force materials and operations.
  - (U) Investigated, selected, and tested a suite of novel technologies that will remove emulsified oil and suspended particulates from oil-water separator effluents and aqueous cleaning/degreasing tanks.
  - (U) Continued to develop affordable technologies to control air polluting emissions from Air Force industrial processes to comply with Clean Air Act Amendments, including pulsed corona reactor technology for jet engine test cells.
  - (U) Finished refinement of pulsed pumping technique as an economical replacement for the current continuous pump-and-treat technology to remove contaminants from groundwater.
  - (U) Developed chemical/catalytic reactors to convert liquid /solid wastes, such as paint stripping wastes and energetic materials, to non-hazardous products, and to treat other complex chemical waste.
  - (U) Developed innovative technologies to treat/recycle metal/halogen contaminated sludge and other hazardous wastes from Air Force industrial operations to reduce disposal/recycle costs and comply with regulatory standards.
- (U) $9,866 Total

(U) FY 1997 ($ in Thousands):

- (U) $2,642 Develop technologies and design criteria for improved monitoring, characterization, and assessment of risks to the environment posed by Air Force activities.
  - (U) Continue to characterize the fate and transport characteristics of Dense Nonaqueous Phase Liquids (DNAPLs) in soils and groundwater using physical model studies to validate and develop models to determine the best effects of physical, chemical, and biological processes to degrade contaminants.
  - (U) Continue to identify and resolve environmental and operational safety issues for Large-Scale Chemical Laser (LSCL) Systems.
  - (U) Continue to determine the atmospheric chemistry of candidate and new Air Force fuels and chemicals; develop a database of the rates of photochemical and dark reactions of Air Force organic solvent vapors, new fire extinguishants, and new fuels in the presence of specific air pollutants.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development
	PROJECT 1900

- (U) $7,019 Develop technologies to reduce/destroy wastes and contamination of the environment caused by Air Force materials and operations.
  - (U) Continue to investigate, select, and test several novel technologies to remove emulsified oil and suspended particulates from oil-water separator effluents and aqueous cleaning/degreasing tanks.
  - (U) Continue to develop innovative technologies to treat/recycle metal/halogen contaminated sludge and other hazardous wastes from Air Force industrial operations to reduce disposal/recycle costs and comply with regulatory standards.
  - (U) Continue to develop affordable technologies to control air polluting emissions from Air Force industrial processes to comply with Clean Air Act Amendments; develop pulsed corona reactor technology for jet engine test cells.
  - (U) Develop chemical reactors to convert liquid wastes and energetic materials to non-hazardous products, and to treat other complex chemical waste effluents.
- (U) $9,661 Total

(U) FY 1998 ($ in Thousands):

- (U) $ 885 Develop technologies and design criteria for improved monitoring, characterization, and assessment of risks to the environment posed by Air Force activities.
  - (U) Continue to determine the atmospheric chemistry of candidate and new Air Force fuels and chemicals; develop a database of the rates of photochemical and dark reactions of Air Force solvent vapors, new fire extinguishants, and new fuels in the presence of specific air pollutants.
  - (U) Continue to identify and resolve the environmental and operational safety issues for Large-Scale Chemical Laser (LSCL) Systems.
  - (U) Complete natural attenuation study to prove that natural biogradation of hydrocarbon contaminants is an acceptable method of treatment.
  - (U) Develop space launch risk assessment model to assess the fate and transport of toxic emissions in catastrophic aborts.
- (U) $3,649 Develop technologies to reduce/destroy wastes and contamination of the environment by Air Force materials and operations.
  - (U) Develop chemical reactors to convert liquid wastes and energetic materials to non-hazardous products and to treat other complex chemical wastes.
  - (U) Develop affordable technology to control air polluting emissions from Air Force industrial processes to comply with Clean Air Act Amendments.
- (U) $4,534 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 1900

(U) FY 1999 ($ in Thousands):

–(U) $ 850 Develop technologies and design criteria for improved monitoring, characterization, and assessment of risks to the environment posed by Air Force activities.

- (U) Continue to identify and resolve the environmental and operational safety issues to Large-Scale Chemical Laser (LSCL) Systems.
- (U) Continue to develop space launch risk assessment model to assess the fate and transport of toxic emissions in catastrophic aborts.
- (U) Continue to determine the atmospheric chemistry of candidate and new Air Force fuels and chemicals; develop a database of the rates of photochemical and dark reactions of Air Force organic solvent vapors, new fire extinguishants, and new fuels in the presence of specific air pollutants.

– (U) $4,977 Develop technologies to reduce/destroy wastes and contamination of the environment by Air Force materials and operations.

- (U) Continue to develop chemical reactors to convert liquid wastes and energetic materials to non-hazardous products and to treat other complex chemical waste effluents.
- (U) Develop mobile source air emission mitigation technology.

– (U) $5,827 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development
	PROJECT 1900

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	9,866	9,960	10,280	10,619	Cont
(U) Current Budget Submit / FY 1998 PB	9,866	9,661	4,534	5,827	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0601102F, Defense Research Sciences.
- (U) PE 0602102F, Materials.
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603723F, Civil and Environmental Engineering Technology.
- (U) PE 0603716D, Strategic Environmental Research and Development Program.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602202F Armstrong Lab Exploratory Development

PROJECT: 7184

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
7184 Crew Technology	25,800	30,204	26,970	26,181	28,895	30,865	30,836	32,146	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops the technology required to improve human performance, protection, and survivability in operational environments. This is accomplished by defining the physical parameters, capabilities, and limits of systems operators; determining human responses to operational stressors such as noise, impact, vibration, hostile fire, sustained acceleration, spatial disorientation, altitude, workload, and sustained operations; and optimizing the human-machine interface. The project produces human factors design criteria, guidelines, and automated design tools for the development of effective technologies for information display, team communications, crew scheduling and fatigue management, control interfaces, emergency escape, crash protection, acceleration protection, and aircrew life support.

(U) FY 1996 ($ in Thousands):

- (U) $1,731 Developed human information processing and alternative system control technologies and reliable, unobtrusive predictors of human system effectiveness.
  - (U) Demonstrated integrated eye-voice-electromyographic control in a complex simulation environment.
  - (U) Completed portable, personal computer-based version of brain actuated controller.
  - (U) Completed demonstration of a neural-based "Workload Redline" concept which combines physiological, performance, and system measurements to predict mental work overload.
  - (U) Completed concept evaluation of airborne physiological monitor for night, low-level, high-speed flight environments.
- (U) $4,713 Developed system design technologies for integration of human performance data and crew system interfaces including a task time estimator.
  - (U) Enhanced a computer-aided design model of an aircraft flight line maintenance technician with the capability to estimate remove/repair task times.
  - (U) Developed computer-aided design technology incorporating actual aircraft controls to provide a totally virtual cockpit accommodation model.
  - (U) Demonstrated the mating of crew station computer-aided design technology with behavioral data visualization technology to produce a performance-sensitive design tool.
- (U) $6,512 Developed visual displays and symbology for improvement of human-machine interfaces.
  - (U) Demonstrated combined use of head-, eye-, brain-, and voice-actuated control of a man-machine system.
  - (U) Evaluated improved symbology set for aircraft off-boresight targeting with helmet-mounted displays.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 7184

- (U) $3,834 Developed injury threshold determination criteria and related technologies for improved protection equipment for aircrew and support personnel.
  - (U) Documented windblast exposure limits used in "safe-to-fly" determinations for helmet-mounted devices.
  - (U) Developed concept for changes to current six degree-of-freedom human impact and ejection acceleration exposure limit model to make it applicable for small aircrew members.
  - (U) Developed draft six degree-of-freedom head/neck model to be used for "safe-to-fly" evaluation of advanced concept helmet-mounted displays.
  - (U) Completed interim study on vibration tolerance characteristics of male and female aircrew members.
- (U) $2,171 Developed technologies to measure and predict human auditory responses and to provide criteria for voice communication for particular Air Force weapon systems and base operations.
  - (U) Completed development of three-dimensional audio technology for multiparty communications enhancement.
  - (U) Developed and demonstrated three-dimensional audio technologies for enhanced survivability and situational awareness.
  - (U) Developed and transitioned lightweight Active Noise Reduction (ANR) headset technology to improve voice communications capability and reduce noise-induced operator hearing loss.
- (U) $3,367 Developed technologies for evaluating and improving aircrew protection and effectiveness in operational environments.
  - (U) Continued research and development of technologies to reduce effects of high-G acceleration on pilot performance.
  - (U) Continued development of life support equipment technologies.
- (U) $3,472 Developed technologies for sustained aircrew operations and integration of life support systems into aircraft to improve aircrew safety and performance.
  - (U) Continued to develop and evaluate fatigue management system and team communication strategies for enhanced aircrew sustained operational performance.
  - (U) Continued applied research in oxygen generation technologies for aircraft and field hospital applications.
  - (U) Continued to develop spatial disorientation ground training technologies and spatial orientation displays for aircrew.
- (U) $25,800 Total

(U) FY 1997 ($ in Thousands):

- (U) $2,002 Develop unobtrusive, reliable predictors of human systems effectiveness.
  - (U) Develop an analytical description of crew performance in Theater Missile Defense attack operations mission.
  - (U) Integrate memory probes, attention allocation, and other mental components into an overall situation awareness conceptual model.

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- (U) $5,545 Develop system design technologies for greater integration of human performance data and crew system interfaces.
  - (U) Complete software to collect and reduce data for whole body, three-dimensional anthropometric scanning system.
  - (U) Demonstrate intelligent agents for multioperator performance in distributed battle management platforms.
  - (U) Develop analytical methodology for cognitive engineering in support of information dominance.
- (U) $7,857 Develop visual displays and symbology technology for improved human-machine interfaces and demonstrate integrated air-to-air virtual cockpit technology.
  - (U) Evaluate improved image intensifier tube for night vision goggle technology.
  - (U) Demonstrate integrated air-to-air virtual cockpit technology.
  - (U) Develop binocular helmet-mounted display (HMD) specifications and HMD test standards.
- (U) $4,349 Develop injury criteria, and technology for improved aircrew and support personnel protection equipment.
  - (U) Verify and transition whole-body restraint concepts for large and small crew members.
  - (U) Validate six degree-of-freedom whole body and head/neck models.
  - (U) Compare multimedia work technologies for use by engineers to evaluate concepts for aircrew protection.
  - (U) Develop human injury assessment methodology by combining manikin data and computer models.
- (U) $2,900 Develop technologies to measure and predict the effects of human auditory responses and to provide criteria for voice communication for particular Air Force weapon systems and base operations.
  - (U) Develop and demonstrate human-centered audio technologies for enhanced situational awareness and improved communications capability.
  - (U) Develop, demonstrate, and transition audio performance measurement technologies for assessment of individual auditory localization ability in operational situations.
  - (U) Develop advanced models, criteria, and technologies for improving human audio communication for Air Force weapon systems and for degrading communications capabilities of opposing forces.
- (U) $3,056 Develop technologies for evaluating and improving personal protection and effectiveness of aircrew and support personnel operating in hazardous environments.
  - (U) Develop and evaluate technologies to reduce the effects of high-G acceleration on pilot performance.
  - (U) Continue exploratory development of life support equipment and high altitude protection technologies.

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- (U) $4,495 Develop technologies for sustained aircrew operations and integration of life support technologies into aircraft to improve aircrew safety and performance.
  - (U) Demonstrate fitness-for-duty performance metrics and team decision making strategies for enhanced performance in long-duration missions.
  - (U) Develop ceramic oxygen generation technology for aircraft and field hospital applications.
  - (U) Develop and transition advanced spatial disorientation demonstrator technologies and continue development of spatial disorientation countermeasures for aircrew.
- (U) $30,204 Total

(U) FY 1998 ($ in Thousands):

- (U) $1,787 Continue to develop unobtrusive, reliable predictors of human systems effectiveness.
  - (U) Develop a computer-based model of workload and situation awareness for crew performance in Theater Missile Defense attack operations mission.
  - (U) Continue integration of memory probes, attention allocation, and other mental components into an overall situation awareness model.
  - (U) Integrate on-line workload classifier with real-time psychophysiological analysis system.
- (U) $4,954 Continue to develop system design technologies for greater integration of human performance data and improved crew system interfaces.
  - (U) Complete first whole-body, three-dimensional anthropometric survey.
  - (U) Complete prototype of expert computer-aided design (CAD) program that incorporates crew station design guidelines.
  - (U) Demonstrate DoD-common surveillance automatic target recognizer workstation integration.
- (U) $7,014 Continue to develop visual displays and symbology technology for improved human-machine interfaces and demonstrate integrated air-to-air and air-to-ground virtual cockpit technology.
  - (U) Develop baseline performance requirement for airborne helmet-mounted eye tracker.
  - (U) Develop visual requirements and symbology for helmet-mounted color display.
  - (U) Demonstrate integrated virtual air-to-air and air-to-ground cockpit design principles.
- (U) $3,306 Continue to develop injury criteria and technology for improved aircrew and support personnel protection equipment.
  - (U) Formulate modeling technology to assess combined coupling aerodynamic and inertial forces on the head and neck during high-speed escape.
  - (U) Validate integration of ejection seat model and human dynamic model.
  - (U) Develop hardware and software specifications for an advanced injury assessment system.
  - (U) Develop seat cushion design guidelines which meet male/female aviator comfort, vibration tolerance, and impact/ejection protection requirements in the extended operational environment.

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– (U) $3,167 Continue to develop improved aural technologies for enhanced human/system interface, develop technologies to measure and predict the effects of human auditory responses, and provide voice communication criteria for particular Air Force weapon systems and base operations.
- (U) Develop, demonstrate, and integrate three-dimensional audio technology applications for command, communications, and control, both air- and ground-based.
- (U) Continue integration of auditory and visual display technologies and symbologies for air-to-air, air-to-ground, and ground applications.
- (U) Develop and demonstrate auditory localization screening test methodology and hardware for assured personnel performance/safety.
- (U) Continue development of advanced models, criteria, and technologies for improving human audio communication for Air Force weapon systems and for degrading communications capabilities of opposing forces.
- (U) Develop smaller and more economical advanced spatial audio system technologies.

– (U) $2,360 Continue to develop technologies for evaluating and improving aircrew protection and effectiveness in operational environments.
- (U) Determine the adverse and favorable effects of prescribed medications on G-tolerance for aircrews.
- (U) Continue development of life support equipment and high altitude protection.

– (U) $4,382 Continue to develop technologies for sustained aircrew operations and integration of life support technologies into aircraft to improve aircrew safety and performance.
- (U) Develop and demonstrate fatigue models and incorporate into campaign-level models for aircrew sustained operations.
- (U) Develop in-flight spatial disorientation (SD) training technologies for non-mishap SD information and mishap consultation data.
- (U) Continue development of personal air purification technologies.
- (U) Determine psychophysiological constraints of helmet-mounted display/symbology.

– (U) $26,970 Total

(U) FY 1999 ($ in Thousands):

– (U) $1,742 Continue to develop unobtrusive, reliable predictors of human systems effectiveness.
- (U) Apply computer model of workload and situation awareness to design evaluation of controls and displays for Theater Missile Defense attack operations mission.
- (U) Complete integration of memory probes, attention allocation, and other mental components into an overall situation awareness model.

– (U) $4,818 Continue to develop system design technologies for greater integration of human performance data and crew systems interfaces.
- (U) Develop a fully integrated, on-line data system to serve as an international resource for human anthropometric data and applications software.
- (U) Develop a computer-aided design (CAD) tool that accurately represents the human body as a software template in the interactive CAD environment.
- (U) Demonstrate models and metrics for distributed situational awareness and adaptive decision-making.

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– (U) $6,792 Continue to develop visual displays and symbology technology for improved human-machine interfaces and demonstrate adaptive interface technology.
- (U) Develop integrated display standards for wide field-of-view helmet-mounted display for night air-to-ground attack mission.
- (U) Develop design alternatives for lightweight integrated helmet-mounted display and sighting system using eye line-of-sight.
- (U) Demonstrate a pilot-vehicle interface whose functionality changes with pilot physiologic and behavioral states driven by the combat situation.

– (U) $3,137 Continue to develop injury criteria and technology for improved aircrew and support personnel protective equipment.
- (U) Use biodynamic modeling to evaluate criteria for through-the-canopy impact and extremity clearance.
- (U) Develop a common Biodynamic Data Bank Format and User Interface for DoD, the National Highway Transportation Safety Administration, and the Federal Aviation Administration.
- (U) Develop stability criteria for helmet-mounted displays in a vibration or multiple impact environment.

– (U) $3,147 Continue expansion of advanced aural technologies for enhanced human/systems interfaces; establish new principles and methodologies of information management for exploitation of information warfare applications.
- (U) Evaluate and apply three-dimensional audio technologies for operator intensive applications in special unmanned air vehicle and command, control, and communications functions using smaller, cost-effective auditory/visual displays and customized symbology.
- (U) Advance methodologies and technologies for quantifying individual auditory localization ability of operational personnel in combat and occupational positions.
- (U) Develop and demonstrate novel voice modification and intelligent jammer technologies for enhanced information warfare operations.

– (U) $1,964 Continue to develop technologies for evaluating and improving aircrew protection and effectiveness in operational environments.
- (U) Develop physical conditioning training regimens to enhance G-tolerance for aircrews.
- (U) Continue research on the adverse and favorable effects of prescribed medications on G-tolerance for aircrew.
- (U) Validate risk prediction model for aircrew decompression sickness in high altitude operations.

– (U) $4,581 Continue to develop technologies for sustained aircrew operations and integrate into aircraft to improve aircrew safety and performance.
- (U) Improve team dynamics for aircrew sustained operations in simulated and field conditions.
- (U) Complete development of ceramic oxygen generation technology.
- (U) Develop helmet-mounted spatial orientation displays that achieve vestibular suppression and continue refining spatial disorientation countermeasures for aircrew.

– (U) $26,181 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development
	PROJECT 7184

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	24,362	29,221	28,681	29,219	Cont
(U) Current Budget Submit / FY 1998 PB	25,800	30,204	26,970	26,181	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary ($ in Thousands)**

(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0602702F, Command, Control, and Communications.
- (U) PE 0603205F, Aerospace Vehicle Technology.
- (U) PE 0603227F, Advanced Simulator Technology.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0603245F, Advanced Fighter Technology Integration.
- (U) PE 0604703F, Aeromedical/Casualty Care Systems Development.
- (U) PE 0604706F, Life Support Systems.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602202F Armstrong Lab Exploratory Development**
	PROJECT **7755**

COST *($ In Thousands)*	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
7755 Aircrew Physiology Technology	7,231	6,488	4,717	4,590	3,547	3,750	3,987	4,284	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** The human operator is the enabling factor in aerospace systems. The goal of this project is to optimize aircrew effectiveness through developing an understanding of: (1) conditions affecting aircrew selection and retention; (2) methods of early disease detection; (3) impact of asymptomatic disease on aircrew performance; (4) therapeutic drug effects on flight safety; and (5) physiological factors affecting operational readiness and effectiveness.

(U) FY 1996 ($ in Thousands):

- (U) $5,742 Developed technologies for improving aircrew standards.
  - (U) Refined standards (i.e., cardiovascular, vision/optical devices, neuropsychiatric, and hearing/vestibular standards) to improve aircrew selection, retention, and performance.
  - (U) Evaluated aircrew performance-based standards in areas such as high-G acceleration, microgravity, and dehydration.
  - (U) Continued to develop better capability to assess physiological factors affecting female aircrew: obstetrics-gynecology (ob-gyn); orthopedic; and G-tolerance.
- (U) $1,489 Developed operational performance enhancement technologies.
  - (U) Evaluated technologies and procedures to minimize impact of dehydration, illness, medications, and physical deconditioning on aircrew performance in the aviation environment.
  - (U) Developed countermeasures for decompression sickness incidents.
- (U) $7,231 Total

(U) FY 1997 ($ in Thousands):

- (U) $5,109 Develop technologies for improving aircrew standards.
  - (U) Continue to refine standards (i.e., cardiovascular, vision/optical devices, neuropsychiatric, and hearing/vestibular standards) to improve aircrew selection, retention, and performance.
  - (U) Develop medical informatics technology to assess impact of asymptomatic disease on aircrew operational performance.
  - (U) Develop and validate operational cockpit glare testing technology.
  - (U) Assess physiological factors affecting female aircrew (i.e., ob-gyn, orthopedic, G-tolerance) performance.
  - (U) Develop template for therapeutic modalities to reduce number of grounded aviators and to enhance performance in the aviation environment.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 7755

- (U) $1,379 Develop operational performance enhancement technologies.
  - (U) Compare advanced operational vision performance technologies (e.g., refractive surgery for aircrew use).
  - (U) Develop methods to identify and remediate physiological impairments arising from flying high performance aircraft.
- (U) $6,488 Total

(U) FY 1998 ($ in Thousands):
- (U) $3,484 Develop performance-based aircrew standards.
  - (U) Develop medical informatics technology to assess force fitness and to assess impact of disease on aircrew.
  - (U) Verify impact of, and begin development of countermeasures for unique female physiological factors affecting aircrew performance.
  - (U) Develop therapeutic modalities to reduce number of grounded aviators and to enhance performance in aviation environment.
- (U) $1,158 Develop operational performance enhancement technologies.
  - (U) Develop and evaluate aircrew vision enhancement technologies for both day and night air combat.
  - (U) Develop methods to identify and remediate physiological.
- (U) $75 Complete expanded physical fitness test battery.
- (U) $4,717 Total

(U) FY 1999 ($ in Thousands):
- (U) $3,391 Develop performance-based aircrew standards.
  - (U) Develop medical informatics technology to assess force fitness and to assess impact of disease on aircrew.
  - (U) Verify impact of, and begin developing countermeasures for, unique female physiological factors affecting aircrew performance.
- (U) $1,124 Develop operational performance enhancement technologies.
  - (U) Evaluate advanced operational vision performance technologies (e.g., photorefractive surgery for aircrew use).
- (U) $75 Complete fire fighter physical fitness program.
- (U) $4,590 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development
	PROJECT 7755

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	7,231	6,682	6,788	6,798	Cont
(U) Current Budget Submit / FY 1998 PB	7,231	6,488	4,717	4,590	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0604703F, Aeromedical/Casualty Care Systems Development.
- (U) PE 0604706F, Life Support Systems.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 7757

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
7757 Toxicology/Radiation/Noise Hazards	13,599	13,936	14,751	14,443	16,024	16,353	17,104	17,820	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project enables the safe operational use of Air Force weapon systems through technology development related to the effects and applications of hazardous materials, noise, and electromagnetic and space radiation used in, or resulting from, Air Force operations. The radiation portion of the project addresses areas such as: safety; risk assessment; mission planning and countermeasures in combat; less than lethal applications for special operations and law enforcement; and biologic effects of exposure to radiofrequency/microwave radiation, lasers, broad-band munitions, and ionizing radiation. Toxicological technology is developed to assess human tolerance levels for chemicals, fuels, and materials to establish exposure criteria and perform trade off analyses between weapon system performance and occupational health and environmental support specifications. Technology to assess and reduce the environmental impact of noise generated by Air Force operations is also developed. This project provides consultative support to other DoD programs by using unique Air Force resources to extend capabilities for development and evaluation of technology to assess and counter toxicological, radiation, and noise hazards.

(U) FY 1996 ($ in Thousands):

- (U) $8,160 Developed technology to exploit the effects and applications of directed energy in Air Force operations.
  - (U) Developed technology to assess the operational impact of laser air defense weapons on visual delivery of precision guided munitions.
  - (U) Developed measures and countermeasures to exploit less-than-lethal biological effects of electromagnetic radiation for Air Force security, peacekeeping, and warfighting operations.
  - (U) Developed scientific database and methods for setting health risk-based safety standards that protect personnel from harmful exposure to electromagnetic radiation with minimal operational impact.
  - (U) Assessed health and safety impact of newly fielded and emerging high-power microwave technologies.
- (U) $4,759 Developed and assessed toxicological technology related to Air Force materials, processes, and clean up standards.
  - (U) Provided systems managers with critical information for risk versus benefit decisions for new materials such as Halon replacements, alternative solvents, and combustion toxicity for composite materials.
  - (U) Developed technology to assess potential environmental hazards and occupational safety of current and proposed fuels for use in Air Force weapon systems.
  - (U) Assessed and related human health risks to clean-up standards for groundwater contaminants such as trichloroethylene.
  - (U) Developed human health risk-based clean-up standards for soil contaminants such as total petroleum hydrocarbons (TPH).

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development
	PROJECT 7757

- (U) $680 Developed measuring and modeling technology to assess and reduce adverse impacts of aircraft noise and sonic booms produced by Air Force operations.
  - (U) Demonstrated airbase noise measurement technology.
  - (U) Developed DoD manual for noise assessment
  - (U) Updated aircraft noise model to allow assessment of selected Air Force operational aircraft.
  - (U) Verified model for topography effects on aircraft noise propagation.
  - (U) Acquired C-17 acoustic signature for occupational and environmental noise exposures.
- (U) $13,599 Total

(U) FY 1997 ($ in Thousands):

- (U) $8,310 Develop technology to exploit the effects and applications of directed energy in Air Force operations.
  - (U) Produce interim ultra-short pulse laser safety standard and continue developing technology to assess occupational safety and operational threats from lasers.
  - (U) Continue developing electromagnetic radiation bioeffects measurement and analysis methods for use in setting risk-based health and safety standards for personnel exposure.
  - (U) Continue developing technologies for assessing bioeffects of less-than-lethal directed energy emissions.
  - (U) Develop analytical algorithms for calculating and predicting direct and inverse scattering of laser and radiofrequency radiation.
- (U) $4,925 Develop and assess toxicological technology related to Air Force materials and processes.
  - (U) Continue toxicological assessment of next generation replacements for Halons and ozone depleting solvents to protect Air Force personnel and provide systems managers with risk versus benefit decision tools.
  - (U) Continue to develop and improve methods and models to assess chemical mixture toxicity in humans, relate human health effects to cleanup standards, and explore biomarkers as an indicator of exposure.
  - (U) Continue development of metabolic techniques for cell culture exposure, species extrapolation for enzymes diversity, and suitable alternatives to animal use for transition to operational toxicology applications.
  - (U) Provide systems managers with critical information for risk versus benefits decision for combustion toxicity of turbine engine exhaust.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 7757

- (U) $701 Develop technology to assess and reduce adverse impacts of aircraft noise and sonic booms produced by Air Force operations.
  - (U) Conduct noise measurements on the F-22 aircraft.
  - (U) Develop model to predict damage from sonic booms on historic structures.
  - (U) Develop technology to assess human annoyance response to sonic booms and low level aircraft overflights.
- (U) $13,936 Total

(U) FY 1998 ($ in Thousands):

- (U) $8,680 Develop technology to exploit the effects and applications of directed energy in Air Force operations.
  - (U) Establish joint Air Force/Army safety standard for the Airborne Laser (ABL).
  - (U) Develop electromagnetic radiation bioeffects assessment tools for use in setting scientifically-based health and safety standards for personnel exposure; complete long-term study on ultrawideband exposure and millimeter wave health and safety.
  - (U) Develop technologies for assessing health and safety concerns of less-than-lethal directed energy emissions.
  - (U) Develop algorithms for calculating and predicting direct and inverse scattering of electromagnetic radiation from total body and specific organs for use in bioeffects measurement and analyses in setting risk-based health and safety standards for personnel exposure.
- (U) $5,280 Develop and assess toxicological technology related to Air Force materials and processes.
  - (U) Continue to develop toxicological assessments for the ultimate Halon replacements and non-ozone depleting alternative solvents.
  - (U) Assess the potential hazards and occupational safety of fuels such as quadricyclane and JP-8 + 100.
  - (U) Develop methodology for extrapolation of chronic exposure data to Short-Term Exposure Limits (STELs).
  - (U) Provide program managers with human health-based data to conduct chemical specific risk assessments.
- (U) $791 Develop technology to assess and reduce adverse impacts of aircraft noise and sonic booms produced by Air Force operations.
  - (U) Demonstrate miniaturized boom monitor that will cut monitoring costs by 80 percent.
  - (U) Conduct joint study with Navy to model noise propagation over water.
  - (U) Demonstrate radar tracking storage technology for noise analysis.
- (U) $14,751 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development PROJECT 7757

(U) FY 1999 ($ in Thousands):

- (U) $8,580 Develop technology to exploit the effects and applications of directed energy in Air Force operations.
  - (U) Develop safety standards for Light Detection and Ranging (LIDAR).
  - (U) Continue developing electromagnetic radiation bioeffects measurement and analysis methods for use in setting risk-based health and safety standards for personnel exposure; publish advanced dosimetry handbook; promulgate revised ultrawideband standard.
  - (U) Continue developing technologies for assessing bioeffects of less-than-lethal directed energy emissions; complete human extrapolation studies.
  - (U) Develop algorithms for ground-based environmental subsurface imaging.
- (U) $5,083 Develop and assess toxicological technology related to Air Force materials and processes.
  - (U) Provide program managers with critical information for risk versus benefit decisions for combustion toxicity of turbine engine exhaust.
  - (U) Improve methods and models to assess the toxicity of total petroleum hydrocarbons (TPH) and develop human health-based cleanup standards for jet fuel contaminated sites.
  - (U) Assess the potential hazards of high energy fuels such as JP-900.
  - (U) Develop application of three-dimensional image analysis and four-dimensional scientific visualization to depict toxicologic data for answering operational toxicity questions.
- (U) $780 Develop technology to assess and reduce adverse impacts of aircraft noise and sonic booms produced by Air Force operations.
  - (U) Conduct measurements of sonic boom cutoff perpendicular to the aircraft flight path.
  - (U) Conduct field measurements of portable active noise reduction technology.
  - (U) Conduct field test to validate structural analysis tool for the impact of sonic booms on historic structures.
- (U) $14,443 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Armstrong Lab Exploratory Development
	PROJECT 7757

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	13,599	14,352	14,364	14,736	Cont
(U) Current Budget Submit / FY 1998 PB	13,599	13,936	14,751	14,443	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602720A, Environmental Quality Technology.
- (U) PE 0602777A, Systems Health Hazard Prevention Technology.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0604706F, Life Support Systems.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	71,766	72,221	69,303	68,416	70,039	72,913	76,433	78,563	Continuing	Continuing
3012 Advanced Propulsion Technology	7,631	7,179	0	0	0	0	0	0	14,810	TBD
3048 Fuels and Lubrication	15,257	12,511	13,577	12,161	12,218	13,192	14,692	15,034	Continuing	Continuing
3066 Turbine Engine Technology	33,752	37,980	40,613	41,357	42,773	43,427	45,115	46,426	Continuing	Continuing
3145 Aerospace Power Technology	15,126	14,551	15,113	14,898	15,048	16,294	16,626	17,103	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Applied Research program develops airbreathing propulsion and aerospace power technologies. The prime areas of focus are turbine engines, dual-mode ramjets, combined cycle engines, fuels, lubricants, and aerospace power technologies. Technology advances in turbine engine propulsion and lubrication systems are part of the Integrated High Performance Turbine Engine Technology (IHPTET) program and will increase engine performance, reduce specific fuel consumption, and lower cost of ownership. Dual-mode ramjet and combined cycle engines will increase weapon lethality and effectiveness against time-critical targets via high-speed propulsion systems. Fuels efforts will reduce system cost, maintenance, and the usage of hazardous cleaning materials while increasing aircraft performance and life through development of thermally stable and high heat sink fuels. Power system technologies are focused to eliminate troublesome, centralized hydraulic systems by replacement with highly reliable electric systems. Power conditioning, thermal management, and battery improvements will significantly enhance reliability, reduce weight, and lower life cycle costs. As of FY 1998, all high-speed propulsion efforts under Project 3012, Advanced Propulsion Technology will be terminated. Note: In FY 1998, additional emphasis has been placed on fuel filter research. In FYs 1999 and out, additional emphasis has been placed on demonstrating IHPTET goals.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	72,237	74,906	75,304	75,539	Cont
(U) Appropriated Value	75,070	74,906			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-1,455	-1,640			
b. SBIR	-947	-975			
c. Other Adjustments	-893	-70			
d. Below Threshold Reprogrammings	-9				
(U) Current Budget Submit/FY 1998 PB	71,766	72,221	69,303	68,416	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: High-speed propulsion efforts are terminated as of FY 1998.

Technical: High-speed propulsion efforts are terminated as of FY 1998.

(U) **C. Other Program Funding Summary:** Not Applicable.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE: February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT: 3012

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3012 Advanced Propulsion Technology	7,631	7,179	0	0	0	0	0	0	14,810	TBD

(U) A. Mission Description and Budget Item Justification: Establishes technology base for advanced propulsion concepts including integral rocket ramjets for missile propulsion providing increased average velocity and lethality along with combined/advanced-cycle engines and hydrocarbon fueled dual-mode combustion ramjets for high-speed vehicles to support future missions such as rapid strike against time-critical targets. This project will be terminated in FY 1998.

(U) FY 1996 ($ in Thousands):

- (U) $4,810 Developed propulsion system components (inlets, dual-mode combustors, ramburners, nozzles, fuel systems, inlet/port covers, boost motors, etc.) for high-speed airbreathing propulsion applications. This effort facilitates technology transition to current and future air vehicles with greater range, increased velocity, and increased maneuverability which enhance weapon effectiveness.
  - (U) Completed sub-scale testing of consumable ramjet structures for elimination of debris during rocket/ramjet transition.
  - (U) Accomplished rocket/ramjet transition test to complete boron fuel technology transfer from Germany to U.S.
  - (U) Identified test techniques/instrumentation/diagnostics for test rig integration to enable and expedite development of dual-mode combusters.
- (U) $2,821 Investigated unique concepts for combining advanced propulsion cycles which provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.
  - (U) Completed testing of two-dimensional sector test rig to demonstrate technology feasibility of the critical combustor concept for Mach 0-6 turboramjet systems.
  - (U) Designed and initiated fabrication of annular sector test rig for evaluating critical combustor component operation of Mach 0-6 turboramjet systems.
  - (U) Investigated techniques for continuous operation of the pulsed detonation wave cycle with potential for very high thrust-to-weight low-cost missile engine.
- (U) $7,631 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion
	PROJECT 3012

(U) FY 1997 ($ in Thousands):

- (U) $4,541 Develop propulsion system components (inlets, dual-mode combustors, ramburners, nozzles, fuel systems, inlet/port covers, boost motors, etc.) for high-speed airbreathing propulsion applications. This effort facilitates technology transition to current and future air vehicles with greater range, increased velocity, and increased maneuverability which enhance weapon effectiveness.
  - (U) Complete testing of full-scale flightweight consumable structures for eliminating debris during rocket/ramjet transition.
  - (U) Determine applicability and quantify benefits of advanced ramjet propulsion technologies (insensitive munitions, low-observables, self throttling, high energy fuels, structures, etc.) for ramjet operation from launch condition through Mach 6 operation.
  - (U) Determine propulsion performance of dual-mode ramjet components utilizing advanced test technologies, instrumentation, and diagnostics.
- (U) $2,638 Investigate unique concepts for combining advanced propulsion cycles which provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.
  - (U) Complete fabrication and initiate testing of annular sector test rig to demonstrate performance of critical combustor components for application to Mach 0-6 turboramjet engines.
  - (U) Complete conceptual design of combined cycle engine demonstrator.
  - (U) Test a boilerplate pulse detonation engine operating at realistic frequencies, thrust levels, and for sufficient time to demonstrate cycle performance.
- (U) $7,179 Total

(U) FY 1998: Not Applicable.

(U) FY 1999: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion — PROJECT: 3012

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	7,680	7,379	7,356	6,945	Cont
(U) Current Budget Submit/FY 1998 PB	7,631	7,179	0	0	TBD

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to termination of the project.

Schedule: Project is terminated as of FY 1998.

Technical: Project is terminated as of FY 1998.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) Program is reported to/coordinated by the Joint Army/Navy/NASA/Air Force (JANNAF) executive committee.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT: 3048

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3048 Fuels and Lubrication	15,257	12,511	13,577	12,161	12,218	13,192	14,692	15,034	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops advanced fuels, lubricants, and component technologies for use in aircraft and missile engines. Conventional petroleum and alternate fuels are developed and evaluated for Air Force applications. Fuels and lubricants must be thermally stable, cost-effective, and operate at higher temperatures.

(U) FY 1996 ($ in Thousands):

- (U) $6,217 Developed high thermal stability and endothermic hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.
  - (U) Demonstrated performance and cost benefits of JP-8+100 fuel to reduce fuel system maintenance.
  - (U) Developed advanced fuel system components that allow the utilization of the heat sink of JP-8+100 fuel.
- (U) $2,279 Developed high performance, low emissions, robust combustor concepts for advanced turbine engines. This will reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.
  - (U) Developed and evaluated a high performance, low emissions trapped vortex combustor concept in atmospheric rig tests using a full-scale sector of an annular combustor to validate this revolutionary concept for gas turbine engines.
  - (U) Evaluated advanced fuel injector concepts to select the best candidate for increased combustion performance and low emissions in advanced gas turbine engines.
- (U) $6,761 Developed lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.
  - (U) Developed liquid lubricants to 600°F bulk oil temperature to increase thermal stability and life while decreasing friction, wear, deposit formation, and corrosion in current and future engines.
  - (U) Validated vapor phase lubrication and magnetic levitation as technology alternatives to liquid lubricants at temperatures exceeding 700°F.
- (U) $15,257 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion PROJECT 3048

(U) FY 1997 ($ in Thousands):

- (U) $4,753 Develop high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.
  - (U) Validate performance and cost benefits of JP-8+100 fuel to increase sortie generation.
  - (U) Validate advanced fuel system components that allow the utilization of the heat sink of JP-8+100 fuel.
- (U) $2,830 Develop high performance, low emissions, robust combustor concepts for advanced turbine engines. This will reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.
  - (U) Evaluate the high performance, low emissions, full-scale sector of a trapped vortex combustor at 20 atmospheres of pressure for transition to Phase III of the Integrated High Performance Turbine Engine Technology (IHPTET) program.
  - (U) Evaluate the effectiveness of a turbocooler fuel/air heat exchanger for cooling the turbine vanes in advanced IHPTET Phase III combustor.
  - (U) Evaluate the best fuel injector concept in a high pressure combustion rig to fully characterize combustion performance and emissions levels.
- (U) $4,928 Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.
  - (U) Verify vapor phase lubrication as primary system in expendable and limited life gas turbine engines.
  - (U) Verify magnetic levitation and control as full replacement for conventional lubricants and bearings in an advanced gas generator.
- (U) $12,511 Total

(U) FY 1998 ($ in Thousands):

- (U) $6,618 Develop high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.
  - (U) Evaluate fuel additives to increase the high temperature stability of fuels above 425°F.
  - (U) Validate advanced fuel system components that allow the utilization of the heat sink of JP-8+100 and other high heat sink fuels.
- (U) $2,680 Develop high performance, low emissions, robust combustor concepts for advanced turbine engines. This will reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.
  - (U) Evaluate high performance, low emissions, full-scale sector of a trapped vortex combustor for transport engine application.
  - (U) Evaluate effectiveness of an endothermic fuel/air heat exchanger for cooling turbine vanes at the exit of a trapped vortex combustor.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion PROJECT 3048

- (U) $4,279 Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.
  - (U) Demonstrate advanced liquid lubricant, fully functional from -40°F to +600°F, in test engine.
  - (U) Integrate vapor phase lubricant system into expendable-class engine demonstrator for full operational evaluation.
  - (U) Develop a fully integrated rotor support and control system based on a high temperature, hybrid (magnetic/mechanical) bearing set.
- (U) $13,577 Total

(U) FY 1999 ($ in Thousands):

- (U) $4,522 Develop high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.
  - (U) Evaluate advanced fuel additives to increase fuel thermal stability to 900 °F.
  - (U) Evaluate fuel system components that utilize the heat sink of supercritical fuels.
- (U) $2,636 Develop high performance, low emissions, robust combustor concepts for advanced turbine engines. This will reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.
  - (U) Evaluate high performance, low emissions, full-scale sector of a trapped vortex combustor using a microwave ignition system.
  - (U) Evaluate effectiveness of an endothermic fuel/air heat exchanger for cooling turbine vanes at the exit of an advanced Integrated High Performance Turbine Engine Technology Phase III microwave combustor.
- (U) $5,003 Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.
  - (U) Complete transition of advanced, broad temperature range, liquid lubricant to a fully qualified, field-ready material.
  - (U) Evaluate vapor phase lubricants for piloted, unlimited life applications.
  - (U) Integrate hybrid magnetic bearing into a core (high pressure), single spool demonstrator engine.
  - (U) Develop hybrid magnetic bearing for full control of a low pressure rotor in preparation for fully integrated, hybrid magnetic bearing supported, dual spool engine demonstrator.
- (U) $12,161 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion — PROJECT: 3048

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	15,355	13,390	12,414	12,254	Cont
(U) Current Budget Submit/FY 1998 PB	15,257	12,511	13,577	12,161	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT: 3066

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3066 Turbine Engine Technology	33,752	37,980	40,613	41,357	42,773	43,427	45,115	46,426	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops technology to increase propulsion system operational reliability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. Analytical and experimental efforts are conducted in fans/compressors, high temperature combustors, turbines, internal flow systems, controls, exhaust systems, and structural design. This project supports the Integrated High Performance Turbine Engine Technology (IHPTET) program.

(U) FY 1996 ($ in Thousands):

- (U) $26,044 Developed core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
  - (U) Designed and fabricated advanced compressors with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher compressor exit temperature capability, lower weight, and improved seals.
  - (U) Designed and fabricated advanced combustors with higher combustion efficiencies, lower manufacturing costs, increased robustness, higher combustion temperature, lower weight, and improved temperature patterns.
  - (U) Designed and fabricated advanced turbines with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) $3,040 Developed turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
  - (U) Designed and fabricated advanced fan with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) $3,156 Developed components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
  - (U) Designed and fabricated advanced combustor with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion
	PROJECT 3066

- (U) $1,512 Developed components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
  - (U) Demonstrated advanced turbine with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) $33,752 Total

(U) FY 1997 ($ in Thousands):

- (U) $25,928 Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
  - (U) Demonstrate advanced compressors with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher compressor exit temperature capability, lower weight, and improved seals.
  - (U) Demonstrate advanced combustors with higher combustion efficiencies, lower manufacturing costs, increased robustness, higher combustion temperature, lower weight, and improved temperature patterns.
  - (U) Demonstrate advanced turbines with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) $6,701 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
  - (U) Demonstrate advanced fan with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) $2,754 Develop components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
  - (U) Demonstrate advanced combustor with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) $2,597 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
  - (U) Demonstrate advanced turbine with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) $37,980 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion
	PROJECT 3066

(U) FY 1998 ($ in Thousands):

- (U) $28,508 Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
  - (U) Design and fabricate Integrated High Performance Turbine Engine Technology (IHPTET) Phase III advanced compressors with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher compressor exit temperature capability, lower weight, and improved seals.
  - (U) Design and fabricate IHPTET Phase III advanced combustors with higher combustion efficiencies, lower manufacturing costs, increased robustness, higher combustion temperature, lower weight, and improved temperature patterns.
  - (U) Design and fabricate IHPTET Phase III advanced turbines with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) $6,730 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
  - (U) Design and fabricate IHPTET Phase III advanced fan with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) $2,731 Develop components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
  - (U) Design and fabricate IHPTET Phase III advanced combustor with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) $2,644 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
  - (U) Design and fabricate IHPTET Phase III advanced turbine with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) $40,613 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion — PROJECT: 3066

(U) FY 1999 ($ in Thousands):

- (U) $29,006 Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
  - (U) Demonstrate Integrated High Performance Turbine Engine Technology (IHPTET) Phase III advanced compressors with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher compressor exit temperature capability, lower weight, and improved seals.
  - (U) Demonstrate IHPTET Phase III advanced combustors with higher combustion efficiencies, lower manufacturing costs, increased robustness, higher combustion temperature, lower weight, and improved temperature patterns.
  - (U) Demonstrate IHPTET Phase III advanced turbines with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) $6,866 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
  - (U) Demonstrate IHPTET Phase III advanced fan with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) $2,823 Develop components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
  - (U) Demonstrate IHPTET Phase III advanced combustor with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) $2,662 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
  - (U) Demonstrate IHPTET Phase III advanced turbine with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) $41,357 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion — PROJECT: 3066

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	33,978	39,181	40,080	41,039	Cont
(U) Current Budget Submit/FY 1998 PB	33,752	37,980	40,613	41,357	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary ($ in Thousands):**

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0603202F, Aircraft Propulsion Subsystem Integration.
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) PE 0602122N, Aircraft Technology.
- (U) PE 0603210N, Aircraft Propulsion.
- (U) PE 0603003A, Aviation Advanced Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion		PROJECT: 3145

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3145 Aerospace Power Technology	15,126	14,551	15,113	14,898	15,048	16,294	16,626	17,103	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops technologies for aerospace power generation, conversion, and transmission systems including advanced electrical power component and subsystem technologies. Power components are developed for aircraft and flight line equipment to increase reliability, maintainability, commonality, and supportability. This project supports an initiative which uses electrical power to replace hydraulic and pneumatic power and their costly logistics support. Essentially, all power electronics technology being developed has dual-use opportunities. Specific application areas include electric automobiles, electric brakes, electrically actuated power steering, and a wide range of variable speed industrial motor drive applications.

(U) FY 1996 ($ in Thousands):

- (U) $13,360 Developed aerospace batteries and power generation, conversion, and transmission components for aircraft systems. These components provide aircraft with a high degree of self-sufficiency, improved reliability, maintainability, and supportability, all yielding a quicker aircraft turn-around time. In addition, ground support equipment requirements will be dramatically reduced.
  - (U) Rig tested components to engine start/auxiliary power unit systems to improve reliability two-fold.
  - (U) Designed and fabricated electrical components essential for a fault tolerant electrical power system.
  - (U) Tested high temperature semiconductor switches to demonstrate increased operating temperature and improved reliability.
- (U) $1,236 Developed battery systems for guidance, navigation, control functions for missile systems, and for use in navigational aids, radios, and sensors for special operations forces. Batteries with higher power density, longer life, increased reliability, and rechargability will provide missiles systems and special operations forces with greater reliability and reduced maintenance costs.
  - (U) Developed lithium cell components for use in rechargeable batteries--a three-fold reduction in mass/volume over existing batteries.
- (U) $530 Developed special purpose power components for advanced surveillance and communications systems, as well as ground power applications.
  - (U) Completed electromagnetic interference (EMI) and thermal modeling activities for aircraft power systems.
- (U) $15,126 Total

(U) FY 1997 ($ in Thousands):

- (U) $12,762 Develop aerospace batteries and power generation, conversion, and transmission components for aircraft systems. These components provide aircraft with a high degree of self-sufficiency, improved reliability, maintainability, and supportability, all yielding a quicker aircraft turn-around time. In addition, ground support equipment requirements will be dramatically reduced.
  - (U) Demonstrate electrical components essential for a fault tolerant electrical power system.
  - (U) Complete test and demonstration of high temperature semiconductor switches to demonstrate increased operating temperature and improved reliability.
  - (U) Complete fabrication of internal engine starter/generator which leads to elimination of engine gear box.

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- (U) $1,252 Develop battery systems for guidance, navigation, control functions for missile systems, and for use in navigational aids, radios, and sensors for special operations forces. Batteries with higher power density, longer life, increased reliability, and rechargability will provide missiles systems and special operations forces with greater reliability and reduced maintenance costs.
  - (U) Demonstrate lithium cells for use in rechargeable batteries--allows three-fold reduction in mass and volume over existing batteries.
- (U) $537 Develop special purpose power components for advanced surveillance and communications systems, as well as ground power applications.
  - (U) Develop next generation electrical conductors with 50% increase in current density and higher operating temperature for advanced lightweight electrical generators.
- (U) $14,551 Total

(U) FY 1998 ($ in Thousands):

- (U) $13,152 Develop aerospace batteries and power generation, conversion, and transmission components for aircraft systems. These components provide aircraft with a high degree of self-sufficiency, improved reliability, maintainability, and supportability, all yielding a quicker aircraft turn-around time. In addition, ground support equipment requirements will be dramatically reduced.
  - (U) Develop advanced power generation, conversion, and distribution components for a fault tolerant electrical power system.
  - (U) Begin testing internal engine starter/generator which leads to elimination of engine gear box.
- (U) $1,466 Develop battery systems for guidance, navigation, control functions for missile systems, and for use in navigational aids, radios, and sensors for special operations forces. Batteries with higher power density, longer life, increased reliability, and rechargability will provide missiles systems and special operations forces with greater reliability and reduced maintenance costs.
  - (U) Develop new cathode materials for lithium batteries to enhance cycle life.
- (U) $495 Develop special purpose power components for advanced surveillance and communications systems, as well as ground power applications.
  - (U) Develop improved ceramic processing of conductors to optimize crystallization of conductors.
- (U) $15,113 Total

(U) FY 1999 ($ in Thousands):

- (U) $12,633 Develop aerospace batteries and power generation, conversion, and transmission components for aircraft systems. These components provide aircraft with a high degree of self-sufficiency, improved reliability, maintainability, and supportability, all yielding a quicker aircraft turn-around time. In addition, ground support equipment requirements will be dramatically reduced.
  - (U) Develop an advanced aircraft electrical power generation and distribution system.
  - (U) Complete testing the internal engine starter/generator which leads to elimination of engine gear box.
- (U) $1,770 Develop battery systems for guidance, navigation, control functions for missile systems, and for use in navigational aids, radios, and sensors for special operations forces. Batteries with higher power density, longer life, increased reliability, and rechargability will provide missiles systems and special operations forces with greater reliability and reduced maintenance costs.
  - (U) Evaluate performance for lithium cells and down-select based on performance of cathode material.

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	PROJECT 3145

- (U) $495 Develop special purpose power components for advanced surveillance and communications systems, as well as ground power applications.
  - (U) Evaluate conductors produced under new process which will provide 25% improved current density and 15% increase in operating temperature capability.
- (U) $14,898 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	15,224	14,956	15,454	15,301	Cont
(U) Current Budget Submit/FY 1998 PB	15,126	14,551	15,113	14,898	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Avionics

	COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	64,747	65,360	69,401	70,469	73,466	78,563	80,036	82,492	Continuing	Continuing
2000	Electronic Countermeasures Technology	12,890	13,235	15,562	16,250	17,268	17,874	18,513	18,981	Continuing	Continuing
2001	Electro-Optical Technology	8,384	8,860	5,749	4,394	5,072	5,542	5,921	6,282	Continuing	Continuing
2002	Microwave Technology	8,682	8,784	10,046	9,529	9,314	10,863	10,344	10,598	Continuing	Continuing
2003	Avionics System Design Technology	7,811	8,242	9,301	9,689	10,316	10,758	11,108	11,445	Continuing	Continuing
6095	Information Fusion Technology	10,161	10,354	11,038	11,534	12,350	12,919	13,375	13,810	Continuing	Continuing
6096	Microelectronics Technology	9,270	7,909	9,689	9,666	9,125	10,156	10,000	10,271	Continuing	Continuing
7622	Radio Frequency Sensor Technology	7,549	7,976	8,016	9,407	10,021	10,451	10,775	11,105	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: For FY 1998 and beyond, several projects in this PE have been combined. For clarity, the FY 1996 and FY 1997 portions of this exhibit have used the new project structure. Project 2000, Active Electronic Countermeasures, and Project 7633, Passive Electronic Countermeasures, have been combined within Project 2000, Electronic Countermeasures Technology. Project 2001, Electro-Optical Technology, and Project 2004, Reconnaissance/Strike Electro-Optical Sensors, have been combined within Project 2001, Electro-Optical Technology. Project 6095, Inertial Reference and Guidance Technology, and Project 7629, Fire Control Avionics, have been combined within Project 6095, Information Fusion Technology. Project 7622, Reconnaissance Strike Radio Frequency Sensors, and Project 7662, Avionics Data Transmission and Reception, have been combined within Project 7622, Radio Frequency Sensor Technology.

(U) A. Mission Description and Budget Item Justification: This Applied Research program develops the technology base for Air Force avionics requirements. Advances in avionics are required to increase combat effectiveness, reduce life cycle costs, facilitate modernization of aging and future aircraft, and provide protection against emerging hostile threat systems. Meeting these needs necessitates simultaneous advances in multiple, interrelated disciplines including: airborne sensors (e.g., infrared, radar, etc.); multi-function high-power electronic devices; target detection, classification, and recognition; fire control; communication and navigation subsystems; and electronic warfare technologies. To permit new capabilities to transition smoothly to warfighters, this program also develops avionics architectures, data processing technologies, and sensor integration techniques. This investment strategy will permit the Air Force to move away from costly independent "black box" avionics to open system avionics that combine common modules, shared components, and commercial devices into integrated, easily-upgradable systems. Advanced, integrated avionics technologies will give warfighters the combat edge they need at an affordable price. Note: Additional emphasis has been placed on avionics technology.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	65,789	71,261	74,737	77,913	Cont
(U) Appropriated Value	68,500	68,061			
(U) Adjustments to Appropriated Value					Cont
a. Congressional/General Reductions	-1,334	-1,504			
b. SBIR	-1,067	-1,134			
c. Omnibus/Other Above Threshold Reprogrammings	-1,352	-63			
(U) Current Budget Submit/FY 1998 PB	64,747	65,360	69,401	70,469	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics	PROJECT 2000

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2000 Electronic Countermeasures Technology	12,890	13,235	15,562	16,250	17,268	17,874	18,513	18,981	Continuing	Continuing

Note: In FY 1998 and out, former Project 2000, Active Electronic Countermeasures, and former Project 7633, Passive Electronic Countermeasures, have been combined within Project 2000, Electronic Countermeasures Technology. For clarity, the FY 1996 and FY 1997 portions of this exhibit include project data from both old projects.

(U) A. **Mission Description and Budget Item Justification:** This program determines the feasibility of active and passive electronic countermeasure technologies and explores, develops, expands, and refines the most promising and cost-effective technologies. The technologies pursued support passive sensing of the entire electromagnetic spectrum in order to provide signal collection, detection, recognition, analysis, identification, location, and countering of enemy electronic emissions whether intentional or unintentional. This project includes development of countermeasure concepts against radar, infrared (IR), and electro-optical threat weapon systems as well as against communication command and control networks. Various links and sensors of threat air defense systems are analyzed and a database of countermeasure techniques and technologies is generated from which specific self-protection or support countermeasures equipment can be developed. Specifically, the program exploits emerging technologies to provide increased capability for: 1) radar warning, radio frequency (RF) electronic warfare, and electronic intelligence applications; 2) IR detection for passive missile warning, IR signature exploitation, and IR countermeasures; 3) laser detection for threat warning and countermeasures; 4) passive and combined passive/active off-board expendables (chaff, decoys, etc.); and 5) hardware and software for associated processing and system integration requirements. These countermeasure capabilities are vital for survival of operational aircraft facing advanced threats in future hostile environments.

(U) FY 1996 ($ in Thousands):

- (U) $2,215 Develop technologies for on-board and off-board (active IR decoys) countermeasures to counter IR-guided missiles.
  - (U) Evaluated concepts for countering imaging IR missile seekers using on-board IR jamming resources.
  - (U) Continued in-house evaluation, using the Dynamic Infrared Missile Evaluator, of both on-board and off-board countermeasures concepts against various types of advanced missile seeker threats.
- (U) $1,019 Develop affordable, off-board RF countermeasure concepts (active decoys) for survivability against advanced radar threats.
  - (U) Evaluated digital RF memory chip technology for application to active decoys.
  - (U) Evaluated techniques and jamming modulations for active decoys to ensure effective countering of advanced radar threats.
- (U) $1,860 Develop on-board RF technology and concepts to achieve affordable solutions to countermeasures requirements related to radar-controlled lethal threat systems.
  - (U) Evaluated concepts to affordably counter monopulse tracking radars.
  - (U) Continued development of the coherent digital exciter jammer subsystem to help provide affordable countermeasures against advanced radar threats.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Avionics
	PROJECT: 2000

- (U) $1,630 Develop on-board radio frequency (RF) countermeasures technology and concepts to jam communications and data links of enemy air defense systems.
  - (U) Evaluated cyclostationary signal processing techniques.
  - (U) Developed concepts to jam data signals used for command and control of hostile lethal threat systems.
- (U) $1,439 Develop generic hardware and software modules to enable low-cost upgrades for existing operational electronic warfare (EW) receivers.
  - (U) Combined de-interleaving, correlation, and threat identification software modules on laboratory hardware.
  - (U) Continued hardware and software development to allow normalization and transfer of threat parameters among systems.
- (U) $1,384 Develop all-digital EW receiver and antenna for improved reliability and flexibility in response to ever changing EW threat environment.
  - (U) Investigated fundamental RF hardware correlator for improved performance and reliability.
- (U) $2,261 Develop an enhanced warning capability with advanced detector and processing technology and integrated missile warning, laser warning, and targeting sensors for improved pilot protection.
  - (U) Completed high altitude missile infrared (IR) signature measurements and model.
  - (U) Identified focal plane array suitable for combined laser/missile detection receiver design.
  - (U) Defined laser receiver specifications for countermeasures cueing.
- (U) $1,082 Develop models for off-board, expendable electronic countermeasures for use in chaff and decoy dispensing programs.
  - (U) Incorporated NATO chaff flight test measurements into laboratory computer model.
- (U) $12,890 Total

(U) FY 1997 ($ in Thousands):

- (U) $1,968 Develop technologies for on-board and off-board (active IR decoys) countermeasures to counter IR-guided missiles.
  - (U) Continue development and in-house evaluation of on-board IR countermeasures against imaging missile seekers.
  - (U) Continue development of IR flare technology using advanced materials.
  - (U) Continue to develop concepts for countermeasures against laser beamrider missiles.
  - (U) Continue to develop concepts for countermeasures against night vision devices which are used to augment IR missile launchers.
- (U) $1,439 Develop off-board RF countermeasures concepts (active decoys) for affordable survivability against radar threats.
  - (U) Test active decoys using advanced jamming modulations tailored to counter coherent radar threats.
  - (U) Identify countermeasures techniques and technology for decoys operating in the high-millimeter band frequency range.
- (U) $1,916 Develop affordable, on-board RF technology and concepts to achieve solutions to countermeasures requirements related to radar-controlled lethal threat systems.
  - (U) Investigate integrated angle, doppler, and range deception techniques to effectively jam coherent monopulse threat tracking radars.
  - (U) Fabricate and test narrow-band, digital RF memory architecture.
  - (U) Test and evaluate a unique modulation component for digital jamming.

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BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Avionics / PROJECT: 2000

- (U) $1,709 Develop on-board radio frequency (RF) countermeasures against voice and data communications elements of enemy air defense systems.
  - (U) Fabricate and test breadboard hardware to jam the special data signals used for command and control of lethal threat systems.
  - (U) Develop techniques to jam communications systems which use featureless waveforms.
- (U) $1,869 Develop technology for generic hardware and software modules to enable low-cost block upgrades to electronic warfare (EW) receivers.
  - (U) Ground test combined de-interleaving, correlation, and threat identification software modules.
  - (U) Run initial concept tests for threat parameter normalization software.
- (U) $1,471 Develop all-digital EW receiver and associated antenna for improved reliability and flexibility in response to ever changing EW threats.
  - (U) Evaluate fundamental angle and RF hardware correlator for improved performance and reliability.
  - (U) Continue to develop angle/frequency discrimination concepts to respond to new threat signals.
- (U) $1,559 Develop an enhanced warning capability with advanced detector and processing technology and integrated missile warning, laser warning, and targeting sensors for an improved pilot protection capability.
  - (U) Develop low-cost multicolor infrared (IR) filtering technique for IR focal plane array system.
- (U) $1,304 Continue development of models for off-board, expendable electronic countermeasures for use in chaff and decoy dispensing programs.
  - (U) Determine if flight-tested "environmental chaff" is suitable for use in combat training exercises.
  - (U) Develop breadboard for advanced, passive, expendable, off-board countermeasures.
- (U) $13,235 Total

(U) FY 1998 ($ in Thousands):

- (U) $3,855 Develop technologies for on-board and off-board (active IR decoys) countermeasures to counter IR-guided missiles and electro-optical directed threat systems.
  - (U) Continue development and in-house evaluation of on-board IR countermeasure against imaging missile seekers.
  - (U) Initiate development of a shielded narrowband IR source for advanced IR decoys to minimize out-of-band detection.
  - (U) Complete analysis of laser beamrider missile countermeasure concepts and downselect for laboratory and field testing.
  - (U) Conduct laboratory tests demonstrating effects of countermeasure concepts against enemy night vision devices.
  - (U) Continue to develop cooperative on-board and off-board IR countermeasure concepts for synergistic effects.
- (U) $4,626 Develop affordable RF jamming technology and concepts which degrade enemy radar, missiles, and command and control systems. This will enhance survivability of our aircraft.
  - (U) Test countermeasures to effectively and affordably degrade monopulse threat tracking radars to assure survivability of our aircraft.
  - (U) Continue evaluation of digital RF memory architecture to provide the capability to defeat coherent doppler fire control radars.
  - (U) Develop digital jamming pulse quality metrics to enhance evaluation of countermeasure technique effectiveness.
  - (U) Investigate concepts for countermeasures against covert threat communication links that use featureless waveforms.
  - (U) Conduct in-house evaluation of RF countermeasure techniques to defeat advanced radar, missile, and communication threats.

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BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Avionics
	PROJECT: 2000

- (U) $771 Develop off-board (expendable) radio frequency (RF) countermeasure concepts for affordable survivability against radar threats.
  - (U) Design active decoys to counter surface and airborne threats using microwave and millimeter wave radars.
  - (U) Continue development of design tools and analytic methods to predict the effectiveness of advanced chaff payloads, dispensing methods, and tactics.
  - (U) Develop and test environmentally degradable and electromagnetically tailorable chaff designs to allow for the resumption of chaff usage during combat training exercises and to provide advanced countermeasure techniques.
- (U) $1,542 Develop technology for generic software modules to enable low-cost block upgrades to electronic warfare receivers.
  - (U) Continue ground testing combined de-interleaving, correlation, and threat identification software modules to detect new threat systems without expensive hardware upgrades.
  - (U) Complete preliminary design of advanced threat parameter normalization software to allow aircraft to share situational awareness data.
- (U) $3,854 Develop affordable RF receiver and antenna technology for use in operational and future aircraft. This technology is needed to detect, characterize, and identify threats in increasingly complex environments while maintaining own aircraft covertness and emission control.
  - (U) Complete testing of wideband digital receiver brassboard to affordably increase threat coverage.
  - (U) Continue development of wideband receiver specialized software for threat characterization, identification, and location.
  - (U) Develop narrowband digital receiver technology to provide a limited capability to inexpensively update operational systems.
  - (U) Complete design of a six to eight gigahertz, low-profile (less than one inch) conformal antenna array and investigate its electromagnetic characterization.
  - (U) Transition software for design and evaluation of flush-mounted conformal arrays.
- (U) $914 Develop missile and laser warning technology to accurately cue countermeasures, improving survivability.
  - (U) Continue development of laser warning discrimination techniques for countermeasure cueing.
  - (U) Continue evaluation of infrared (IR) clutter rejection techniques for two times improvement in IR missile warning range.
  - (U) Continue development and evaluation of multi-frequency, non-mechanical filters for fifty percent reduction in false alarm rates.
  - (U) Complete development of laser warning breadboard.
- (U) $15,562 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2000

(U) FY 1999 ($ in Thousands):

- (U) $4,016 Develop technologies for on-board and off-board (active infrared (IR) decoys) countermeasures to counter IR-guided missiles and electro-optical directed threat systems.
  - (U) Continue development and in-house evaluation of on-board IR countermeasure against imaging missile seekers.
  - (U) Continue development of a self-contained IR source for application to advanced IR decoys.
  - (U) Conduct laboratory tests of laser beamrider missile countermeasure concepts.
  - (U) Continue to develop cooperative on-board and off-board IR countermeasure concepts.
  - (U) Conduct in-house laboratory evaluation of radio frequency (RF) countermeasure techniques to defeat advanced radar, missile, and communication threats.
- (U) $4,820 Develop affordable RF jamming technology and concepts which degrade enemy radar, missiles, and command and control systems. This will enhance survivability of our aircraft.
  - (U) Develop new, multifunction RF waveforms for flexible countermeasures against unexpected/unknown threats systems.
  - (U) Continue developing advanced deception countermeasures techniques to assure capability to degrade new/upgraded threat radars.
  - (U) Develop techniques to degrade modern communications networks used for enemy command and control.
- (U) $803 Develop off-board (expendable) RF countermeasure concepts for affordable survivability against radar threats.
  - (U) Continue design of active decoys to counter surface and airborne threats using microwave and millimeter wave radars.
  - (U) Demonstrate advanced active or passive expendable payloads that decoy tracking radars away from our aircraft.
- (U) $1,607 Develop technology for generic software modules to enable low-cost block upgrades to electronic warfare receivers.
  - (U) Continue testing of combined de-interleaving, correlation, and threat identification software modules.
  - (U) Complete preliminary design of advanced threat parameter normalization software.
- (U) $4,016 Develop affordable RF receiver and antenna technology for use in operational and future aircraft. This technology is needed to detect, characterize, and identify threats in increasingly complex environments while maintaining own aircraft covertness and emission control.
  - (U) Continue development of wideband all digital receiver brassboard--incorporate new hardware and software elements.
  - (U) Field test wideband receiver specialized software for threat characterization, identification, and signal angle-of-arrival resolution.
  - (U) Continue evaluation of narrowband receiver technology to provide a limited capability to inexpensively update operational systems.
  - (U) Evaluate fundamental angle-of-arrival and RF hardware correlator for improved performance and reliability.
  - (U) Continue investigation of conformal antenna array technology and electromagnetic characterization.
- (U) $988 Develop missile and laser warning technology to accurately cue countermeasures, improving survivability.
  - (U) Develop laser warning discrimination techniques for cueing countermeasures.
  - (U) Continue evaluation of IR clutter rejection techniques for improved IR missile warning.
  - (U) Continue development of multi-color, non-mechanical filters for IR missile warning.
- (U) $16,250 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2000

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	12,890	14,648	15,380	16,107	Cont
(U) Current Budget Submit/FY 1998 PB	12,890	13,235	15,562	16,250	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603270F, Electronic Combat Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics	PROJECT 2001

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2001 Electro-Optical Technology	8,384	8,860	5,749	4,394	5,072	5,542	5,921	6,282	Continuing	Continuing

Note: In FY 1998 and out, former Project 2001, Electro-Optical Technology, and Project 2004, Reconnaissance/Strike Electro-Optical Sensors, have been combined within Project 2001, Electro-Optical Technology. For clarity, the FY 1996 and FY 1997 portions on this exhibit include project data from both old projects.

(U) A. Mission Description and Budget Item Justification: This project focuses on the development of military unique and essential devices and components for airborne optical sensing, optical processing, and integration of electro-optical technology into avionics sensor systems. Electro-optical technologies provide faster, more accurate detection and targeting capability combined with the benefits of low weight and low-power requirements. The results of this technology provide the warfighter with increased situational awareness, enhanced defense suppression, and improved precision weapon delivery.

(U) FY 1996 ($ in Thousands):

- (U) $881 Develop short pulse infrared source technology for target recognition and designation.
  - (U) Developed solid state and semiconductor technologies for application to target recognition and designation.
- (U) $881 Develop electro-optical detector technology for advanced reconnaissance and strike sensors.
  - (U) Demonstrated improved discrimination capability of detector arrays using quantum well technology to provide dual-color inputs.
- (U) $1,008 Develop high-throughput, real-time optical processing technology for imaging and target recognition.
  - (U) Designed sources and components for greater speed and testability of optical subsystems.
- (U) $2,348 Develop ultra-violet technology for imaging, tracking, and jet engine analysis.
  - (U) Developed semiconductor technology for high performance detector arrays/laser diodes.
- (U) $1,633 Develop advanced electro-optical sensor technology for combined navigation and air-to-ground targeting in a multi-function sensor. This effort is aimed at alleviating the weight, drag, maintenance, and cost problems of a dual sensor approach.
  - (U) Conducted long-range demonstration of combined navigation and targeting capability.
  - (U) Completed fabrication of breadboard sensor system for combined navigation and targeting applications.
- (U) $816 Develop and demonstrate a low-cost, maintainable, high performance, non-mechanical method of directing the passive sensor field of view. Mechanical methods of scanning the target scene are inherently bulky, expensive, and unreliable. A non-mechanical approach will also permit use of low-cost staring focal plane arrays which will enhance overall performance.
  - (U) Demonstrated feasibility of small, portable, non-mechanical beam steering device.
  - (U) Characterized absolute pointing accuracy of a future phased array beam steering component.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2001

- (U) $817 Develop and demonstrate frequency agile electro-optical technologies to enhance air-to-ground and air-to-air sensor performance, target detection ranges, and identification.
  - (U) Completed preliminary assessment of wavelength conversion materials which will provide the capability to tune the frequency of the laser, provide operation in varied atmospheric transmission regions and, in turn, permit longer operating ranges.
- (U) $8,384 Total

(U) FY 1997 ($ in Thousands):

- (U) $1,933 Develop short pulse infrared and ultraviolet source technologies for target recognition and designation.
  - (U) Continue development and evaluation of solid state and semiconductor technologies for application to target recognition and designation.
- (U) $1,490 Develop high-throughput, real-time optical processing technology to improve precision in imaging and target recognition.
  - (U) Develop and evaluate sources and components for greater speed and testability of optical subsystems.
- (U) $1,603 Develop ultraviolet technology for imaging, tracking, and jet engine analysis.
  - (U) Continue development and evaluation of semiconductor technology to improve the performance and reliability of detector arrays.
- (U) $931 Develop advanced electro-optical sensor technology for combined navigation and air-to-ground targeting in a multi-function sensor. This thrust is aimed at alleviating the weight, drag, maintenance, and cost problems of a dual sensor approach.
  - (U) Complete development of algorithms that can perform targeting on multiple scenes at the same time.
  - (U) Complete development of electronic stabilization algorithms allowing for range enhancement of electro-optical sensor technology for combined navigation and air-to-ground targeting.
- (U) $585 Develop and demonstrate a low-cost, maintainable, high performance, non-mechanical method of directing the passive sensor field of view. Mechanical methods of scanning the target scene are inherently bulky, expensive, and unreliable. A non-mechanical approach will also permit the use of low-cost staring focal plane arrays which will enhance overall performance.
  - (U) Complete the design, fabrication, and absolute pointing accuracy verification of a phased array beam steering component.
- (U) $2,318 Develop and demonstrate frequency agile electro-optical technologies to enhance air-to-ground and air-to-air sensor performance, target detection ranges, and identification.
  - (U) Complete application and requirements analysis of electro-optical technologies for precision targeting of ground-based and airborne threats.
- (U) $8,860 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2001

(U) FY 1998 ($ in Thousands):

- (U) $1,704 Develop ultraviolet technology for applications such as missile threat warning, communications, and jet engine analysis.
  - (U) Continue to develop solid state laser technology for a safer, high-power, more reliable, ultraviolet source in one-fifth the size.
  - (U) Develop solar-blind, ultraviolet detector technology for smaller, higher performance missile warning receivers with significantly reduced false alarm rates.
- (U) $413 Develop high-speed opto-electronics technology for faster interfaces between electronic components. Applications include high-speed data processing, analog to digital converters, digital radar, and real-time image and target recognition. These development efforts are jointly planned with the Defense Advanced Research Projects Agency.
  - (U) Develop optical interconnect technology for high-speed electronic and opto-electronic multichip modules that will provide four times data rate increase with greater antenna to processor distances for digital radar applications.
  - (U) Develop optical lithography technology for the fabrication of high-speed, integrated electronics and opto-electronic multichip modules with increased resolution and five times faster throughput at one-tenth the cost.
- (U) $991 Develop affordable, supportable, manufacturable high definition/resolution displays with the following performance characteristics: all digital interface, sunlight readability, and high reliability.
  - (U) Demonstrate technology to increase the optical efficiency of active matrix liquid crystal displays by at least a factor of two.
  - (U) Continue adapting low-cost, commercial-based, digital display interface to drive high definition military displays.
  - (U) Continue development of large area, high resolution, sunlight readable cockpit field emission display.
  - (U) Begin development of flat panel head-up display (HUD) to improve reliability over existing cathode ray tube HUDs and explore replacement of classical optics with lighter, more compact diffractive projection optics.
- (U) $1,816 Develop advanced electro-optical sensor technologies, including non-mechanical beam steering techniques, for a single compact, affordable navigation and targeting sensor.
  - (U) Complete design and begin fabrication of a multi-function sensor, incorporating multiple apertures, with a three times improvement in target detection range and four times improvement in identification range.
- (U) $825 Develop and demonstrate frequency agile electro-optical technologies to enhance air-to-ground and to air-to-air sensor performance, increase target detection and identification ranges, and defeat heat-seeking missiles.
  - (U) Demonstrate, through ground and airborne experiments, the value of modular wind profiling to cargo and bomb drop applications.
  - (U) Develop narrow bandwidth, tunable infrared (IR) source technology for multispectral sensing.
  - (U) Develop first-generation coatings to enhance the reliability of mid-IR optics.
- (U) $5,749 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2001

(U) FY 1999 ($ in Thousands):

- (U) $510 Develop high-speed opto-electronics technology for faster interfaces between electronic components. Applications include high-speed data processing, analog to digital converters, digital radar, and real-time image and target recognition. These development efforts are jointly planned with the Defense Advanced Research Projects Agency.
  - (U) Develop improved components for greater speed and testability resulting in higher throughput capabilities.
  - (U) Fabricate and test opto-electronic high-speed interconnects for electronic multi-chip modules to increase data throughput for multi-function airborne sensors.
- (U) $1,059 Develop affordable, supportable, manufacturable high definition/resolution displays with the following performance characteristics: all digital interface; sunlight readability; and high reliability.
  - (U) Demonstrate in-house high definition digital display with several formats.
  - (U) Continue development of large area, high resolution, sunlight readable cockpit field emission display.
  - (U) Continue development of flat panel head-up display (HUD) to replace low reliability cathode ray tube HUDs and continue exploring replacement of classical optics with lighter, more compact diffractive projection optics.
- (U) $1,942 Develop advanced electro-optical sensor technologies, including non-mechanical beam steering techniques, for a single compact, affordable navigation and targeting sensor.
  - (U) Complete fabrication and begin field and tower testing multi-function sensor.
- (U) $883 Develop and demonstrate frequency agile electro-optical technologies to enhance air-to-ground and to air-to-air sensor performance, increase target detection and identification ranges, and defeat heat-seeking missiles.
  - (U) Continue to demonstrate, through ground and airborne experiments, the value of modular wind profiling to cargo and bomb drop applications.
  - (U) Continue to develop narrow bandwidth, tunable infrared (IR) source communication technology.
  - (U) Continue development of IR sensor coatings with improved performance and reliability characteristics.
- (U) $4,394 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2001

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	8,384	9,526	10,001	10,474	Cont
(U) Current Budget Submit/FY 1998 PB	8,384	8,860	5,749	4,394	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0602702F, Command, Control, and Communications.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) PE 0602712E, Materials and Electronics Technology.
- (U) PE 0603739E, Advanced Electronics Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Avionics

PROJECT: 2002

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2002 Microwave Technology	8,682	8,784	10,046	9,529	9,314	10,863	10,344	10,598	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project focuses on the generation, control, reception, and processing of microwave and millimeter wave power. Develops technologies such as solid state and vacuum electronic power devices and amplifiers, low noise and signal control components, high-temperature electronics, multi-function monolithic integrated circuits, and high density packaging and interconnects. Develops techniques for integrating various combinations of these technologies to demonstrate significantly improved performance with smaller size, lower weight, lower cost, and higher reliability in military-specific applications. The requirements for device and component technology developments are based on Air Force and other DOD weapon system needs in the areas of radar, communications, electronic warfare (EW), navigation, and smart weapons applications.

(U) FY 1996 ($ in Thousands):

- (U) $1,851 Develop mixed-mode, microwave/digital multi-function integrated circuits components for radar and EW receivers and for digital phased array radars.
  - (U) Demonstrated single chip monolithic integrated circuits for 7-11 gigahertz receiver applications.
  - (U) Continued to develop advanced analytical methods for evaluating mixed-mode integrated components.
  - (U) Developed miniature digital receivers for radar and electronic combat phased array systems.
- (U) $1,691 Develop high-power, solid state amplifiers for radar and communication applications.
  - (U) Continued development of high-power, high-efficiency amplifiers for phased array radars to improve their performance and efficiency in the 7-11 gigahertz frequency band.
  - (U) Designed high-power transmit amplifiers for precision guided weapons.
  - (U) Designed advanced transistors and fabrication techniques for microwave power amplifiers that produce higher power (via improved heat dissipation) for compact, reliable, and affordable radio frequency sensors.
- (U) $1,691 Develop reliable, high-operating-temperature electronics for microwave transmitters used in airborne applications.
  - (U) Developed and evaluated candidate materials that will improve the reliability of microwave transistors.
  - (U) Developed integrated circuits for reliable, high-power operation of advanced EW and radar applications.
- (U) $1,579 Develop high-power vacuum electronics devices and components for EW, radar, and communications applications.
  - (U) Designed components for advanced microwave tubes.
  - (U) Developed millimeter wave power modules to increase range of communications and electronic combat transmitters over the 20 to 40 gigahertz frequency range.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2002

- (U) $1,870 Develop millimeter wave integrated circuits for terminal guidance and communications systems.
  - (U) Continued development of low-cost, micro-machined, millimeter wave circuits in the 60 gigahertz frequency range.
  - (U) Continued development of integrated circuit signal control components to improve the performance and reliability of millimeter wave terminal guidance radars.
- (U) $8,682 Total

(U) FY 1997 ($ in Thousands):

- (U) $1,623 Develop mixed-mode, microwave/digital multi-function integrated circuits components for radar and electronic warfare (EW) receivers and for digital phased array radars.
  - (U) Continue to develop advanced analytical methods for evaluating mixed-mode integrated components.
  - (U) Design and develop mixed-mode signal control component for reduced weight and volume of airborne receiver systems.
- (U) $1,950 Develop high-power, solid state amplifiers for radar and communications applications.
  - (U) Design and develop high-power, high-efficiency amplifiers for phased array radars which increase the performance and efficiency in the 1-20 gigahertz frequency band.
  - (U) Develop high-power transmit amplifiers for precision guided weapons.
  - (U) Develop advanced transistors and fabrication techniques for microwave power amplifiers that produce higher power (via improved heat dissipation) for compact, reliable, and affordable radio frequency sensors.
- (U) $1,780 Develop reliable, high-operating-temperature electronics for microwave transmitters used in airborne applications.
  - (U) Continue development of candidate materials that will improve the reliability of microwave transistors.
  - (U) Develop integrated circuits for reliable, high-power operation of advanced EW and radar applications.
- (U) $1,782 Develop high-power vacuum electronics devices and components for EW, radar, and communications applications.
  - (U) Fabricate components for advanced microwave tubes to improve reliability of radio frequency subsystems.
  - (U) Continue fabrication and testing of millimeter wave power modules to increase range capability of communications and electronic combat transmitters over the 20 to 40 gigahertz frequency range.
- (U) $1,649 Develop millimeter wave integrated circuits for terminal guidance and communications systems.
  - (U) Continue development and initiate test of integrated circuit signal control components to improve the performance and reliability of millimeter wave terminal guidance radars.
- (U) $8,784 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2002

(U) FY 1998 ($ in Thousands):

- (U) $1,650 Develop military essential mixed-mode (e.g., high-power/low-noise, microwave/digital, electronic/electro-optical, etc.) multi-function components for radar and electronic warfare (EW) receivers and for digital phased array radars. Application of this compact and more flexible sensor technology will improve warfighter situational awareness, enhance defense suppression, and improve precision weapon delivery.
  - (U) Evaluate and validate advanced analytical methods for designing integrated analog/digital components to reduce non-recurring engineering costs for systems such as high performance radar and EW receivers.
  - (U) Fabricate miniature digital receivers which will reduce the weight and volume of airborne receiver systems and enhance situational awareness by increasing target detection/tracking sensitivity.
- (U) $3,320 Develop high-power (1 to 100 watts), military unique, solid state transmitters for radar and communications applications. This technology will enable the warfighter to detect and track low radar cross-section targets at greater ranges, improve situational awareness, and enable development of compact affordable transmitters for smaller platforms such as advanced unmanned air vehicles.
  - (U) Demonstrate 10-watt, 7-12 gigahertz amplifiers for multifunction phased array radars having 25% range improvement without increasing aircraft power requirements.
  - (U) Demonstrate and transition the first low-cost, 35 gigahertz high-power transmit amplifiers to enable all-weather, precision guided weapons which will improve the range and probability of kill of advanced smart missiles.
  - (U) Fabricate and test advanced transistors for microwave amplifiers that produce higher power (via improved heat dissipation) for compact, reliable, and affordable radio frequency sensors.
- (U) $1,780 Develop high-operating-temperature, military-essential, solid state microwave transmitters used in ground-based and airborne radar applications. This technology allows compact transmitters to be located in remote areas of the platform for increased sensor coverage.
  - (U) Develop high yield process technologies to enable high-operating-temperature microwave transistors that will improve the reliability and lower the life cycle costs of air defense radars.
  - (U) Fabricate and evaluate high-operating-temperature integrated circuits to demonstrate potential for application to advanced electronic warfare and radar applications with reduced cooling requirements.
- (U) $1,650 Develop military unique, very high-power (100 to 1,000 watts) vacuum electronics devices and components for electronic warfare, radar, and communications applications which will result in modular, very compact and affordable microwave and millimeter wave transmitters.
  - (U) Fabricate and test components for advanced microwave tubes for very high-power and wide-bandwidth radar and EW transmitters at one-fifth the size.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2002

- (U) $1,646 Develop military unique millimeter wave integrated circuits for terminal guidance and communications systems with reduced size and weight, thereby, enabling the inclusion of these sensors on very small platforms.
  - (U) Fabricate and evaluate millimeter wave integrated circuit signal control components to improve the performance and reliability of terminal guidance radars with enhanced target tracking and detection capabilities.
- (U) $10,046 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,202 Develop military essential mixed-mode (e.g., high-power/low-noise, microwave/digital, electronic/electro-optical, etc.) multi-function components for radar and electronic warfare (EW) receivers and for digital phased array radars. Application of this compact and more flexible sensor technology will improve warfighter situational awareness, enhance defense suppression, and improve precision weapon delivery.
  - (U) Demonstrate and refine advanced analytical methods for evaluating mixed-mode integrated components to reduce non-recurring engineering costs for systems such as high performance radar and EW receivers.
  - (U) Demonstrate miniature digital receivers which will reduce the weight and volume of airborne receiver systems and enhance situational awareness by increasing target detection/tracking sensitivity.
- (U) $2,106 Develop high-power (1 to 100 watts), military unique, solid state transmitters for radar and communications applications. This technology will enable the warfighter to detect and track low radar cross-section targets at greater ranges, improve situational awareness, and enable development of compact affordable transmitters for smaller platforms such as advanced unmanned air vehicles.
  - (U) Demonstrate 5-watt output power, 35 gigahertz high-power transmit amplifiers for precision guided weapons which will improve the range and probability of kill of advanced smart missiles.
  - (U) Demonstrate advanced transistors and fabrication techniques for microwave power amplifiers that have improved power dissipation and enhanced reliability for use in compact and affordable RF sensors.
  - (U) Develop compact millimeter wave (94 gigahertz) high-power transmitter components for advanced terminal guidance radar sensors that will have improved range capabilities for target detection and tracking.
- (U) $1,628 Develop high yield process technologies to enable high-operating-temperature, military-essential, solid state microwave transmitters used in ground-based and airborne radar applications. This technology allows compact transmitters to be located in remote areas of the platform for increased sensor coverage.
  - (U) Demonstrate candidate materials that will improve the reliability of microwave transistors used in ground and air defense radars which have increased reliability and lower life cycle costs.
  - (U) Demonstrate integrated circuits for reliable, high-power operation of advanced electronic warfare and radar applications which will increase the range for detecting targets and jamming threats.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2002

- (U) $1,724 Develop military unique, very high-power (100 to 1,000 watts) vacuum electronics devices and components for electronic warfare, radar, and communications applications which will result in modular, very compact and affordable microwave and millimeter wave transmitters.
  - (U) Demonstrate components for advanced microwave tubes resulting in increased power and efficiency and reduced size and cost for compact radar and electronic warfare transmitters.
- (U) $1,869 Develop military unique millimeter wave integrated circuits for terminal guidance and communications systems with reduced size and weight, thereby, enabling the inclusion of these sensors on very small platforms.
  - (U) Demonstrate millimeter wave integrated circuit signal control components to improve the performance and reliability of terminal guidance radars with enhanced target tracking and detection capabilities.
- (U) $9,529 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2002

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	9,403	9,450	9,681	9,600	Cont
(U) Current Budget Submit/FY 1998 PB	8,682	8,784	10,046	9,529	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE: February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Avionics	PROJECT: 2003

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2003 Avionics System Design Technology	7,811	8,242	9,301	9,689	10,316	10,758	11,108	11,445	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops advanced avionics technology for digital processing, software tools and techniques, and systems architectures. Develops new concepts, demonstrates feasibility, and advances technology for avionics system needs. Advances technology for avionics displays, digital processing hardware, sensor integration, and real-time distributed software to improve weapon system performance and avionics availability. Advances in these avionics technologies will multiply weapon systems effectiveness, enhance reliability, and reduce life cycle costs.

(U) FY 1996 ($ in Thousands):

- (U) $1,437 Develop advanced technologies to increase functionality and flexibility of embedded, real-time airborne data processing.
  - (U) Developed a process to translate old computer code from existing avionics processors into advanced commercial-based avionics.
  - (U) Developed technology for measuring the performance of distributed, multi-processor avionics software.
  - (U) Identified Ada 9X features for incorporation into distributed, multi-processor avionics applications.
- (U) $2,381 Develop advanced integration, fusion, and data management technologies that enable increased exploitation of avionics assets to provide for more cost-effective system solutions.
  - (U) Developed a model of a scaleable, coherent, interface network increasing avionics reliability and improve real-time performance.
  - (U) Designed an object-oriented data base management system scenario definition and validation, final object definition, manipulation, and control language specifications.
- (U) $2,381 Develop advanced machine intelligence technologies to provide a capability for improved communications, recognition, understanding of sensor data, and pilot aids.
  - (U) Evaluated associative control technology for application to avionics.
  - (U) Characterized avionics system requirements for application of commercial personal computer memory card technology.
  - (U) Developed dynamic, real-time scheduling methodology for distributed, multi-processor avionics architectures and determined scheduling requirements of real-time avionics applications.
  - (U) Completed feasibility study on reducing Global Positioning System (GPS) error through the mitigation of ionospheric effects.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2003

- (U) $1,612 Develop affordable, supportable, producible high definition/resolution displays with all-digital interfaces, that are readable in sunlight, and that are highly reliable (>10,000 hours mean time between failure).
  - (U) Investigated technology to increase the optical efficiency of active matrix liquid crystal displays in order to facilitate dissemination of situational data to pilots.
  - (U) Performed an in-house evaluation and demonstration of high definition digital display, with several formats, for application to aircraft such as the Joint Surveillance Target Attack Radar System (JSTARS).
- (U) $7,811 Total

(U) FY 1997 ($ in Thousands):

- (U) $1,303 Develop advanced technologies to increase functionality and flexibility of embedded, real-time airborne data processing.
  - (U) Develop techniques and tools necessary for translating old computer code from existing avionics processors into advanced commercial-based avionics processors.
  - (U) Develop technology for quantifying trade offs between performance and costs for distributed, multi-processor avionics software.
  - (U) Develop and define a maturation strategy for incorporating Ada 9X features in a distributed, multi-processor avionics application.
- (U) $2,491 Develop advanced integration, fusion, and data management technologies that enable increased exploitation of avionics assets to provide for more cost-effective system solutions.
  - (U) Develop and test an avionics brassboard of a scaleable, coherent, interface network that will increase avionics reliability and improve real-time performance.
  - (U) Develop distributed, fault-tolerant extensions to basic object-oriented data base management system.
  - (U) Analyze performance and environmental requirements of targeted aging platforms; select commercial-off-the-shelf candidate for demonstration of cost-effective upgrade capability.
- (U) $2,442 Develop advanced machine intelligence technologies to provide a capability for improved communications, recognition, understanding of sensor data, and pilot aids.
  - (U) Develop insertion concepts for development of avionics breadboards which are compatible with commercial personal computer memory card standards.
  - (U) Design dynamic, real-time scheduling algorithms to improve the correlation of sensors.
  - (U) Continue evaluation of associative control process technology for application to avionics.
- (U) $2,006 Develop affordable, supportable, producible high definition/resolution displays with all-digital interfaces, that are readable in sunlight, and that are highly reliable (>10,000 hours mean time between failure).
  - (U) Continue investigation of technology to increase the optical efficiency of active matrix liquid crystal displays to facilitate dissemination of situational data to the pilot.
  - (U) Develop field-emissive display for high-brightness, sunlight-readable cockpit flight instruments.
- (U) $8,242 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics PROJECT 2003

(U) FY 1998 ($ in Thousands):

- (U) $1,962 Develop avionics software engineering technologies to improve reliability, quality, and supportability of both existing and next-generation weapon system software. Successful re-engineering of existing software will dramatically improve the cost of modernizing aging avionics.
  - (U) Develop an automated method for translating embedded computer software from obsolete avionics processors to advanced commercial-based processors with no loss of performance or capability.
  - (U) Demonstrate advanced techniques for debugging Air Force application specific avionics software.
  - (U) Demonstrate automated software testing capability for verifying accuracy of text and dynamic symbology in smart avionics displays.
  - (U) Develop initial capability for in-flight self-testing and self-correcting mission-critical avionics software.
- (U) $1,732 Develop advanced machine intelligence technologies to provide a capability for enhanced management of critical on-board sensors and detection/recognition of targets.
  - (U) Demonstrate ability to update inertial navigation system using old Global Positioning System (GPS) data to project position when current GPS data is not available.
  - (U) Demonstrate real-time, object-oriented database management system for increased situational awareness.
  - (U) Continue development and application of the associative control process (reinforcement learning) technology for combat information fusion.
- (U) $2,897 Develop advanced integration technology and evaluate the feasibility of integrating commercial-off-the-shelf components for affordable avionics modernization.
  - (U) Develop methods for packaging commercial-off-the-shelf products into reliable, maintainable avionics hardware modules.
  - (U) Demonstrate utility of laptop computer processor/memory card technology for upgrading existing fighter aircraft processors.
- (U) $2,710 Develop low-cost integrated radio frequency subsystems through the exploitation of advanced optical and analog-to-digital conversion hardware.
  - (U) Evaluate Defense Advanced Research Projects Agency and tri-Service developments in analog and digital photonics to replace high-cost and bulky electrical networks.
  - (U) Evaluate Defense Advanced Research Projects Agency and tri-Service developments in analog-to-digital conversion technology to reduce the cost of electronic warfare, communication/navigation/identification, and radio frequency receivers.
- (U) $9,301 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2003

(U) FY 1999 ($ in Thousands):

- (U) $2,045 Develop avionics software engineering technologies to improve reliability, quality, and supportability of both existing and next-generation weapon system software. Successful re-engineering of existing software will dramatically improve the cost of modernizing aging avionics.
  - (U) Demonstrate an automated system for translating embedded software from obsolete avionics processors to advanced commercial-based processors with no loss in performance or capability.
  - (U) Develop enhanced capability for automated avionics software test generation for complex weapon system software.
  - (U) Demonstrate automated avionics software testing capability.
  - (U) Develop and provide an initial demonstration of an enhanced prototype capability for creating self-testing and self correcting avionics mission-critical software.
  - (U) Develop software design architecture for scaleable avionics software.
- (U) $1,803 Develop advanced machine intelligence technologies to provide a capability for enhanced management of critical on-board sensors and detection/recognition of targets.
  - (U) Demonstrate an enhanced distributed real-time embedded avionics object-oriented database management system conforming to multi-level security standards.
  - (U) Demonstrate advanced multiple target identification capability based on integration of information from disparate sources.
  - (U) Demonstrate advanced sensor manager for tactical air-to-air and air-to-ground surveillance.
  - (U) Develop efficient target recognition techniques based on machine intelligence research.
  - (U) Continue development and application of the associative control process (reinforcement learning) technology for combat information fusion.
- (U) $3,018 Develop advanced integration technology and evaluate the feasibility of integrating commercial-off-the-shelf components for affordable avionics modernization.
  - (U) Perform environmental stress testing and integrated product demonstrations verifying commercial-off-the-shelf usage in varying applications.
- (U) $2,823 Develop low-cost integrated radio frequency subsystems through the exploitation of advanced optical and analog-to-digital conversion hardware.
  - (U) Develop breadboard optics components for system demonstration.
  - (U) Develop breadboard radio frequency conversion components on radio frequency electronics modules for system demonstration.
- (U) $9,689 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 2003

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	7,811	8,877	9,321	9,761	Cont
(U) Current Budget Submit/FY 1998 PB	7,811	8,242	9,301	9,689	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603253F, Advanced Avionics Integration.
- (U) PE 0602301E, Intelligence System Program.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Avionics

PROJECT: 6095

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
6095 Information Fusion Technology	10,161	10,354	11,038	11,534	12,350	12,919	13,375	13,810	Continuing	Continuing

Note: In FY 1998 and out, former Project 6095, Inertial Reference and Guidance Technology, and Project 7629, Fire Control Avionics, have been combined within Project 6095, Information Fusion Technology. For clarity, the FY 1996 and FY 1997 portions of this exhibit include project data from both old projects.

(U) A. **Mission Description and Budget Item Justification**: Develops the baseline technologies required to perform management and fusion of on-board sensor information for timely, comprehensive situation awareness, automatic target recognition, integrated fire control, and bomb damage assessment. This project determines the feasibility of technologies and concepts for fire control that aid in precisely locating, identifying, and targeting airborne and surface targets (with emphasis on reduced signature targets and targets of opportunity) to enable new covert tactics for successful accomplishments of air-to-air and air-to-surface strike scenarios

(U) FY 1996 ($ in Thousands):

- (U) $846 Develop reference sensors, system integration, and estimation technology to generate a common precision reference to enable high-payoff multiple platform operations through sharing of sensor data.
  - (U) Completed detailed design of a small, low-cost, precision fiber optic gyroscope needed for multiple platforms to share information in a battle area.
- (U) $874 Develop advanced solid state miniature inertial sensor technology suitable for airborne applications to reduce size, weight, power, and cost, and to increase system reliability.
  - (U) Fabricated and tested first iteration of a packaged, navigation-grade, micro-machined silicon accelerometer for highly reliable, all-solid state inertial guidance and navigation systems.
- (U) $883 Develop technologies to reduce jamming vulnerability and increase precision targeting and strike accuracy of Global Positioning System (GPS) data and to exploit the benefits of GPS data, improving offensive and defensive combat capabilities and reducing costs.
  - (U) Completed detailed design of signal acquisition techniques to improve the jam resistance of GPS data.
- (U) $880 Develop technology for low-observable, wideband, multi-function antennas for communication, navigation, and identification functions to reduce the number of antennas required and to increase weapon systems survivability.
  - (U) Completed design of a wideband digital antenna electronics unit providing small, low-cost, low-loss, beam forming/null-steering communication, navigation, and identification antennas.
- (U) $467 Develop advanced air engagement technologies for detection and tracking of conventional and low-cross-section threats to increase weapon system lethality and survivability.
  - (U) Completed evaluation of vector neural network tracking algorithm.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 6095

- (U) $1,670 Develop sensor management and fusion technologies to increase air combat situational awareness, increase range, and improve high-confidence target identification.
  - (U) Evaluated advanced multispectral radar signal fusion techniques in a laboratory environment.
  - (U) Explored sensor fusion concepts for integrating sensor data from all on-board offensive and defensive sensors.
- (U) $1,202 Develop innovative targeting techniques for surface strike applications utilizing all available (on-board and off-board) threat targeting information.
  - (U) Developed design for utilizing off-board information in support of various theater missile defense boost phase intercept concepts.
- (U) $1,268 Develop advanced automatic target recognition algorithm techniques.
  - (U) Developed advanced target information extraction techniques for using the radar phased information to estimate the location of radar target scatters to support improved performance automatic target recognition algorithms.
  - (U) Determined thermal features that remain constant (as a function of time and day and target thermal conditions) to support high performance infrared target recognition algorithms.
- (U) $601 Develop advanced synthetic signature and scene generation capability to train automatic target recognition algorithms.
  - (U) Demonstrated feasibility of using synthetic infrared target signatures to improve automatic target recognition algorithms.
  - (U) Performed verification experiments for high-fidelity, high-speed synthetic aperture radar signature and scene prediction.
- (U) $601 Develop analytical and empirical automatic target recognition modeling techniques to determine performance boundaries of automatic target recognition.
  - (U) Determined best automatic target recognition performance possible for two different target types using synthetic data to support sensor trade off studies.
- (U) $869 Develop robust, ultra high-range radar algorithms for both air-to-air and air-to-ground applications.
  - (U) Evaluated performance of advanced, ultra high-range radar algorithms compared to operational identification technologies.
- (U) $10,161 Total

(U) FY 1997 ($ in Thousands):

- (U) $979 Develop reference sensors, system integration, and estimation technology to generate a common precision reference to enable high-payoff multiple platform operations through sharing of sensor data.
  - (U) Develop advanced reference and navigation algorithms to enable multiple platforms to share information in a battle area.
- (U) $971 Develop advanced solid state miniature inertial sensor technology to increase the reliability of inertial sensors required for aircraft and to reduce overall avionics size, weight, power, and cost.
  - (U) Fabricate and test second iteration of a packaged, navigation-grade, micro-machined silicon accelerometer for highly reliable, all-solid state inertial guidance and navigation systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Avionics — PROJECT: 6095

- (U) $848 Develop technology for reduced jamming vulnerability and increased precision targeting and strike accuracy of Global Positioning System (GPS) data and to exploit the benefits of GPS data to improve offensive and defensive combat capabilities at reduced cost.
  - (U) Test signal acquisition techniques to improve the jam resistance of GPS data for aircraft navigation and reference systems.
- (U) $895 Develop technology for low-observable, wideband, multi-function antennas for communications, navigation, and identification functions to reduce the number of antennas required and to increase weapon systems survivability.
  - (U) Complete fabrication and laboratory evaluation of a breadboard wideband digital antenna electronics unit providing small, low-cost, low-loss, beam forming/null-steering communication, navigation, and identification antennas.
- (U) $379 Develop advanced aircraft air engagement technologies for detection and tracking of conventional and low cross section threats to increase weapon system lethality and survivability.
  - (U) Evaluate operational payoff of innovative tracking schemes by using real flight data in ground tests of algorithms.
- (U) $982 Develop sensor management technologies and innovative deployment tactics to increase air combat situational awareness, increase range, and improve high-confidence target identification.
  - (U) Ground test and evaluate algorithms which fuse all available radar data for a more comprehensive target picture.
  - (U) Evaluate sensor management technologies capable of integrating ownship sensor data and off-board data to improve situational awareness.
  - (U) Evaluate candidate technologies that allow aircraft in the same flight to share information to promote commonality of fire control functions across various platforms.
- (U) $220 Develop innovative surface strike targeting techniques using all available (on-board and off-board) threat targeting information.
  - (U) Design targeting scheme that uses off-board information to aid in development of the fire control solution passed to the weapon.
- (U) $1,531 Develop advanced automatic target recognition algorithm techniques.
  - (U) Integrate advanced feature extraction techniques to evaluate performance improvement in automatic target recognition.
  - (U) Evaluate performance of automatic target recognition using advanced thermal invariance algorithms.
  - (U) Demonstrate feasibility of multispectral infrared (IR) fusion of thermal, spatial, and motion features of threat aircraft.
- (U) $1,061 Develop advanced synthetic signature and scene generation capability to train automatic target recognition algorithms.
  - (U) Integrate advanced IR target generation with scene generation capability.
  - (U) Demonstrate high-fidelity, high-speed synthetic aperture radar signature and scene prediction.
- (U) $919 Develop analytical and empirical automatic target recognition modeling techniques to determine performance boundaries of automatic target recognition.
  - (U) Use real and synthetic data to evaluate performance of automatic target recognition algorithm against multiple target types.
- (U) $1,569 Develop robust, ultra-high-range radar algorithms for both air-to-air and air-to-ground applications.
  - (U) Demonstrate advanced, robust, ultra high-range radar algorithms in a laboratory environment.
- (U) $10,354 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics PROJECT 6095

(U) FY 1998 ($ in Thousands):

- (U) $3,216 Develop reference sensors, system integration, and estimation technology to generate a common precision reference to enable high-payoff multiple platform operations through sharing of sensor data.
  - (U) Develop advanced reference and navigation algorithms to enable multiple platforms to share information in a battle area.
  - (U) Complete testing of a fiber optic gyroscope (FOG) that provides an order of magnitude improvement in bias drift rate over current FOGs to support the need for unjammable, high accuracy reference data shared by multiple platforms.
  - (U) Complete testing of the second iteration of a packaged, navigation-grade, micro-machined silicon accelerometer for highly reliable, all-solid state inertial guidance and navigation systems.
- (U) $2,218 Develop and evaluate multisensor management technologies to optimize search techniques, increase air combat situational awareness, increase detection ranges, allow high-confidence target identification, and enhance surface strike applications.
  - (U) Complete evaluation of sensor management technologies capable of integrating ownship sensor data (offensive and defensive sensors) and off-board data to increase air combat situational awareness and provide all aspect fire control capability.
  - (U) Refine targeting scheme for utilizing off-board information for final weapon solution.
  - (U) Assess cooperative fire control solutions involving multi-ship strikes and unmanned assets.
- (U) $2,832 Demonstrate rapid evaluation of multi-sensor system concepts to support all-aspect fire control, cooperative engagement, target tracking, and situation awareness.
  - (U) Complete medium fidelity sensor models and preliminary performance measurement capabilities for multi-sensor testbed. Archive limited sets of actual sensor data for fusion concept evaluation.
  - (U) Develop limited man-in-the-loop capability for multi-sensor testbed.
- (U) $554 Apply emerging open software architecture standards and practices to the development and evaluation of real-time, on-board, adaptive information fusion systems for reduced targeting errors and enhanced situation awareness.
  - (U) Design an architectural framework describing the functions, interfaces, and measures of performance for advanced information fusion systems.
  - (U) Initiate development of avionics fusion architecture components in conjunction with fusion researchers from the Department of Defense, industry, and academia.
  - (U) Establish baseline performance characteristics for avionics fusion applications and quantify the effects of reference system-related errors on fusion algorithms.
- (U) $1,220 Develop low-cost techniques using on-board sensors for cooperative air-to-ground identification of friendly forces to reduce fratricide and increase mission effectiveness.
  - (U) Develop techniques and supporting radar and infrared technologies necessary for existing aircraft to identify friendly ground forces.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 6095

- (U) $998 Develop advanced automatic target recognition (ATR) techniques.
  - (U) Verify feasibility of integrating advanced radio frequency (RF)/electro-optical (EO)/infrared (IR) target generation capability.
  - (U) Extract exploitable 'signature fingerprints' from high-range resolution and synthetic aperture radar data for use in target identification/synthetic model development.
  - (U) Continue integration of advanced radar feature extraction techniques to evaluate performance improvement in radar ATR versus current approaches.
  - (U) Evaluate performance enhancement of IR ATRs using advanced thermal invariance algorithms.
  - (U) Begin development of ATR algorithms which employ computational learning and invariant IR and RF features to enhance the performance of radar, IR, and multispectral ATR systems.
- (U) $11,038 Total

(U) FY 1999 ($ in Thousands):

- (U) $3,418 Develop reference sensors, system integration, and estimation technology to generate a common precision reference to enable high-payoff, multiple platform operations through sharing of sensor data.
  - (U) Continue to develop advanced reference and navigation algorithms to enable multiple platforms to share information in a battle area.
  - (U) Continue development and evaluation of techniques for optimizing inertial sensors for integration with Global Positioning System (GPS) and inertial systems.
- (U) $1,159 Develop and evaluate multisensor management technologies to optimize search techniques, increase air combat situational awareness, increase detection ranges, allow high-confidence target identification, and enhance surface strike applications.
  - (U) Develop advanced information fusion technologies for fighter aircraft which enable detection, tracking, and engagement of low-observable aircraft.
- (U) $2,667 Demonstrate rapid evaluation of multi-sensor system concepts to support all-aspect fire control, cooperative engagement, target tracking, and situation awareness.
  - (U) Expand fusion testbed capability by adding additional truth targets, additional sensor models, and enhanced measures of performance.
  - (U) Continue development of limited man-in-the-loop capability for fusion testbed.
  - (U) Update and refine open system avionics architecture for real-time, embedded, adaptive information fusion systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics PROJECT 6095

- (U) $1,044 Apply emerging open software architecture standards and practices to the development and evaluation of real-time, on-board, adaptive information fusion systems for reduced targeting errors and enhanced situation awareness.
  - (U) Continue to design an architectural framework describing the functions, interfaces, and measures of performance for advanced information fusion systems.
  - (U) Continue to evaluate avionics information fusion architecture concepts in conjunction with fusion researchers from the Department of Defense, industry, and academia.
  - (U) Initiate design of avionics fusion applications which quantify the effects of reference-system-related errors on fusion algorithms.
- (U) $1,739 Develop low-cost techniques using on-board sensors for cooperative air-to-ground identification of friendly forces to reduce fratricide and increase mission effectiveness.
  - (U) Continue development of techniques and supporting radar and infrared technologies necessary for existing aircraft to identify friendly ground forces.
- (U) $1,507 Develop advanced automatic target recognition (ATR) techniques.
  - (U) Demonstrate integration of advanced radio frequency (RF)/electro-optical (EO)/infrared (IR) target generation capability.
  - (U) Demonstrate extraction of exploitable 'signature fingerprints' from high range resolution and synthetic aperture radar data for use in target identification.
  - (U) Complete integration of advanced radar feature extraction techniques to evaluate performance improvement in radar ATR versus current approaches.
  - (U) Continue development of ATR algorithms which employ computational learning and invariant IR and RF features to enhance the performance of radar, infrared, and multispectral ATR systems.
  - (U) Initiate development of advanced, model-based, multisensor ATR algorithm technology to provide dramatic performance improvements over current single sensor ATR systems.
- (U) $11,534

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 6095

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	10,161	11,547	12,125	12,696	Cont
(U) Current Budget Submit/FY 1998 PB	10,161	10,354	11,038	11,534	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603203F, Advanced Avionics Integration.
- (U) PE 0602602F, Conventional Munitions.
- (U) PE 0603270F, Electronic Warfare Technology.
- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies
- (U) PE 0603762E, Sensor and Guidance Technology
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Avionics

PROJECT: 6096

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
6096 Microelectronics Technology	9,270	7,909	9,689	9,666	9,125	10,156	10,000	10,271	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project focuses on military unique, avionics aspects of microelectronics such as high-speed devices and circuits; packaging and power distribution; design tools; and hardware design languages. The warfighter requirements for technology developments are based on Air Force and other DOD weapon systems needs in the areas of radar, communications, electronic warfare, navigation, and smart weapons applications. Paramount to success is the development of high-speed analog-to-digital converter circuits, design, packaging, and power management support technologies that provide for the utilization of commercial off-the-shelf products and military essential avionics devices and circuits. Computer aided engineering technology is key to addressing the low-cost, very high performance, low power, tough environmental, multi-organization development, and high complexity challenges of our warfighting electronics. The developed technology is unavailable through commercial sources.

(U) FY 1996 ($ in Thousands):

- (U) $3,265 Develop advanced integrated circuits, including analog to digital converter circuits, for military radio frequency and digital support electronics.
  - (U) Developed digital integrated circuits for electronic engine control.
  - (U) Continued development of pressure and accelerometer microsensors to measure aircraft performance.
  - (U) Developed devices and integrated circuits for direct X-band analog-to-digital conversion for radar support electronics.
- (U) $2,308 Develop surface protective coatings and distributed power management and packaging technology.
  - (U) Evaluated circuits for direct X-band analog-to-digital conversion to improve reliability and performance of radar support electronics.
  - (U) Continued evaluation of an advanced surface protective coatings process for integrated circuits.
- (U) $1,745 Develop and integrate advanced design tools into a commercial software environment for affordable upgrades.
  - (U) Designed model year upgrades for the radar signature prediction accelerator and advanced cockpit three-dimensional graphics generator.
- (U) $1,952 Develop hardware design language technology for more effective control of obsolete parts and logistic support costs for existing weapon systems.
  - (U) Developed hardware design language models and validation suites for existing weapon system electronics to allow for affordable replacement of obsolete parts.
- (U) $9,270 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 6096

(U) FY 1997 ($ in Thousands):

- (U) $2,892 Develop advanced integrated circuits, including analog to digital converter circuits, for military radio frequency (RF) and digital support electronics.
  - (U) Optimize devices and fabrication processes for a transceiver chip set to improve performance and reliability of digital support electronics.
  - (U) Fabricate and test devices and integrated circuits for direct X-band analog-to-digital conversion to improve reliability and performance of radar support electronics.
  - (U) Design and develop high-speed circuits to augment the capability of commercial circuits for processing complex RF signals.
- (U) $1,414 Develop surface protective coatings, distributed power management, microsensors, and digital engine control technology to improve the reliability of electronic subsystems.
  - (U) Evaluate advanced packaging techniques for the direct X-band analog-to-digital conversion to improve reliability and performance of radar support electronics.
  - (U) Design and develop direct mount electronic engine control circuits that can withstand very high temperatures.
  - (U) Complete evaluation of an advanced surface-protective coating process for integrated circuits.
- (U) $1,574 Develop and integrate advanced design tools into a commercial software environment for affordable model year upgrades.
  - (U) Demonstrate a rapid design approach to interface avionics sensors with the processor.
  - (U) Develop a reuse library for aircraft electronics integrated circuit designs.
- (U) $2,029 Develop hardware design language technology for more effective control of obsolete parts and logistic support costs for existing weapon systems.
  - (U) Complete the digital hardware design language validation suite.
  - (U) Develop methods for mixing analog and digital models in the same validation suite.
  - (U) Continue development of reengineering support tools and electronics libraries for aging aircraft electronics suites.
- (U) $7,909 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 6096

(U) FY 1998 ($ in Thousands):

- (U) $2,616 Develop advanced high-speed devices and fabrication processes for digital integrated circuits to allow high-speed military sensors to interface with slower commercial processing components, thereby eliminating bulky, costly, and temperature-sensitive down-conversion electronics. These technologies include very high-speed analog-to-digital converter circuits, digital radio frequency memory chips, etc.
  - (U) Demonstrate high-speed devices and fabrication processes for a transceiver chip set to improve performance and reliability of high dynamic range, high sensitivity receivers while achieving a factor of fifty reduction in size.
  - (U) Fabricate and test devices and integrated circuits for greater than ten gigahertz analog-to-digital conversion for radar and electronic warfare sensors with high sensitivity receivers.
- (U) $2,616 Develop surface protective coatings, distributed power management, and packaging technologies for high performance digital integrated circuits to improve reliability and lower the cost of components that are required to operate in harsh military environments.
  - (U) Develop high frequency, 100 megahertz power switching devices for modular avionics sensors. The results of the effort will provide more efficient power conversion technology for advanced sensors such as phased array antennas and electronic warfare transmitters and receivers.
- (U) $1,744 Develop and integrate advanced design tools into a commercial software environment for affordable model year upgrades.
  - (U) Develop and demonstrate a second, more capable version of the software tools for on-the-fly reconfigurable computing for flexible mission profiles.
  - (U) Demonstrate utility of software tools for re-engineering/replacing electronic components that are obsolete or no longer manufactured.
  - (U) Complete development of a extensive, portable library of reusable military integrated circuit designs to speed insertion of advanced technology.
- (U) $2,713 Develop next-generation hardware design languages (HDLs) to enable more effective interchange of replacement part design information, better control of obsolete parts, and reduced logistics support costs.
  - (U) Complete support documentation to promote digital and analog HDLs as industry standards.
  - (U) Complete development of digital HDL training material and validation suite; transition to users (e.g., air logistics centers and system program offices).
  - (U) Develop an improved version of the software tools for using both analog and digital HDLs for circuits with analog and digital components.
- (U) $9,689 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 6096

(U) FY 1999 ($ in Thousands):

- (U) $2,575 Develop advanced high-speed devices and fabrication processes for digital integrated circuits to allow high-speed military sensors to interface with slower commercial processing components, thereby eliminating bulky, costly, and temperature-sensitive down-conversion electronics. These technologies include very high-speed analog-to-digital converter circuits, digital radio frequency memory chips, etc.
  - (U) Continue to demonstrate high-speed devices and fabrication processes for a transceiver chip set to improve performance and reliability of high dynamic range, high sensitivity receivers while achieving a factor of fifty reduction in size.
  - (U) Demonstrate devices and integrated circuits for greater than ten gigahertz analog-to-digital conversion for radar and electronic warfare sensors that will have high sensitivity receivers.
- (U) $2,622 Develop surface protective coatings, distributed power management, and packaging technologies for high performance digital integrated circuits to improve reliability and lower the cost of components that are required to operate in harsh military environments.
  - (U) Continue development of high frequency, 100 megahertz, power switching devices for modular avionics sensors. The results of the effort will provide more efficient and distributed power conversion technology for advanced sensors such as phased array antennas and electronic warfare transmitters and receivers.
- (U) $1,749 Demonstrate microsensor components to improve the performance/reliability of electronic navigation subsystem and to measure aircraft performance under adverse military environments.
  - (U) Specify the requirements for software tools for very high frequency digital designs. The demands on the software tools will change dramatically as very large scale integrated circuits exceed 300 megahertz.
  - (U) Connect the reconfigurable computing tools to graphical algorithm capture tools and high level automatic design synthesis tools to make them as easy to program and use as microprocessors.
  - (U) Identify the requirements for additional legacy system re-engineering tools to support aging aircraft modernization.
- (U) $2,720 Develop next-generation hardware design languages (HDLs) to enable more effective interchange of replacement part design information, better control of obsolete parts, and reduced logistics support costs.
  - (U) Develop best practices for Air Force use of the new industry standard analog and object-oriented HDL.
  - (U) Develop a validation suite for the analog and object oriented extended HDL, such that contractors and government agencies can effortlessly exchange design information.
  - (U) Develop a library of technology independent automatic digital logic generators for a specific application domain.
- (U) $9,666 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 6096

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	9,591	8,636	9,223	9,840	Cont
(U) Current Budget Submit/FY 1998 PB	9,270	7,909	9,689	9,666	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0602702F, Command, Control and Communications.
- (U) PE 0602705A, Electronics and Electronic Devices.
- (U) PE 0602234N, Materials, Electronics and Computers.
- (U) PE 0602712E, Materials and Electronics.
- (U) PE 0603739E, Manufacturing Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Avionics — PROJECT: 7622

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
7622 Radio Frequency Sensor Technology	7,549	7,976	8,016	9,407	10,021	10,451	10,775	11,105	Continuing	Continuing

Note: In FY 1998 and out, former Project 7622, Reconnaissance Strike Radio Frequency Sensors, and Project 7662, Avionics Data Transmission and Reception, have been combined within Project 7622, Radio Frequency Sensor Technology. For clarity, the FY 1996 and FY 1997 portions of this exhibit include project data from both old projects.

(U) A. Mission Description and Budget Item Justification: Determines feasibility of technology for reliable, all-weather, reconnaissance and precision strike radio frequency sensors and information transfer systems. Emphasis is on: acquisition of surface and airborne targets with difficult to detect signatures due to reduced radar cross sections, concealment and camouflage measures, severe clutter, and/or heavy jamming; and satisfying the growing need to transmit data between aircraft with high integrity, low probability of detection, and high jam resistance. Assured low probability of detection communications are required to reduce aircraft physical and electromagnetic vulnerability and provide major improvements in strike effectiveness by eliminating the requirement for "no communications" operations.

(U) FY 1996 ($ in Thousands):

- (U) $1,733 Develop advanced microwave sensor technology for air-to-air radar and target detection, including electronic protection, multi-dimensional image processing, adaptive algorithms that also explore reducing overall system life cycle cost.
  - (U) Developed and tested a high quality radar signal generator for laboratory use in supporting microwave sensor technology.
  - (U) Developed advanced techniques for mitigating direct path electronic countermeasures.
  - (U) Developed efficient and effective techniques (array manifolding and signal processing) to mitigate direct path interference for medium pulse repetition frequencies.
- (U) $1,175 Develop advanced technology for microwave sensors for air-to-ground and air-to-air clutter rejection.
  - (U) Examined and developed advanced techniques for mitigating radome multi-path reflection.
  - (U) Developed advanced techniques for exploring mutual coupling solutions for adaptive algorithms to improve clutter rejection.
- (U) $1,510 Develop integrated radar/targeting engineering analysis tools to evaluate sensor targeting errors for front-line fighter aircraft.
  - (U) Developed display software for integrated synthetic aperture radar evaluation tools.
  - (U) Designed support modules for radar expert analysis tools.
- (U) $1,175 Develop two-dimensional imaging technology for enhanced, all-aspect, air-to-air target identification capability.
  - (U) Generated synthetic signature validation on high-quality, two-dimensional imagery data.
  - (U) Developed preliminary radar system design concept using two-dimensional imaging technology.
  - (U) Integrated one-dimensional and two-dimensional algorithms and assessed utility for target identification capability.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 7622

- (U) $645 Develop technology to improve communication system electromagnetic interference rejection which in turn will provide the pilot more reliable communications in the combat environment.
  - (U) Continued development and evaluation of low-cost techniques to reduce radiated co-site interference for assured communications.
- (U) $662 Develop technology for short-range, low probability of detection, jam-resistant capabilities for voice communication and low-data-rate information exchange to eliminate the need for "comm out" operations and to increase survivability.
  - (U) Completed development and laboratory evaluation of omni-directional laser communications breadboard for highly covert, short-range communications.
  - (U) Completed design and initiate fabrication of joint Army/Air Force ultraviolet non-line-of-site communications breadboard to enable effective communications during nap-of-the-earth flight operations.
- (U) $649 Develop technology for automation of cockpit communications to reduce pilot workload and increase the availability of communications during combat operations.
  - (U) Designed voice-activated expert system brassboard that controls cockpit communications.
- (U) $7,549 Total

(U) FY 1997 ($ in Thousands):

- (U) $1,145 Develop advanced microwave sensor technology for air-to-air radar and target detection, including electronic protection, multi-dimensional image processing, and adaptive algorithms, that also explore reducing life cycle cost.
  - (U) Develop concept for an integrated analog/digital radio frequency system to reduce receiver hardware specifications and field maintenance.
- (U) $2,237 Develop tools and techniques that significantly reduce the cost and time to develop complex, synthetic, airborne radar environments.
  - (U) Develop user-friendly, automated, object-oriented programming system to allow ground controllers to maneuver synthetic aperture radar to penetrate foliage and mitigate hostile electromagnetic environments.
- (U) $2,267 Develop integrated radar/targeting engineering analysis tools to evaluate sensor targeting errors for front-line fighter aircraft.
  - (U) Establish baseline radar analysis library with emphasis on user-friendly, automated, object-oriented and reusable software.
- (U) $253 Develop two-dimensional radar imaging technology for enhanced all aspect air-to-air target identification capability.
  - (U) Develop two-dimensional imaging technology to enhance front-line fighter first-look, first-kill capability.
- (U) $648 Develop technology to improve communication system electromagnetic interference rejection which in turn will provide the pilot more reliable communications in the combat environment.
  - (U) Complete development and evaluation of low-cost techniques to reduce radiated co-site interference for assured communications.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 7622

- (U) $747 Develop technology for short-range, low probability of detection, jam-resistant capabilities for voice communication and low-data-rate information exchange to eliminate the need for "comm out" operations and to increase survivability.
  - (U) Complete initial breadboard and laboratory test joint Army/Air Force ultraviolet, non-line-of-site communications concept which will enable effective communications during nap-of-the-earth flight operations.
  - (U) Develop preliminary design and assess radiated co-site interference for use of non-traditional communications capability.
- (U) $679 Develop technology for automation of cockpit communications to reduce pilot workload and increase the availability of communications during combat operations.
  - (U) Complete design and begin fabrication of a brassboard to demonstrate a voice-actuated expert system that will control cockpit communications.
- (U) $7,976 Total

(U) FY 1998 ($ in Thousands):

- (U) $2,782 Develop advanced microwave sensor technology for air-to-air radar and target detection, including electronic protection, multi-dimensional image processing, and adaptive algorithms, to improve performance and also reduce life cycle cost.
  - (U) Refine integrated radio frequency (RF) techniques. These techniques will improve weapon system performance, reduce RF system operating costs, and increase situational awareness in some operating environments.
  - (U) Develop limited processing improvements of adaptive algorithms for terrain scattered interference cancellation, radome reflection lobe cancellation, and side/main lobe cancellation in advanced fighter aircraft radars.
  - (U) Develop limited set of radar engineering analysis tools to evaluate sources of sensor targeting errors in front-line fighter aircraft.
- (U) $2,577 Develop advanced airborne sensors for air-to-ground targeting and attack with robust performance in adverse weather, severe jamming, natural clutter, or concealment by foliage or camouflage.
  - (U) Develop targeting scenes, using improved analytical clutter generation, for limited evaluation of advanced synthetic aperture radar (SAR) sensors.
  - (U) Develop limited capability to analyze advanced SAR sensors and predict their performance characteristics given particular system parameters, processing, target aspects, motion compensation systems, and targeting scenarios.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 7622

- (U) $2,013 Develop technology for information transmission between airborne vehicles and cooperating assets with high fidelity, low probability of detection, and high jam resistance to improve strike effectiveness.
  - (U) Complete laboratory test of joint Army/Air Force ultraviolet, non-line-of-sight, communications concept which will enable effective communications during nap of the earth flight operations.
  - (U) Design a hybrid radio frequency/electro-optical interference rejection filter to provide a three orders of magnitude increase in rejection of interfering signals while reducing size, weight, power, and cost of airborne communication receivers.
  - (U) Continue fabrication and begin integration of an expert system brassboard that manages communication systems for assured communications.

- (U) $644 Develop and apply advanced information transmission design and analysis tools to maximize combat effectiveness and affordability of communication, navigation, and identification (CNI) systems.
  - (U) Upgrade design and analysis tool for low probability of detection subsystem waveforms to support development of advanced intercept receivers.
  - (U) Develop more sophisticated design and analysis tools for evaluation of implementation of subsystem level components in advanced CNI designs.
- (U) $8,016 Total

(U) FY 1999 ($ in Thousands):

- (U) $3,641 Develop advanced microwave sensor technology for air-to-air radar and target detection, including electronic protection, multi-dimensional image processing, and adaptive algorithms, to improve performance and also reduce life cycle cost.
  - (U) Continue to refine and evaluate integrated radio frequency (RF) techniques. These techniques will improve weapon system performance, reduce RF system operating costs, and increase situational awareness in all operating environments.
  - (U) Continue to develop limited processing improvements of adaptive algorithm for terrain scattered interference cancellation, radome reflection lobe cancellation, and side/main lobe cancellation in advanced fighter aircraft.
- (U) $3,403 Develop advanced airborne sensors for air-to-ground targeting and attack with robust performance in adverse weather, severe jamming, natural clutter, or concealment by foliage or camouflage.
  - (U) Continue to develop targeting scenes, using improved analytical clutter generation, for use in evaluation of advanced synthetic aperture radar (SAR) sensors.
  - (U) Continue development of limited analytical tools to predict the performance characteristics of advanced SAR sensors given particular system parameters, target aspects, motion compensation systems, and targeting scenarios.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Avionics / PROJECT: 7622

- (U) $1,418 Develop technology for information transmission between airborne vehicles and cooperating assets with high fidelity, low probability of detection, and high jam resistance to improve strike effectiveness.
  - (U) Continue to develop technology for short-range, low data rate, low probability of detection, jam resistant information transfer capability to eliminate the need for "comm out" operations and to increase survivability.
  - (U) Continue designing a hybrid radio frequency/electro-optical interference rejection filter to provide a three orders of magnitude increase in rejection of interfering signals while reducing size, weight, power, and cost of airborne communication receivers.
  - (U) Complete conceptual design for an advanced communications/navigation/identification suite that meets the harsher power, weight, and size contraints characteristic of unmanned tactical aircraft and unmanned aerial vehicles.
- (U) $945 Develop and apply advanced information transmission design and analysis tools to maximize combat effectiveness of communications, navigation,and identification subsystems.
  - (U) Complete upgrade of a low probability of detection subsystem waveform design and analysis tool used to characterize advanced intercept receiver designs.
  - (U) Continue developing more sophisticated design and anaylsis tools for evaluation of subsystem level components implementation in advanced communication, navigation, and identification designs.
  - (U) Complete integration of an expert system brassboard that manages communication systems for assured communications.
- (U) $9,407 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Avionics
	PROJECT 7622

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	7,549	8,577	9,006	9,435	Cont
(U) Current Budget Submit/FY 1998 PB	7,549	7,976	8,016	9,407	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0603253F, Advanced Avionics Integration.
- (U) PE 0602782A, Command, Control and Communications (C3) Technology.
- (U) PE 0602232N, Navy C3 Technology.
- (U) PE 060379N, Advanced Technology Demonstration Program.
- (U) This project has been coordinated through the Project Reliance process (Joint Directors of Laboratories Sensor and Electronic Warfare Panels) to harmonize efforts and eliminate duplication.
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(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602269F Hypersonic Technology Program

PROJECT: 1025

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1025 Hypersonic Technology	12,624	7,153	9,840	12,984	12,983	13,865	12,829	12,968	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification: This Applied Research program develops advanced hypersonic technologies and will provide revolutionary technology options to satisfy future Air Force needs such as future hypersonic weapons and space launch concepts. This effort captures applicable hypersonic technologies from the National Aero-Space Plane (NASP) program. This program will focus on hydrocarbon fueled hypersonic vehicle technologies and demonstrate their feasibility. Technologies developed under this program will be dual-use and applicable to both DoD and NASA requirements. Planned efforts include analyses, hypersonic materials/structures, airbreathing propulsion, hydrocarbon fuels, and integrated technology test demonstrations. Note: The FY 1997 decrease and increases in FY 1998 and out are due to adjustment of the program plan.

(U) FY 1996 ($ in Thousands):

- (U) $8,697 Designed, developed, and tested propulsion components, structures, and integrated propulsion designs for advanced hypersonic propulsion concepts.
  - (U) Investigated advanced fuel injection/flame holding technologies to optimize scramjet performance.
  - (U) Completed preliminary evaluation and testing of candidate scramjet combustion concepts capable of demonstrating positive thrust at Mach 4-8.
  - (U) Performed detailed design of selected scramjet engines (e.g., inlet, combustor, and nozzle) capable of demonstrating positive thrust at Mach 4-8.
  - (U) Fabricated structures designed for integration into flowpath of selected engine designs.
  - (U) Reverse engineered foreign scramjet hardware to determine foreign design methodology.
  - (U) Studied endothermic fuel concepts to extend hydrocarbon-fueled scramjet capability from Mach 4-8 to Mach 10.
- (U) $2,067 Designed, developed, and tested advanced high-temperature, high-strength materials and structures for hypersonic applications.
  - (U) Continued characterization of high-temperature, lightweight materials and coatings for the internal sections of hypersonic propulsion engines.
  - (U) Completed characterization of new lightweight, high-temperature structure concepts to support fabrication of flightweight engines.
- (U) $727 Developed technologies for instrumentation and test in realistic hypersonic conditions.
  - (U) Validated structural test methodology for high-temperature and lightweight hypersonic vehicle structures (e.g., fuselage sections).
  - (U) Designed hypersonic test instrumentation that can withstand and accurately sense internal flow conditions (e.g., temperature, pressure, heat flux, etc.) without disturbing airflow or engine operating conditions.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602269F Hypersonic Technology Program PROJECT 1025

- (U) $699 Developed and extended analysis and computational technologies from low-speed and supersonic flight to the hypersonic environment.
  - (U) Evaluated analytical tools available for aeromechanical, structural, propulsion, flight path dynamics, etc. to determine the necessary interactions for an integrated design methodology to create an affordable hypersonic design.
- (U) $434 Conducted feasibility studies, design trades, and simulations to integrate hypersonic technologies into advanced vehicle designs for hypersonic applications which will improve warfighting capability and satisfy the requirements of Global Reach/Global Power.
  - (U) Conducted mission analyses to characterize user requirements and technology maturity.
- (U) $12,624 Total

(U) FY 1997 ($ in Thousands):

- (U) $6,013 Design, develop, and test propulsion components, structures, and integrated propulsion designs for advanced hypersonic propulsion concepts.
  - (U) Complete investigation of advanced injection/flameholding technologies to optimize scramjet performance.
  - (U) Continue detailed design and fabrication of components for a scramjet engine (e.g., inlet, combustor, and nozzle) capable of demonstrating positive thrust at Mach 4-8 while withstanding the severe internal conditions.
  - (U) Determine foreign scramjet hardware performance potential through detailed analysis and test, and evaluate potential suitability to U.S. scramjets.
  - (U) Demonstrate endothermic fuel concepts to extend hydrocarbon-fueled scramjet capability from Mach 4-8 to Mach 10.
- (U) $243 Design, develop, and test advanced high-temperature, high-strength materials and structures for hypersonic applications.
  - (U) Perform detailed characterization and testing of selected high-temperature, lightweight materials for the internal sections of hypersonic propulsion engines.
- (U) $267 Develop technologies for instrumentation and test in realistic hypersonic conditions.
  - (U) Fabricate and experimentally verify hypersonic test instrumentation that can withstand and accurately sense internal flow conditions (e.g., temperature, pressure, heat flux, etc.) without disturbing airflow or engine operating conditions.
- (U) $480 Develop and extend computational technologies from low-speed and supersonic flight to the hypersonic environment.
  - (U) Develop initial concepts to extend interdisciplinary computational fluid dynamics and vehicle thermal management modeling for an integrated design methodology to create an affordable hypersonic design.
- (U) $150 Conduct feasibility studies, design trades, and simulations to integrate hypersonic technologies into advanced vehicle designs for hypersonic applications which will improve warfighting capability and satisfy the requirements of Global Reach/Global Power.
  - (U) Conduct mission analyses to characterize user requirements and technology maturity.
  - (U) Conduct detailed missile designs to guide technology requirements definition and development.
- (U) $7,153 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602269F Hypersonic Technology Program — PROJECT: 1025

(U) FY 1998 ($ in Thousands):

- (U) $7,827 Design, develop, and test propulsion components, structures, and integrated propulsion designs for advanced hypersonic propulsion concepts.
  - (U) Continue detailed design and initiate fabrication of test components for a scramjet engine (e.g., inlet, combustor, and nozzle) capable of demonstrating positive thrust at Mach 4-8 while withstanding the severe internal conditions.
  - (U) Complete reverse engineering and component/subscale testing of foreign scramjet hardware to determine foreign design methodology. Determine need for further testing at larger scale.
  - (U) Complete demonstration of endothermic fuel concepts to increase performance and alleviate flowpath temperatures in Mach 4-8 engine.
- (U) $498 Design, develop, and test advanced high-temperature, high-strength materials and structures for hypersonic applications.
  - (U) Complete detailed characterization and testing of first set of down-selected high-temperature, lightweight materials for the internal sections of hypersonic propulsion engines.
- (U) $300 Develop technologies for instrumentation and test in realistic hypersonic conditions.
  - (U) Continue fabrication and testing of hypersonic test instrumentation that can withstand and accurately sense internal flow conditions (e.g., temperature, pressure, heat flux, etc.) without disturbing airflow or engine operating conditions.
- (U) $765 Develop and extend computational technologies from low-speed and supersonic flight to the hypersonic environment.
  - (U) Complete refinement of concepts to extend interdisciplinary computational fluid dynamics and vehicle thermal management modeling for an integrated design methodology to create an affordable hypersonic design. Initiate validation of computational methods in instrumented engine flowpath test rigs.
- (U) $450 Conduct feasibility studies, design trades, and simulations to integrate hypersonic technologies into advanced vehicle designs for hypersonic applications that will improve warfighting capability and satisfy the requirements of Global Reach/Global Power.
  - (U) Continue mission analyses to characterize user requirements and technology maturity.
  - (U) Refine detailed missile designs to guide inter-disciplinary technology requirements definition and development for integrated hypersonic vehicles.
- (U) $9,840 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602269F Hypersonic Technology Program
	PROJECT 1025

(U) FY 1999 ($ in Thousands):

- (U) $10,107 Design, develop, and test propulsion components, structures, and integrated propulsion designs for advanced hypersonic propulsion concepts.
  - (U) Continue testing of scramjet engine components (e.g., inlet, combustor, and nozzle) capable of demonstrating positive thrust at Mach 4-8 while withstanding the severe internal conditions.
  - (U) Initiate detailed design of freejet test engine and initiate fabrication of components.
  - (U) Apply endothermic fuel concepts to specific designs of Mach 4-8 engines.
- (U) $495 Design, develop, and test advanced high-temperature, high-strength materials and structures for hypersonic applications.
  - (U) Initiate detailed characterization and testing of high-temperature, lightweight materials selected for the internal sections of specific engine configurations.
- (U) $682 Develop technologies for instrumentation and test in realistic hypersonic conditions.
  - (U) Apply hypersonic test instrumentation to specific freejet engine configurations and initiate establishment of test instrumentation protocol for freejet testing.
- (U) $800 Develop and extend computational technologies from low-speed and supersonic flight to the hypersonic environment.
  - (U) Continue validation of computational methods in instrumented engine flowpath test rigs.
- (U) $900 Conduct feasibility studies, design trades, and simulations to integrate hypersonic technologies into advanced vehicle designs for hypersonic applications that will improve warfighting capability and satisfy the requirements of Global Reach/Global Power.
  - (U) Continue mission analyses to characterize user requirements and technology maturity.
  - (U) Update detailed missile design to guide inter-disciplinary technology requirements definition and development for integrated hypersonic vehicles.
- (U) $12,984 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602269F Hypersonic Technology Program — PROJECT: 1025

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	18,448	7,471	18,477	16,685	Cont
(U) Appropriated Value	19,900	7,471			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-693	-149			
b. SBIR	-384	-162			
c. Omnibus/Other Above Threshold Reprogrammings	-3,199	-7			
d. Below Threshold Reprogrammings	-3,000				
(U) Current Budget Submit/FY 1998 PB	12,624	7,153	9,840	12,984	Cont

(U) Change Summary Explanation:

Funding: Development of hypersonic technologies was previously conducted under the National Aero-Space Plane (NASP) program and the Hypersonic Systems Technology Program (HySTP). In FY 1995, the Air Force canceled HySTP and refocused efforts into a hypersonic technology initiative. This required a major restructure of the program requiring Congressional approval. Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602201F, Flight Dynamics.
- (U) PE 0602203F, Aerospace Propulsion
- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602601F Phillips Laboratory Exploratory Development

	COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	130,112	147,712	111,136	123,514	132,746	140,551	144,546	146,825	Continuing	Continuing
1010	Geophysics and Weather Technology	26,911	25,744	16,507	19,076	19,558	20,325	20,682	21,144	Continuing	Continuing
1011	Rocket Propulsion Technology	36,613	33,863	29,505	36,509	38,030	39,555	39,920	39,279	Continuing	Continuing
3326	Lasers and Imaging Technology	19,316	18,553	21,252	20,716	20,436	20,111	21,396	22,070	Continuing	Continuing
5797	Advanced Weapons and Survivability Technology	16,705	16,039	15,403	15,950	17,059	17,632	17,959	18,510	Continuing	Continuing
8809	Space and Missile Technology	30,567	53,513	28,469	31,263	37,663	42,928	44,589	45,822	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification: This is the Applied Research program for the Phillips Laboratory. In geophysics, this PE develops technologies to understand, mitigate, and exploit effects of weather and geophysics environments on the design and operation of Air Force systems. This includes defining, modeling, and developing techniques to predict the phenomena of solar and space environments. In rocket propulsion, this PE develops technologies for boost and orbit transfer, satellite maneuvering, and tactical/ballistic missile rocket propulsion. In lasers, this PE examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. Technologies researched include high power laser devices, mid-infrared semiconductor laser devices, semiconductor diode laser arrays, optical components, advanced beam control and atmospheric compensation technologies, techniques for laser target vulnerability assessments, and nonlinear optics processes and techniques. Advanced weapons examines high power microwave and other unconventional weapon concepts using innovative technologies such as compact toroids. This also provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets. In space and missiles, this PE develops the following technologies: spacecraft platform (e.g., structures, controls, power, and thermal management); space-based payload (e.g., sensors, satellite communications, and survivable electronics); satellite control (e.g., spacecraft software); ballistic missile/launch vehicle-specific (e.g., astrodynamics and guidance, navigation, and control avionics); and integrated experiments of advanced technologies for transition to planned systems (e.g., payload/platform/launch vehicle merging). Note: Congress added $12.3 million in FY 1996 (Project 1010, $5 million for the High-Frequency Active Auroral Research Program (HAARP), Project 1011, $6 million for Integrated High Payoff Rocket Propulsion Technology (IHPRPT), and Project 3326, $1.3 million for the Advanced Electro-Optical Spectrograph) plus $27.4 million in FY 1997 (Project 1010, $7.5 million for HAARP, and Project 8809, $10.1 million for MightySat and $9.8 million for the Rocket System Launch Program) which explains the perceived decrease in FYs 1998 and 1999. Also, the emphasis on Geophysics and Weather Technology has been decreased, while additional emphasis has been placed on space and associated technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	131,733	121,107	125,521	134,584	Cont
(U) Appropriated Value	136,746	153,507			
(U) Adjustments to Appropriated Value		-3,736			
a. Congressional/General Reductions	-2,736	-1,916			
b. SBIR	-1,724	-143			
c. Omnibus/Other Above Threshold Reprogrammings	-2,174				
(U) Current Budget Submit/FY 1998 PB	130,112	147,712	111,136	123,514	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:** Not Applicable.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602601F Phillips Laboratory Exploratory Development

PROJECT: 1010

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1010 Geophysics and Weather Technology	26,911	25,744	16,507	19,076	19,558	20,325	20,682	21,144	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project develops the technologies to understand, mitigate, and exploit the effects of the weather and geophysics environments on the design and operation of Air Force systems. This includes defining, modeling, and developing techniques to predict the phenomena of solar and space environments. Models are developed to specify and predict optical and infrared backgrounds and signatures of spacecraft and missiles, as well as techniques to predict when and where ionospheric disturbances will occur. Atmospheric drag effects on satellites are studied. Space debris is measured and modeled for its impact on spaceborne systems. New techniques for measuring, modeling, simulating, and predicting meteorological effects that impact the Air Force mission are researched. Additionally, seismic technology for nuclear test monitoring and test ban treaty verification is matured.

(U) FY 1996 ($ in Thousands):

- (U) $4,712 Develop space radiation specification and solar hazard prediction techniques for space system design and operations.
  - (U) Formulated and updated radiation belt models that are essential for Air Force and DOD space system designs and operations.
  - (U) Developed adaptive optical techniques for improved imaging of disruptive solar events.
- (U) $4,107 Develop atmospheric optical background simulations, models, and integrated codes for space system design and operation.
  - (U) Collected data from the mid-course space experiment for use in developing stellar, on-board calibration sources for advanced space-based surveillance and tracking systems.
- (U) $2,518 Develop active and passive remote sensing techniques for target signature identification and atmospheric wind profile measurements.
  - (U) Used the Flying Infrared Signatures Technology Aircraft (FISTA) to collect infrared signatures of the B-2, other aircraft, and missiles to validate existing operational target and scenes codes.
  - (U) Tested an airborne laser imaging, detection, and ranging demonstrator on the FISTA to increase the accuracy of target measurements by characterizing the optical path between the aircraft and the target.
- (U) $4,476 Develop global ionosphere models to improve communications and space system applications.
  - (U) Extended the Parameterized Real-Time Ionospheric Specification Model to 22,000 kilometers and transitioned it to operational use.
- (U) $1,926 Measure and model the effects of local plasmas on Air Force space systems.
  - (U) Measured degradation of radio frequency transmissions passing through plasmas generated around aerospace vehicles.
- (U) $410 Develop seismic event identification techniques for nuclear test ban treaty verification.
  - (U) Delivered a physical model for guided crustal waves for applications in the Eurasian and Middle East region.
- (U) $4,768 Evaluate the interaction between high power, high-frequency, ground transmitted radio waves and the ionosphere.
  - (U) Conducted research to characterize the background ionosphere.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 1010

- (U) $3,994 Develop weather analysis, simulation, and prediction techniques for use in global and theater combat weather systems.
  - (U) Delivered an advanced-parameter, global cloud analysis model to Air Force Global Weather Central.
  - (U) Completed data fusion project to integrate disparate weather data from battlefields to enhance theater weather forecasting.
- (U) $26,911 Total

(U) FY 1997 ($ in Thousands):

- (U) $4,305 Develop space radiation specification and solar hazard prediction techniques for space system design and operations.
  - (U) Design the follow-on Compact Radiation Effects Satellite payload that will analyze potentially dangerous high energy particles in space.
- (U) $3,251 Develop atmospheric optical background simulations, models, and integrated codes for space system design and operation.
  - (U) Extend the wavelength coverage of the operational atmospheric backgrounds code into the ultraviolet and millimeter wavelength regions.
- (U) $1,913 Develop active and passive remote sensing techniques for target signature identification and atmospheric wind profile measurements.
  - (U) Use Flying Infrared Signatures Technology Aircraft measurements to expand and validate the spectral in-band radiance images of target and scene codes improving the warfighter's target discrimination capabilities.
- (U) $4,459 Develop global ionosphere models to improve communications and space system applications.
  - (U) Incorporate scintillation data into the operational wideband model to improve accuracy of communications disruption warnings.
- (U) $7,500 Evaluate the interaction between high power, high-frequency, ground transmitted radio waves and the ionosphere.
  - (U) Expand high frequency transmitter power from 360 kilowatts (kw) to 960kw to enhance experimental research capabilities.
  - (U) Conduct experimental research on the generation of Extremely Low Frequency/Very Low Frequency (ELF/VLF) waves in the ionosphere for potential communications and underground structure imaging applications.
- (U) $4,316 Develop global and theater weather analysis, simulation, and prediction techniques for combat weather system applications.
  - (U) Complete theater-scale analysis procedures for combat weather displays and theater weather forecast model initialization.
- (U) $25,744 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 1010

(U) FY 1998 ($ in Thousands):

- (U) $4,352 Develop space radiation specification and solar hazard prediction techniques for space system design and operations.
  - (U) Transition quasi-dynamic radiation belt models to product center and industry for satellite design and orbit selection.
  - (U) Complete initial report on the threat of space particles for counterspace activities.
  - (U) Deliver solar proton prediction scheme to 50th Weather Squadron to warn of radio-blackouts over the polar caps.
- (U) $3,193 Develop background clutter mitigation techniques for space system design and operation.
  - (U) Transition Mid-course Space Experiment and Miniature Seeker Technology Integration (MSTI-3) satellite data to atmospheric spatial structure background codes to develop enhanced target-background discrimination algorithms.
- (U) $1,385 Develop active and passive remote sensing techniques for atmospheric parameter measurements.
  - (U) Use advanced modeling and simulation technologies to provide real-time target and background scene generation capability for training and hardware-in-the-loop simulations
  - (U) Develop compact solid state wind sensing lidar for ballistic wind applications (e.g., cargo drops and B-52 bomb drops).
  - (U) Evaluate lidar designs for remote sensing of atmospheric optical and wind turbulence for aircraft safety and surveillance systems.
- (U) $3,958 Develop global ionosphere models to improve communications and space system applications.
  - (U) Deliver Coupled Ionospheric Scintillation Model to Air Weather Service for support to Air Force communications systems.
  - (U) Transition Global Ionospheric Forecast Model to user in support of Command, Control, Communication, and Intelligence (C3I), Spacetrack, and surveillance systems.
- (U) $3,619 Develop global and theater weather analysis, simulation, and prediction techniques for combat weather system applications.
  - (U) Complete validation of satellite data unified retrieval method to support theater weather forecast models.
  - (U) Incorporate satellite-based cloud module into simulation procedures for system design and testing.
  - (U) Develop method to incorporate radar and lidar weather data into combat weather support forecast modules
- (U) $16,507 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 1010

(U) FY 1999 ($ in Thousands):

- (U) $4,460 Continue the development of space radiation specification and solar hazard prediction techniques for space system design and operations.
  - (U) Develop coronal mass ejection model needed by 50th Weather Squadron (50WS) to provide three to seven day warning of geomagnetic disturbances that cause false launch indicators, satellite tracking errors, and communications disruptions.
  - (U) Upgrade Phillips Lab's Integrated Space Environment Model and deliver to 50WS for use in space weather hazard alerts.
  - (U) Deliver magnetospheric substorm model to 50WS for use in predicting satellite surface charging and Command, Control, Communication, and Intelligence (C3I) disruptions.
- (U) $3,217 Continue the development of background clutter mitigation techniques for space system design and operation.
  - (U) Develop improved optical and infrared background models that support advanced sensor imaging techniques for detection and tracking of dim targets, such as cruise missiles.
- (U) $1,625 Continue the development of active and passive remote sensing techniques for atmospheric parameter measurements and simulation of battlefield environments.
  - (U) Demonstrate and validate design concepts for real-time target and background scene generation capability.
  - (U) Test and evaluate solid state wind sensing lidars for B-52 applications.
  - (U) Develop compact, solid state ultraviolet differential absorption lidar for trace gas and chemical detection for use on aircraft.
- (U) $5,899 Continue the development of global ionosphere models to improve communications and space system applications.
  - (U) Develop scintillation warning techniques/displays for command, control, and communication system outage alerts.
  - (U) Deliver Theoretical Ionosphere-Atmosphere Real-time Algorithm to Air Weather Service for navigation, communications, and space track applications.
- (U) $3,875 Continue the development of global and theater weather analysis, simulation, and prediction techniques for combat weather system applications.
  - (U) Tailor numerical weather prediction models to forecast contrails for stealth aircraft operations.
  - (U) Develop radiative cloud module for weather scene simulation techniques for training and wargaming applications.
- (U) $19,076 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**
	PROJECT **1010**

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	28,223	19,287	18,244	20,957	Cont
(U) Current Budget Submit/FY 1998 PB	26,911	25,744	16,507	19,076	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0601102F, Defense Research Sciences.
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603410F, Space Systems Environmental Interactions Technology.
- (U) PE 0603707F, Weather Systems Advanced Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602601F Phillips Laboratory Exploratory Development

PROJECT: 1011

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1011 Rocket Propulsion Technology	36,613	33,863	29,505	36,509	38,030	39,555	39,920	39,279	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** The technologies developed in this project are boost and orbit transfer, satellite maneuvering, and tactical and ballistic missile rocket propulsion. This project develops technologies and provides technology options for rocket propulsion advanced demonstrations, components, or subsystems. Technologies of interest are those which will improve reliability, operability, survivability, affordability, environmental compatibility, and performance of future space and missile launch sub-systems while reducing material, manufacturing, and support costs. Technology will be developed to reduce the weight and cost of components using new materials, improved designs, and improved manufacturing techniques. All efforts in this project are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) initiative; a joint DOD, NASA, and industry effort to focus rocket propulsion technology on national needs.

(U) FY 1996 ($ in Thousands):

- (U) $3,848 Develop propellants with a high-energy density.
  - (U) Determined feasibility of solid hydrogen and metallic clusters, metal atom doped cryogenic-solids, and solids with impurities as high-energy-density materials.
  - (U) Continued development of cryogenic solids, high-pressure solids, extended solids, and high-energy density material additives in cryogenic solids for future use in a solid or hybrid rocket with revolutionary performance increases.
  - (U) Test fired combustion chamber using solid oxygen as a fuel.
  - (U) Test fired the first liquid high-energy density additive (quadricyclane) in a 4,000 lb. engine. Began increased-scale demonstrations.
  - (U) Continued search for new, higher-energy compounds for solid and liquid propellants.
  - (U) Conducted synthesis of solid, non-ozone depleting oxidizers.
  - (U) Developed scale-up capability for liquid, high-energy-density materials.
- (U) $6,266 Develop propulsion technologies for tactical missiles.
  - (U) Fabricated and began demonstrating components such as no-erosion, altitude-compensating nozzles used in solid rocket missiles.
  - (U) Developed lightweight insulating liners for reduced-weight solid rocket motors.
  - (U) Designed a nozzle (supersonic splitline flexseal nozzle) that reduces missile weight and increases missile agility.
  - (U) Tested environmentally safe, minimum-smoke propellants for use in tactical missiles to eliminate missile vulnerability caused by exhaust plume signature tracking.
  - (U) Initiated development of hybrid propulsion systems for potential use as a tactical missile.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 1011

- (U) $14,166 Develop propulsion technology for reliable, safe, and low-cost boost and orbit transfers.
  - (U) Manufactured low-cost, coated carbon-carbon ceramic components and hybrid polymers for future demonstration of high temperature, non-erosive, lightweight components for solid rocket motors.
  - (U) Used advanced manufacturing and fabrication methods to produce fluid film bearings. Integrated the bearings into a breadboard turbopump to validate cost and weight savings. Began testing hydrostatic bearings in turbopump assemblies under "real" conditions.
  - (U) Fabricated a combustion chamber to produce increased performance bearings using powder metallurgy technology.
  - (U) Designed and fabricated an altitude compensating nozzle to be integrated into a liquid propellant engine.
  - (U) Developed and evaluated new injectors that are less expensive and increase engine reliability and performance over existing injectors.
  - (U) Designed and developed the fabrication processes to produce a high performance, low-cost cryogenic upper stage combustion chamber for an expander cycle.
  - (U) Designed and fabricated an advanced preburner engine component that uses liquid cryogenic propellants, meets high throttle requirements and does not vaporize the propellants.
  - (U) Characterized new, lightweight components and developed the processes required to use the materials in liquid fuel rockets.
  - (U) Compiled data on hybrid propulsion concepts to develop state-of-the-art hybrid rocket motor technologies.
- (U) $7,376 Develop advanced boost and orbit transfer propellants which are environmentally safe during manufacture, storage, use, and disposal.
  - (U) Characterized and evaluated the synthesized non-toxic, non-cryogenic, high-performance storable liquid fuels and oxidizers.
  - (U) Designed non-toxic, non-cryogenic, high-performance storable liquid fuels and oxidizers.
  - (U) Developed lab procedures to minimize propellant, explosive, and pyrotechnic waste products. Optimize disposal procedures.
  - (U) Synthesized alternative, environmentally acceptable propellants that increase the stability and mechanical integrity of missiles.
  - (U) Tested ways to improve and make more efficient the manufacturing of new environmentally-safe solid rocket fuels.
  - (U) Manufactured and evaluated laboratory quantities of new high-energy chemicals to be used in environmentally-safe propellants.
- (U) $4,957 Develop propulsion technology for satellite control and on-orbit transfer.
  - (U) Developed concepts and components for solar thermal propulsion.
  - (U) Investigated the beam divergence of a 1000-watt anode thruster (an arcjet) and evaluated methods that could reduce divergence.
- (U) $36,613 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 1011

(U) FY 1997 ($ in Thousands):

- (U) $2,253 Develop high-energy-density materials.
  - (U) Complete analysis of solid hydrogen and metallic clusters, metal atom doped cryogenic solids, and solids with impurities. Transition the best high-energy-density materials into the cryogenic solid properties and combustion programs. Begin testing and evaluation of downselected propellants to transition into future high-performance boost and orbit transfer propulsion systems.
  - (U) Finish exploring cryogenic solid, high-pressure solid, and extended solid properties. Determine candidates for cryogenic solid combustion programs that will show revolutionary performance increases by replacing current liquid or solid propulsion systems with cryogenic solid or hybrid-fuel rockets in future space launch missions.
  - (U) Develop techniques to accurately measure high-energy-density additive concentrations in cryogenic solids to maximize future propulsion system performance.
  - (U) Test fire cryogenic hybrid-fuel rocket using oxygen and a cryogenic hydrocarbon to demonstrate performance increases over current liquid propulsion systems.
  - (U) Perform large-scale engine tests/demonstrations with new additives (quadricyclane). Prepare for launch-size demonstrations and begin transitioning additives into system-ready applications.
  - (U) Complete strained-ring hydrocarbon high-energy compound development. Identify the best candidates for a scale-up program to replace current liquid fuels.
  - (U) Select solid, non-ozone depleting oxidizers and other synthesized, new, high-energy-density materials for development. Begin small scale demonstrations of environmentally-safe solid rocket motor fuel processing using these new ingredients.
- (U) $3,134 Develop propulsion technologies for tactical missile system applications.
  - (U) Test fabrication techniques to manufacture lightweight solid rocket engine liners.
  - (U) Complete testing and demonstration of environmentally safe, minimum-smoke propellants to eliminate vulnerability caused by exhaust plume signature tracking.
  - (U) Develop the fabrication processes for novel nozzle concepts (supersonic splitline flexseal nozzle) that reduce missile weight while increasing missile agility.
  - (U) Evaluate commercial technologies and practices for their possible incorporation into low-cost, high-performance, environmentally-safe tactical missiles.
  - (U) Analyze new propellants and components to develop a lightweight, highly-maneuverable propulsion system that will assure high kill ratios against the next generation of highly maneuverable aircraft.
  - (U) Continue development of hybrid propulsion systems for potential use as a tactical missile.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 1011

– (U) $15,390 Develop propulsion technology to meet the needs of reliable, safe, and low-cost boost and orbit transfers.

- (U) Demonstrate low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for use in solid rocket space launch and missile motors.
- (U) Demonstrate the fluid film bearing designs and verify their performance and integrity when used in liquid turbopumps on future boost and orbit transfer systems.
- (U) Design and test injectors that enable reduced cost, increased reliability, and increased engine performance in liquid boost and orbit transfer engines.
- (U) Fabricate and test a high-performance, low-cost cryogenic upper stage combustion chamber for an expander cycle application.
- (U) Fabricate and test an advanced preburner engine component that uses using liquid cryogenic propellants that meets the high throttling requirements and does not vaporize propellants.
- (U) Continue to characterize new materials and develop processes required to apply the materials to liquid-propellant rocket production with dramatic weight reductions.
- (U) Develop design and processing techniques for high-strength, low-weight engine and motor components (metals and non-metals).

– (U) $7,499 Develop advanced boost and orbit transfer propellants which are environmentally safe during manufacture, storage, and use.

- (U) Evaluate ignition characteristics, determine combustion efficiencies, and report the results of the synthesized non-toxic, non-cryogenic, high-performance, storable liquid fuels and oxidizers to begin developing a high-performance, environmentally safe, liquid replacement for current space launch systems.
- (U) Fabricate and test non-toxic, non-cryogenic, high-performance, storable liquid additives for use with these new propellants (capable of withstanding the firing conditions created by the new propellants).
- (U) Determine alternative disposal procedures/technologies to thermolyze or breakdown propellant, explosive, and pyrotechnic wastes into their non-hazardous constituent parts.
- (U) Integrate all of the current solid propellant work being done under the high-energy-density materials program and incorporate the most promising chemicals into state-of-the-art propellants (liquid, solid, and hybrid).
- (U) Evaluate and analyze radically new methods of solid rocket motor and propellant manufacturing to develop low-cost, environmentally friendly solid rocket motors that exceed the performance of current liquid propellant rockets.
- (U) Scale-up and demonstrate the most innovative high-energy chemicals that are currently being synthesized within government and contractor laboratories. The most promising chemicals (solid or liquid) will be fed into an innovative propellants project to be used in next generation propellants for space launch systems.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 1011

- (U) $1,403 Develop techniques for use in sustainment of strategic systems while at the same time being potentially advantageous to the development of the next generation booster.
  - (U) Continue the development of service life assessment techniques of current solid rocket propellant missile systems.
- (U) $4,184 Develop satellite propulsion technology for control and on-orbit transfer.
  - (U) Develop and evaluate improved designs to fabricate a pulsed plasma thruster with increased power efficiency.
  - (U) Design solar thrusters and concentrators for satellite propulsion systems with longer life.
  - (U) Develop and improve technologies for implementation of the high power Hall thruster.
- (U) $33,863 Total

(U) FY 1998 ($ in Thousands):

- (U) $3,111 Develop propellants with a high-energy density.
  - (U) Continue testing and evaluation of downselected propellants to transition into future high-performance boost and orbit transfer propulsion systems. These potential propellants were culled from the analysis of solid hydrogen and metallic clusters, metal atom doped cryogenic solids, and solids with impurities conducted previously.
  - (U) Begin subscale testing of potential candidates for cryogenic solid combustion programs that will show revolutionary performance increases by replacing current liquid or solid propulsion systems with cryogenic solid or hybrid-fuel rockets in future space launch missions.
  - (U) Continue testing and comparison of techniques to accurately measure high energy-density additive concentrations in cryogenic solids to maximize future propulsion system performance.
  - (U) Complete performance of large-scale engine tests/demonstrations with new additives (quadricyclane). Continue preparation for launch-size demonstrations and transitioning additives into system-ready applications.
  - (U) Continue selection of solid, non-ozone depleting oxidizers and other synthesized, new, high energy-density materials for development. Continue small-scale demonstrations of environmentally-safe solid rocket motor fuel processing using these new ingredients.

- (U) $6,261 Develop propulsion technologies for tactical missiles.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 1011

- (U) Continue to test fabrication techniques to manufacture lightweight solid rocket motor liners.
- (U) Evaluate and test advanced propellants for future air-to-air and air-to-surface missile systems.
- (U) Complete development of the fabrication processes for novel nozzle concepts (supersonic splitline flexseal nozzle) that reduce missile weight while increasing missile agility. Conduct testing.
- (U) Continue to evaluate and test commercial technologies and practices for their possible incorporation into low-cost, high-performance, environmentally-safe tactical missiles.
- (U) Continue analysis and testing of new propellants and components to develop a lightweight, highly-maneuverable propulsion system that will assure high kill ratios against the next generation of highly maneuverable aircraft.

– (U) $7,867 Develop propulsion technology for reliable, safe, and low-cost boost and orbit transfers.

- (U) Continue to demonstrate low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for use in solid rocket space launch and missile motors.
- (U) Complete fabrication and testing of an advanced preburner engine component that uses using liquid cryogenic propellants that meets the high throttling requirements and does not vaporize propellants.
- (U) Begin development of compatible case/liner and insulator system for higher combustion temperature propellants to be used in strategic systems.

– (U) $4,942 Develop advanced boost and orbit transfer propellants which are environmentally safe during manufacture, storage, use, and disposal.

- (U) Continue the fabrication and testing of non-toxic, non-cryogenic, high-performance, storable liquid additives for use with the above new propellants (capable of withstanding the firing conditions created by the new propellants).

-- (U) $5,820 Develop techniques for use in sustainment of strategic systems while at the same time being potentially advantageous to the development of the next generation booster.

– (U) $1,504 Develop propulsion technology for satellite control and on-orbit transfer.

- (U) Continue the Hall thruster development for possible inclusion into the next generation satellites.
- (U) Continues work in the development and evaluation of improved designs to fabricate pulsed plasma thrusters with increased power efficiency, the next level of improvements.
- (U) Continue the design and test of solar thrusters and concentrators for satellite propulsion systems with longer life.

– (U) $29,505 Total

(U) FY 1999 ($ in Thousands):

– (U) $4,048 Develop propellants with a high-energy density.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 1011

- (U) Continue testing and evaluation of downselected propellants to transition into future high-performance boost and orbit transfer propulsion systems. These potential propellants were culled from the analysis of solid hydrogen and metallic clusters, metal atom doped cryogenic solids, and solids with impurities previously conducted.
- (U) Continue subscale testing of potential candidates for cryogenic solid combustion programs that will show revolutionary performance increases by replacing current liquid or solid propulsion systems with cryogenic solid or hybrid-fuel rockets in future space launch missions.
- (U) Continue testing and comparison of techniques to accurately measure high energy-density additive concentrations in cryogenic solids to maximize future propulsion system performance.
- (U) Begin evaluation of next generation of hydrocarbon fuel additives to improve the performance of current and future space launch systems.
- (U) Continue selection of solid, non-ozone depleting oxidizers and other synthesized, new, high energy-density materials for development. Continue small-scale demonstrations of environmentally-safe solid rocket motor fuel processing using these new ingredients.

– (U) $4,475 Develop propulsion technologies for tactical missiles.

- (U) Continue to test fabrication techniques to manufacture lightweight solid rocket motor liners.
- (U) Continue to evaluate and test advanced propellants for future air-to-surface missile systems.
- (U) Continue to evaluate and test commercial technologies and practices for their possible incorporation into low-cost, high-performance, environmentally-safe tactical missiles.
- (U) Continue analysis and testing of new propellants and components to develop a lightweight, highly-maneuverable propulsion system that will assure high kill ratios against the next generation of highly maneuverable aircraft.

– (U) $14,863 Develop propulsion technology for reliable, safe, and low-cost boost and orbit transfers.

- (U) Continue to demonstrate low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for use in solid rocket space launch and missile motors.
- (U) Complete demonstration of the fluid film bearing designs and verify their performance and integrity when used in liquid turbopumps on future boost and orbit transfer systems.
- (U) Complete fabrication and test of a high-performance, low-cost cryogenic upper stage combustion chamber for an expander cycle application.

- (U) Continue to characterize new materials and develop processes required to apply the materials to liquid-propellant rocket production with dramatic weight reductions.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 1011

- (U) Continue to develop design and processing techniques for high-strength, low-weight engine and motor components (metals and non-metals).
- (U) Continue development of altitude compensating thrust chamber assembly technology improvements which will provide significant gains in performance for reusable launch vehicles.
- (U) Verify performance and weight improvements of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles.

– (U) $4,917 Develop advanced boost and orbit transfer propellants which are environmentally safe during manufacture, storage, use, and disposal.

- (U) Continue the evaluation of ignition characteristics, determine combustion efficiencies, and report the results of the synthesized non-toxic, non-cryogenic, high-performance, storable liquid fuels and oxidizers to begin developing a high-performance, environmentally safe, liquid replacement for current space launch systems.
- (U) Continue the fabrication and testing of non-toxic, non-cryogenic, high-performance, storable liquid additives for use with the above new propellants (capable of withstanding the firing conditions created by the new propellants).
- (U) Continue the determination of alternative disposal procedures/technologies to thermolyze or breakdown propellant, explosive, and pyrotechnic wastes into their non-hazardous constituent parts. Continuing effort as new oxidizers and fuels are developed.
- (U) Continue the integration of the current solid propellant work being done under the high energy-density materials program and incorporate the most promising chemicals into state-of-the-art propellants (liquid, solid, and hybrid).
- (U) Continue to scale-up and demonstrate the most innovative high-energy chemicals that are currently being synthesized within government and contractor laboratories. The most promising chemicals (solid or liquid) are fed into an innovative propellants project to be used in next generation propellants for space launch systems.
- (U) Continue developing higher combustion temperature propellants for use in future strategic systems.

– (U) $4,541 Develop techniques for use in sustainment of strategic systems while at the same time being potentially advantageous to the development of the next generation booster.

– (U) $3,665 Develop propulsion technology for satellite control and on-orbit transfer.

- (U) Continue work in the development and evaluation of improved designs to fabricate pulsed plasma thrusters with increased power efficiency.
- (U) Continue the design and test of solar thrusters and concentrators for satellite propulsion systems with longer life.

– (U) $36,509 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 1011

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	36,923	30,293	30,447	31,169	Cont
(U) Current Budget Submit/FY 1998 PB	36,613	33,863	29,505	36,509	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0602303A, Missile Technology.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) PE 0603311F, Ballistic Missile Technology.
- (U) PE 0603401F, Advanced Spacecraft Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602601F Phillips Laboratory Exploratory Development

PROJECT: 3326

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3326 Lasers and Imaging Technology	19,316	18,553	21,252	20,716	20,436	20,111	21,396	22,070	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. Technologies researched include advanced, short-wavelength laser devices for application as illuminators and imaging sources as well as advanced optical imagers for target identification and assessment. Laser technologies will be studied for their utility in aimpoint selection, target maintenance, and damage assessment. Additionally, high power laser devices, mid-infrared semiconductor laser devices, semiconductor diode laser arrays, optical components, advanced beam control and atmospheric compensation technologies, techniques for laser target vulnerability assessments, and nonlinear optics processes and techniques are developed.

(U) FY 1996 ($ in Thousands):

- (U) $2,897 Develop generic high energy laser technologies for applications such as illuminators for use in wavelength-specific military missions.
  - (U) Demonstrated atomic-iodine laser pumped by chemically produced nitrogen-chloride. This laser is potentially significantly lighter weight than a comparable chemical oxygen-iodine laser.
  - (U) Completed semiconductor laser amplifier optimization studies of beam quality, output power, and coherence for applications such as laser communications.
- (U) $4,493 Develop basic laser source and target coupling technology for high-payoff applications such as laser-induced microwave emissions.
  - (U) Performed initial investigation of laser-induced microwave emissions to provide novel effect for upsetting electronic systems.
  - (U) Evaluated laser-induced microwave effects on military system materials.
- (U) $5,517 Develop long-range optical imaging technologies for increased resolution and data fusion to support missions such as space object identification and ground target identification from space.
  - (U) Conducted fundamental risk reduction experiments and demonstrations for technology critical to deep space imaging concepts selected in FY 1995. The concepts provide long-range signature/imaging capabilities currently not available.
  - (U) Identified a focused development of key concepts and technologies for transition to high-payoff applications for optical sensing, imaging, and stand-off detection. This will decrease cost and weight of space-based optics.
  - (U) Developed effort to incorporate real-time image processing algorithms into generic, on-platform processing schemes to reduce data transmission requirements.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 3326

- (U) $2,118 Investigate and develop nonlinear optics (NLO) technologies to support imaging and other applications.
  - (U) Demonstrated feasibility of using specially prepared NLO crystals to simultaneously convert a commercially available near-infrared laser to tunable, multiple near-infrared and mid-infrared wavelengths. NLO components provide a compact, lightweight, efficient, less complex system for countermeasures, imaging, sensing, and communication applications.
  - (U) Demonstrated all-optical technique to stabilize and extend the modulation bandwidth of semiconductor lasers with the potential to increase optical communication data rates and reduce system size, weight and complexity.
  - (U) Demonstrated an automatic technique for the correction of figure errors in lightweight membrane mirrors and initiated an effort to characterize the performance and limitations of this technique. Nonlinear optics are an improvement over currently used technologies by providing a more compact, lighter-weight, faster, and less complex system for correcting figure errors.
- (U) $3,035 Investigate and develop advanced high energy laser optical components.
  - (U) Initiated program to identify and develop techniques to perform in situ status and health evaluation of optical components installed in a high energy laser system. Such techniques are useful for predicting performance degradation and/or catastrophic failure of optical components in operational high energy laser systems.
  - (U) Identified potentially non-toxic coolants and bonding processes for use in cooled transmissive optical components such as aperture sharing elements and cooled windows for high energy laser systems. Active cooling of transmissive optics may be necessary to reduce optical distortion due to laser heating.
  - (U) Continued developing very low absorption, low-scatter optical thin film coatings by investigating new coating materials and coating process modifications. This work will result in reduced cooling requirements, less optical distortion, decreased size and weight, and increased efficiency of optical systems used in airborne and space platforms.
- (U) $1,256 Design, fabricate, and test a coude imaging spectrograph that will be used in conjunction with the adaptive optics system to obtain high spectral resolution. This is the only large format, high sensitivity camera for the Advanced Electro-Optical System on Maui, HI.
- (U) $19,316 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 3326

(U) FY 1997 ($ in Thousands):

- (U) $2,864 Develop generic, high energy laser technologies for applications such as illuminators for use in wavelength-specific military missions.
  - (U) Investigate performance parameters and scaling potential of atomic-iodine laser pumped by chemically produced, nitrogen chloride.
  - (U) Demonstrate lasing of 100 milliwatts at a wavelength of five micrometers from a diode laser.
- (U) $1,105 Develop basic laser source and target coupling technology for use in high-payoff applications such infrared countermeasures and creating laser-induced microwave effects.
  - (U) Complete experiment and analysis to assess the effectiveness of laser-induced microwave emissions in military applications; results will provide a database on a novel effect used for upsetting electronic systems.
- (U) $2,782 Develop long-range optical imaging technologies for increased resolution and data fusion to support missions such as space object identification and ground target identification from space.
  - (U) Conduct initial development of experiments on active and passive spectral technologies which increase performance and reduce cost of space-based optical sensors used for ground target identification.
  - (U) Develop advanced concepts for smart integrated sensor-processors to reduce data bandwidth requirements on space-based sensors.
  - (U) Develop advanced concepts for lightweight deployable large optics to permit long dwell optical surveillance from higher orbits.
- (U) $2,112 Investigate and develop nonlinear optics (NLO) technologies to support imaging and other applications.
  - (U) Continue to characterize automatic, all-optical techniques for producing pristine images from large, lightweight mirrors. Nonlinear optics are an improvement over currently used technologies by providing a more compact, lighter-weight, faster, and less complex system for correcting figure errors.
  - (U) Initiate an effort to produce a very efficient, mid-infrared source that uses a standard, near-infrared solid state laser and multiple nonlinear optical processes. NLO components provide a compact, light-weight, efficient, less complex system for countermeasures, imaging, sensing and communication systems.
  - (U) Begin studying NLO techniques for high bandwidth laser communications with automatic aimpoint maintenance and lightweight optics for space applications. These techniques have the potential to increase optical communication data rates, reduce system size, weight and complexity, and improve system efficiency.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 3326

- (U) $2,161 Investigate and develop advanced, high energy laser optical components.
  - (U) Complete development of techniques to evaluate optical components installed in an operational high energy laser system for transition to advanced technology development.
  - (U) Complete testing and accept delivery of a cooled, transmissive optical element which is environmentally safe, and relieves thermal overload in optical systems.
  - (U) Complete development of very low absorption, low-scatter optical, thin-film coatings. Transition technology to industry for scaling. This work will result in reduced cooling requirements, less optical distortion, decreased size and weight, and increased efficiency of optical systems used in airborne and space platforms.
- (U) $3,877 Develop laser radar for space surveillance and remote sensing applications.
  - (U) Demonstrate capabilities to collect range, range rate, and doppler images against unaugmented low-earth orbit satellite. The technology provides improved range resolution and system operation without illumination from the sun.
- (U) $3,652 Develop high power semiconductor lasers/arrays at alternate wavelengths for applications and uses such as forward looking infrared (FLIR) systems and IR missile warning sensor jamming, chemical agent detection, illuminators, efficient semiconductor laser array pumping modules and infrared countermeasures (IRCM).
  - (U) Demonstrate ten watts peak output power at quasi-continuous wave operation from a two micron semiconductor diode laser array module at room temperature. This demonstration will provide a baseline for high efficiency pump laser arrays used as a subcomponent in Band 4 optically-pumped semiconductor lasers.
  - (U) Demonstrate 200 milliwatts continuous laser output power at four microns wavelength from a single semiconductor diode. The collected data will be used to scale output power to levels required for next generation, high efficiency, compact Band 4 IRCM sources for small tactical aircraft self-protection not provided by bulkier optically-pumped semiconductor lasers.
- (U) $18,553 Total

(U) FY 1998 ($ in Thousands):

- (U) $932 Develop generic, high energy laser technologies for applications such as illuminators and use in wavelength-specific military missions.
  - (U) Apply FY 1997 experimental results to technology demonstration of a high energy, chemical nitrogen chloride iodine transfer laser. This laser has the potential to be significantly lighter weight than a comparable chemical oxygen-iodine laser.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 3326

– (U) $4,421 Develop long-range optical imaging technologies for increased resolution and data fusion to support missions such as space object identification.
- (U) Conduct initial development of experiments on active and passive spectral technologies which increase performance and reduce cost of space-based optical sensors used for ground target identification.
- (U) Evaluate on-board image processing concepts to decrease communication bandwidth requirements.
- (U) Establish lab test facility for large deployable optics technology and smart sensors.

– (U) $4,978 Develop basic laser source and target coupling technology for high-payoff applications such as infrared countermeasures (IRCM).
- (U) Begin investigating effects of laser illumination on materials relevant to degrade and damage IRCM applications.

– (U) $1,765 Investigate and develop nonlinear optics (NLO) technologies to support imaging and other applications.
- (U) Transition technology for automatic, all-optical compensation techniques for large lightweight mirrors with poor optical quality to imaging satellite systems development projects. Nonlinear optics are an improvement over currently used technologies by providing a more compact, lighter-weight, faster, and less complex system for correcting figure errors.
- (U) Demonstrate a tunable mid-infrared laser converter with better than 50% conversion efficiency from the near-infrared. This converter could potentially improve IRCM and sensing system efficiencies by a factor of two.
- (U) Begin investigating NLO techniques to decrease system complexity and increase speed of aimpoint imaging and tracking for countermeasure applications.
- (U) Continue to investigate NLO techniques to increase current laser communication bandwidths with automatic crosslink acquisition and tracking and lightweight optics. The use of NLO will provide a more lightweight, efficient communications system capable of handling more information.

– (U) $4,356 Develop high power semiconductor lasers/arrays at alternate wavelengths for applications and uses such as forward looking infrared (FLIR) systems and IR missile warning sensor jamming, chemical agent detection, illuminators, efficient semiconductor laser array pumping modules and infrared countermeasures (IRCM).
- (U) Demonstrate an incoherent 20 watt peak output power, continuous wave operation, two micron semiconductor diode laser array module at room temperature. This device will provide a compact, high power, efficient pump laser array used as a subcomponent in band 4 optically-pumped semiconductor lasers to increase their performance.
- (U) Demonstrate 750 milliwatts continuous laser output power at four microns wavelength from a single semiconductor diode. This demonstration will establish the feasibility of direct electrical-to-optical generation of mid-infrared wavelengths, enabling improved packing efficiency and reliability by a factor of two for small tactical aircraft self-protection.
- (U) Demonstrate two watts coherent peak output power at quasi-continuous wave operation from a single, band 1 semiconductor diode at room temperature. The collected data will demonstrate the necessary powers needed to jam band 1 infrared surface-to-air missiles.

– (U) $4,800 Develop coherent laser diode arrays for improved performance/higher power in applications requiring high power levels.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
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- (U) Demonstrate 100 watts continuous wave power from an array of phased diode lasers to establish the baseline technology for advanced laser defenses such as large aircraft self-protection.
- (U) Demonstrate and evaluate a 200 watt high power system with a one cubic foot laser head. This one cubic foot design will provide that basis for high performance aircraft and space asset self-protection system designs.

– (U) $21,252 Total

(U) FY 1999 ($ in Thousands):

– (U) $1,218 Develop generic, high energy laser technologies for applications such as illuminators and use in wavelength-specific military missions.
- (U) Investigate alternate lightweight, high energy density donor sources to power the atomic-iodine laser. Using sources which are lighter and provide more energy than hydrogen will decrease the weight of the chemical oxygen iodine laser.

– (U) $5,857 Develop long-range optical imaging technologies for increased resolution and data fusion to support missions such as space object identification and ground target identification from space.
- (U) Conduct initial development of experiments on active and passive spectral technologies which increase performance and reduce cost of space-based optical sensors used for ground target identification.
- (U) Evaluate on-board image processing concepts to decrease communication bandwidth requirements.
- (U) Establish lab test facility for large deployable optics technology and smart sensors.

– (U) $3,195 Develop basic laser source and target coupling technology for high-payoff applications such as infrared countermeasures (IRCM).
- (U) Continue investigating effects of laser illumination on materials relevant to degrade and damage IRCM applications.

– (U) $809 Investigate and develop nonlinear optics (NLO) technologies to support imaging and other applications.
- (U) Continue investigating NLO techniques to decrease system complexity and increase speed of aimpoint imaging and tracking for countermeasure applications.
- (U) Demonstrate high laser communication bandwidths with automatic crosslink acquisition and tracking and lightweight optics. The use of NLO will provide a more lightweight, efficient communications system capable of handling more information.
- (U) Evaluate performance of and study scaling issues associated with tunable-mid-infrared laser converters to maintain improved efficiency at higher powers.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
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- (U) $5,159 Develop high power semiconductor lasers/arrays at alternate wavelengths for applications and uses such as forward looking infrared (FLIR) systems and IR missile warning sensor jamming, chemical agent detection, illuminators, efficient semiconductor laser array pumping modules and infrared countermeasures (IRCM).
  - (U) Demonstrate 40 watts incoherent peak output power at quasi-continuous wave operation from a two micron semiconductor diode laser array module at room temperature. This demonstration will provide a baseline for high efficiency pump sources used as a subcomponent in portable, high brightness band 4 optically-pumped semiconductor lasers for FY 2000 field experiments.
  - Demonstrate two watts peak/one watt average output power at greater than four microns wavelength from a single semiconductor diode laser to establish the baseline for all semiconductor direct diode laser-based small tactical aircraft self-protection not provided by lower efficiency optically-pumped semiconductor lasers.
  - Demonstrate a less than three times diffraction limited beam at one watt peak output power from a single, band 1 semiconductor diode laser at room temperature. The collected data will demonstrate the necessary beam quality needed to directionally focus the power downrange and jam band 1 infrared surface-to-air missiles.
- (U) $4,478 Develop coherent laser diode arrays for improved performance/higher power in applications requiring high power levels.
  - (U) Demonstrate a factor of two increase (200 watts) in continuous wave power from an array of phased diode lasers to establish the baseline for using such devices in directed energy weapons systems.
  - (U) Continue to evaluate a 200 watt high power system with a one cubic foot laser head for high performance aircraft and space asset self-protection applications.
- (U) $20,716 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 3326

U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	19,316	19,244	21,919	22,406	Cont
(U) Current Budget Submit/FY 1998 PB	19,316	18,553	21,252	20,716	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602101N, Directed Energy Weapons.
- (U) PE 0602307A, Laser Weapon Technology.
- (U) PE 0603314A, High Energy Laser and Directed Energy Components.
- (U) PE 0603319F, Airborne Laser Demonstrator.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development** PROJECT **5797**

COST *($ In Thousands)*	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
5797 Advanced Weapons and Survivability Technology	16,705	16,039	15,403	15,950	17,059	17,632	17,959	18,510	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** High power microwave (HPM) and other unconventional weapon concepts using innovative technologies such as compact toroids are explored in this project. Technologies that support a wide range of Air Force missions such as space control, command and control warfare, and counter-air warfare are developed. This project provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets. In addition to directed energy weapon threats, this project conducts assessments of specific space environmental (natural and man-made) effects on space systems and develops hardening technologies and methodologies.

(U) FY 1996 ($ in Thousands):

- (U) $6,619 Develop generic advanced weapon technologies that support many Air Force applications.
  - (U) Developed advanced, pulse-power technologies that will power new, HPM source designs.
  - (U) Continued development of narrowband and ultra-wideband HPM sources and antennas for command and control warfare efforts.
  - (U) Developed high-performance computer codes to support plasma and pulsed power research.
  - (U) Investigated ability of HPM to neutralize biological weapons.
  - (U) Transitioned ultra-wideband antenna to PE 0603605F.
- (U) $2,895 Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.
  - (U) Developed computer modeling codes that predict HPM coupling into aircraft. Completed B-2 shielding survey.
  - (U) Developed technologies to harden military assets against HPM damage and effects.
  - (U) Continued characterization of HPM upset of various system's hardware, including command and control network equipment.
  - (U) Developed specifications, standards, and hardness maintenance technologies for systems such as the F-16, Hawk missile, and F-22.
  - (U) Completed counter-air effectiveness analyses of HPM weapons.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 5797

- (U) $3,399 Develop high power microwave (HPM) technologies that will support applications such as suppression of enemy air defenses, counter-air, command and control warfare, and aircraft self-protection.
  - (U) Completed HPM weapons concept exploration for command and control warfare.
  - (U) Continued theoretical analysis of predicted HPM weapons' effectiveness for suppression of enemy air defense and command and control warfare.
  - (U) Downselected wideband, HPM source which provides aircraft self-protection.
  - (U) Developed downselected narrowband source technology for application in suppression of enemy air defenses.
  - (U) Completed HPM weapons application analysis for use in counter-air applications.
- (U) $1,769 Develop HPM technologies, including susceptibility and effects experiments and modeling and data base development, to support space control applications.
  - (U) Completed effects experiments on two imaging components and two low noise amplifiers.
  - (U) Performed assessments of HPM technology with space control threat application.
  - (U) Initiated evaluation of basing modes for HPM threat technologies.
- (U) $2,023 Assess the vulnerability of various space assets to threats such as solar radiation, space debris, and directed energy weapons.
  - (U) Developed satellite lethality and assessment models for four assets.
  - (U) Provided advanced sensor design and assessments for a multi-spectral, multi-sensor data analysis workstation.
  - (U) Completed space payload assessment and environmental interaction experiments.
- (U) $16,705 Total

(U) FY 1997 ($ in Thousands):

- (U) $5,102 Develop generic advanced weapon technologies that support many Air Force applications.
  - (U) Continue to develop advanced pulse-power, microwave, and radio-frequency technologies for offensive and defensive weapon systems.
  - (U) Develop high-performance computer codes to support narrowband HPM source and pulsed power research.
  - (U) Develop first-generation, compact, high-voltage pulsed electrical power generator for microwave and radio frequency sources.
  - (U) Assess ability of pulsed power and HPM technology to neutralize biological weapons.
  - (U) Continue to develop narrowband and wideband sources and antennas.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 5797

- (U) $2,713 Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.
  - (U) Continue to develop computer modeling codes that predict high power microwave (HPM) coupling into advanced technology aircraft. Complete coupling experiments on small-aircraft simulator that can be transferred to aircraft such as the F-22.
  - (U) Develop protection technology for external HPM threat to advanced technology fighter aircraft.
  - (U) Complete command and control warfare effectiveness analyses on command and control facilities using postulated HPM threats.
  - (U) Transition specifications and standards and HPM hardness technologies to F-16 and F-22 program offices.
  - (U) Continue program of establishing thresholds of differing effects caused by differing microwave threats as applied to a wide variety of electronics subsystems.
  - (U) Develop HPM protection criteria for large aircraft, such as cargo-transport, air-refueling, and bomber aircraft.
- (U) $3,671 Develop HPM technologies that will support applications such as suppression of enemy air defenses, command and control warfare, and aircraft self-protection.
  - (U) Continue in situ experimentation with installed systems for command and control warfare using HPM.
  - (U) Begin in situ demonstrations of selected HPM sources that provide aircraft self-protection.
  - (U) Refine computer models of weapon effectiveness for all weapon applications.
  - (U) Perform experiment using downselected narrowband source for suppression of enemy air defenses.
- (U) $2,453 Develop HPM technologies, including susceptibility and effects experiments and modeling and data base development, to support space control applications.
  - (U) Execute susceptibility experiments and analysis of effects on two subsystems and two devices.
  - (U) Select and evaluate technologies that lead to selection of best concepts for basing of HPM technology.
  - (U) Develop requirements for source technology development in support of threat demonstration.
  - (U) Begin to develop experimental methodologies to measure effects of HPM on satellite systems.
- (U) $2,100 Assess the vulnerability of various space assets to threats such as solar radiation, space debris, and directed energy weapons.
  - (U) Develop directed energy weapon lethality and assessment models for five satellites.
  - (U) Continue satellite survivability/vulnerability/lethality assessments for ground-based laser technology.
  - (U) Transition advanced data fusion techniques to the multi-spectral, multi-sensor data analysis workstation.
- (U) $16,039 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 5797

(U) FY 1998 ($ in Thousands):

- (U) $6,055 Develop generic advanced weapon technologies that support many Air Force applications.
  - (U) Apply high performance, parallel, plasma physics computer codes to narrowband source and compact pulsed power design.
  - (U) Perform integrated experiments to assess coupling compact, high voltage electrical generators; gigawatt narrowband devices; and efficient antennas.
  - (U) Complete development of high power, first generation wideband source, including antenna.
  - (U) Complete the assessment of the ability of pulsed power and high power microwave (HPM) technology to neutralize biological weapons.
- (U) $1,985 Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.
  - (U) Continue to identify HPM protection requirements for large aircraft (cargo-transport and bombers) that would be carrying HPM devices.
  - (U) Continue to develop practical methods to protect existing and advanced technology aircraft from proposed/identified , external HPM threats.
  - (U) Continue to develop techniques and technology to evaluate HPM coupling and effects into hardened, command-post like structures with modern electronics.
  - (U) Continue to develop and validate techniques to evaluate HPM effects on families of electronics components found in difficult-to-obtain weapons/threats.
  - (U) Continue to develop and validate advanced computer models which provide predictions for HPM coupling and effects into a wide variety of structures (command posts) and weapons systems of moderate complexity.
- (U) $3,358 Develop HPM technologies that will support applications such as suppression of enemy air defenses, command and control warfare, and aircraft self-protection.
  - (U) Use new technology ultra-wideband (UWB) sources to perform effects experiments on structures with command and control electronics systems.
  - (U) Prepare and implement diagnostic procedures and instrumentation for a critical experiment to demonstrate UWB capability to defeat infrared seekers.
  - (U) Improve transition of computer modeling code and experimental data into operational (flyout) modeling codes to model HPM effects on postulated missile threats.
  - (U) Integrate previously down-selected narrow-band source with newly developed pulsed-power generator for suppression of enemy air defenses.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 5797

- (U) $2,012 Develop high power microwave (HPM) technologies, including susceptibility and effects experiments and modeling and data base development, to support space control applications.
  - (U) Transition effects analysis and experimentation from subsystem to systems, begin to demonstrate and quantify effects on systems.
  - (U) Thoroughly evaluate best basing mode for HPM technology demonstration.
  - (U) Begin source development to support threat demonstration.
- (U) $1,993 Assess the vulnerability of various space assets to threats such as solar radiation, space debris, and directed energy weapons.
  - (U) Continue to develop directed energy weapon lethality and assessment models for five satellites.
  - (U) Continue satellite survivability/vulnerability/lethality assessments for ground-based laser technology.
  - (U) Continue to transition advanced data fusion techniques to the multi-spectral, multi-sensor data analysis workstation.
- (U) $15,403 Total

(U) FY 1999 ($ in Thousands):

- (U) $6,196 Develop generic advanced weapon technologies that support many Air Force applications.
  - (U) Develop and test components for next-generation, compact, high voltage, high impedance, pulsed electrical power sources for microwave and radio frequency sources.
  - (U) Complete the transition of high performance plasma physics computer simulation codes to designers of microwave and pulsed power devices.
  - (U) Develop technology to increase the energy efficiency of multigiwatt narrowband sources.
  - (U) Develop technologies for next-generation wideband sources and antennas.
- (U) $2,087 Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.
  - (U) Finalize development of computer modeling codes that predict HPM coupling into advanced technology aircraft.
  - (U) Finalize development of fratricide protection technology for advanced technology fighter aircraft.
  - (U) Begin integrating specifications and standards and HPM hardness technologies to F-16 and F-22 program offices.
  - (U) Continue directed energy weapon lethality/survivability enhancements and characterization of equipment upset of various foreign and U.S. systems.
  - (U) Transfer HPM protection technology for large aircraft, such as cargo-transport, air-refueling, and bomber aircraft.

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– (U) $3,494	Develop high power microwave (HPM) technologies that will support applications such as suppression of enemy air defenses, command and control warfare, and aircraft self-protection. – (U) Finalize in situ experimentation with installed systems for command and control warfare using HPM. – (U) Continue in situ demonstrations of selected HPM sources that provide aircraft self-protection. – (U) Continue to hone computer models of weapon effectiveness for all weapon applications. – (U) Demonstrate technology with experiment using downselected narrowband source for suppression of enemy air defenses.
– (U) $2,096	Develop HPM technologies, including susceptibility and effects experiments and modeling and data base development, to support space control applications. – (U) Execute lab-level critical experiments to directly support future threat demonstration. – (U) Continue source technology development to support threat demonstration. – (U) Continue susceptibility experiments on subsystems to support threat demonstration.
– (U) $2,077	Assess the vulnerability of various space assets to threats such as solar radiation, space debris, and directed energy weapons. – (U) Select directed energy weapon lethality and assessment models for five satellites. – (U) Continue survivability/vulnerability/lethality assessments for ground-based laser technology. – (U) Continue to transition advanced data fusion techniques to the multi-spectral, multi-sensor data analysis workstation.
– (U) $15,950	Total

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BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**
	PROJECT **5797**

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	16,705	16,608	16,871	17,516	Cont
(U) Current Budget Submit/FY 1998 PB	16,705	16,039	15,403	15,950	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602120A, Electronic Survivability and Fuzing Technology.
- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602601F Phillips Laboratory Exploratory Development

PROJECT: 8809

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
8809 Space and Missile Technology	30,567	53,513	28,469	31,263	37,663	42,928	44,589	45,822	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project focuses on five major space and missile technology areas: spacecraft platform technologies (e.g., structures, controls, power, and thermal management); space-based payload technologies (e.g., sensors, satellite communications, and survivable electronics); satellite control technologies (e.g., spacecraft software); ballistic missile/launch vehicle specific technologies (e.g., astrodynamics and guidance, navigation, and control avionics); and integrated experiments of advanced technologies for transition to planned systems (e.g., payload/platform/launch vehicle merging).

(U) FY 1996 ($ in Thousands):

- (U) $6,224 Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact solar power cells, lightweight batteries, and improved power generation concepts.
  - (U) Fabricated and tested solar cell flex array deployment and solar to electric energy conversion efficiency.
  - (U) Fabricated and evaluated solid state primary battery for space and missile launch vehicles.
  - (U) Characterized and evaluated lightweight thermal bus components for future space vehicle thermal management subsystems.
- (U) $5,745 Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression and lightweight composite satellite and launch vehicle structures.
  - (U) Initiated advanced 'mechanisms' technology development program to replace current generation pin pullers, tie down bolts, etc.
  - (U) Completed non-pyrotechnic release device technology development.
  - (U) Completed preliminary design for the launch vibration isolation program.
  - (U) Completed multi-functional structures technology program.
- (U) $5,745 Develop technologies for space-based payload subsystems such as hardened sensors and satellite communications.
  - (U) Continued improvements to long-wavelength mercury cadmium telluride detectors under low background radiation conditions.
  - (U) Developed optimized low-noise, high-performance quantum well infrared photodetectors in the mid-, long-, and very long-wavelength spectral regions.
  - (U) Designed radio frequency communication modems, modem controllers, and associated high-speed network components.
  - (U) Continued development of integrated space-based surveillance models that address background clutter, target cross section, and propagation losses. Developed algorithms to improve the accuracy of space-based observation systems using existing resources.
  - (U) Evaluated component technologies for large aperture space-based surveillance antennas.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 8809

- (U $4,045 Develop technologies for space-based payload components such as hardened electronics and computer memories.
  - (U) Designed and evaluated advanced packaging technology whose goal is the reduction of size/volume/weight by a factor of ten.
  - (U) Fabricated standard space-based surveillance signal processing module.
- (U) $2,995 Develop technologies for satellite control such as standardized, reusable software for astrodynamics, and command and control.
  - (U) Designed and developed common satellite control software.
  - (U) Developed astrodynamics parallel processing code for propagation and differentiation correction program.
  - (U) Constructed algorithms for integrated space technology product development.
- (U) $4,999 Develop ground and small satellite integration technologies for space and near-space experiments.
  - (U) Fabricated MightySat-I satellite, assembled four of five experiments, and assembled Ultra High Frequency (UHF) ground control stations.
  - (U) Completed initial design of the MightySat-II.1 satellite that will demonstrate hyperspectral imaging technologies, electric propulsion technologies, and several concepts for advanced structures.
- (U) $814 Develop technologies supporting launch vehicles and ballistic missile such as guidance, navigation, and control avionics.
  - (U) Designed solid state micro-mechanical guidance instruments for future Air Force ballistic missile environments.
  - (U) Fabricated next generation thrust axis accelerometer which could provide low life cycle cost Minuteman III guidance upgrade.
- (U) $30,567 Total

(U) FY 1997 ($ in Thousands):

- (U) $5,710 Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact solar power cells, lightweight batteries, and innovative power generation concepts.
  - (U) Complete solar cell flex array technology development effort.
  - (U) Complete solid state primary battery for space and missile launch vehicle applications.
  - (U) Develop ten degrees Kelvin cryocoolers for evaluation and characterization.
- (U) $5,273 Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression and lightweight composite satellite and launch vehicle structures.
  - (U) Continue the advanced adaptive structures technology development program.
  - (U) Conduct proof-of-concept experiments for the launch vehicle vibration isolation program.
  - (U) Initiate the advanced launch vehicle structures technology development program.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 8809

– (U) $5,082	Develop technologies for space-based payload subsystems such as hardened sensors and satellite communications. – (U) Continue improvement of long-wavelength mercury cadmium telluride detectors and optimize for large focal plane arrays. – (U) Develop larger format, quantum well, infrared photodetector focal plane arrays. – (U) Evaluate and characterize radio frequency communications modem, modem controllers and network components. – (U) Integrate space-based surveillance models into wargaming simulations for immediate performance feedback. – (U) Integrate and test space-based surveillance antenna component technologies to support system level design concepts.
– (U) $3,737	Develop technologies for space-based payload components such as hardened electronics and memories. – (U) Evaluate and fabricate advanced packaging technology whose goal is a ten times size/volume/weight reduction. – (U) Evaluate a standard space-based surveillance signal processing module.
– (U) $3,679	Develop technologies for satellite control such as standardized, reusable software for astrodynamics. – (U) Develop satellite control software for applications such as multi-mission advanced ground intelligent control. – (U) Assemble next generation gravitational astrodynamics model, permitting non-maintainable orbits analysis. – (U) Write software routines for integrated space technology product development.
– (U) $18,770	Develop ground and small satellite integration technologies for space and near-space experiments. – (U) Complete MightySat-I spacecraft and experiments assembly. Integrate experiments with spacecraft. Technologies to be evaluated include: Increased power solar cells, lightweight composite structure, shape memory release device, microparticle impact detector, electronics miniaturization techniques. Perform environmental test and checkout. Integrate MightySat-I on Shuttle Hitchhiker Ejection System. – (U) Assemble and integrate exploratory ground, hardware-in-the-loop, and small satellite technologies, and techniques to validate overall concept. – (U) Design and fabricate the baseline MightySat Phase II vehicle. Tailor vehicle to meet requirements of first flight which is demonstrating nine distinct experiments. These include a hyperspectral imager, pulsed plasma thrusters, multi-functional structures, and miniaturized electronics. – (U) Develop near-space capabilities for experiments requiring high altitudes, long durations, and guided recovery systems.
– (U) $1,831	Develop technologies such as guidance, navigation, and control avionics to support launch vehicles and ballistic missile flights. – (U) Fabricate solid state micro-mechanical guidance instruments for future ballistic missile environments. – (U) Evaluate and test next generation thrust axis accelerometer. – (U) Develop improved techniques to determine accurate gravity field values--major source of error in space inertial navigation systems.
– (U) $9,431	Develop Rocket System Launch Program launch capability using excess ballistic missile assets to test low-cost pop-up upperstage systems.
– (U) $53,513	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 8809

(U) FY 1998 ($ in Thousands):

–(U) $5,594 Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact solar power cells, lightweight batteries, and innovative power generation concepts.
- (U) Begin thin film solar cell development
- (U) Complete development and integration testing of solid state primary battery for space and missile launch vehicle applications.
- (U) Evaluate and characterize ten to thirty degrees Kelvin cryocoolers.

– (U) $4,158 Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression and lightweight composite satellite and launch vehicle structures.
- (U) Complete the advanced adaptive structures technology development program.
- (U) Complete proof-of-concept experiments for the launch vehicle vibration isolation program and initiate avionics isolation program.
- (U) Continue the advanced launch vehicle structures technology development program.

– (U) $3,059 Develop technologies for space-based payload subsystems such as hardened sensors and satellite communications.
- (U) Continue improvement of long-wavelength mercury cadmium telluride detectors and optimize for large focal plane arrays.
- (U) Complete development of large format, quantum well, infrared photodetector focal plane arrays and evaluate.
- (U) Integrate space-based surveillance models into wargaming simulations for immediate performance feedback.

– (U) $3,955 Develop technologies for space-based payload components such as hardened electronics and memories.
- (U) Continue evaluation and fabrication of advanced packaging technology whose goal is a ten times size/volume/weight reduction.
- (U) Complete radiation hardened electronic materials investigation.
- (U) Deliver interconnect and die advancement technologies.

– (U) $3,080 Develop technologies for satellite control such as standardized, reusable software for astrodynamics and autonomous operations.
- (U) Continue development of satellite control software for applications such as multi-mission advanced ground intelligent control.
- (U) Examine the use of wide area surveillance and distributed network for observation collection and processing.
- (U) Continue writing software routines for integrated space technology product development.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 8809

- (U) $7,152 Develop ground and small satellite integration technologies for space and near-space experiments.
  - (U) Launch MightySat-I from Space Shuttle mission STS-88. Conduct flight operations. One-year on-orbit will validate space applied research technologies minimizing the risk of inserting advanced technology into operational satellites.
  - (U) Begin development of technologies manifested for MightySat II.2 which tentatively include autonomous navigation and control, autonomous decision-making, threat-warning component technologies, and a fly wheel-storage device.
  - (U) Conclude fabrication of MightySat II.1 spacecraft bus and begin integration of experiments for FY 2000 launch.
  - (U) Demonstrate the capability to perform precision wavefront control of large aperture, sparse optical arrays via a fully integrated UltraLITE ground experiments.
  - (U) Continue the development of near-space capabilities and bus technologies for experiments requiring high altitudes, long durations, and guided recovery systems.
- (U) $1,471 Develop technologies such as guidance, navigation, and control avionics to support launch vehicles and ballistic missile flights.
  - (U) Complete improved techniques to determine accurate gravity field values, a major source of error in space inertial navigation systems.
- (U) $28,469 Total

(U) FY 1999 ($ in Thousands):

- (U) $6,429 Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact solar power cells, lightweight batteries, and innovative power generation concepts.
  - (U) Continue thin film solar cell development.
  - (U) Complete solid state secondary (rechargeable) battery cell design for space and missile launch vehicle applications.
  - (U) Begin development of advanced deployable radiator.
- (U) $5,476 Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression and lightweight composite satellite and launch vehicle structures.
  - (U) Conduct proof-of-concept experiments for the launch vehicle avionics isolation program.
  - (U) Continue the advanced launch vehicle structures technology development program.
  - (U) Continue feasibility demonstrations of autonomous active structural controls to dynamic precision spacecraft structures.
  - (U) Initiate the advanced multi-functional electronics and electrical systems structures technology development program.
- (U) $2,404 Develop technologies for space-based payload subsystems such as hardened sensors and satellite communications.
  - (U) Continue improvement of long-wavelength mercury cadmium telluride detectors and optimize for large focal plane arrays.
  - (U) Begin development of optical links, ultraviolet sensor and large format quantum well arrays.
  - (U) Continue developing very low absorption, low-scatter optical, thin-film coatings. Transfer technology to industry for scaling.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 8809

- (U) $3,948 Develop technologies for space-based payload components such as hardened electronics and memories.
  - (U) Continue evaluation and fabrication of advanced packaging technology whose goal is a ten times size/volume/weight reduction.
  - (U) Transition interconnect and die advancement technologies to PE 0603401F, Advanced Spacecraft Technology.
  - (U) Begin advanced device insulation technology development.
- (U) $3,489 Develop technologies for satellite control such as standardized, reusable software for astrodynamics and autonomous operations.
  - (U) Continue development of satellite control software for applications such as multi-mission advanced ground intelligent control.
  - (U) Demonstrate the use of wide area surveillance and distributed network for observation collection and processing.
  - (U) Combine software routines for integrated space technology product development into wargaming exercises.
- (U) $9,517 Develop ground and small satellite integration technologies for space and near-space experiments.
  - (U) Conclude MightySat-I flight operations. Develop and distribute final report.
  - (U) Complete payload integration and launch vehicle integration of MightySat II.1 to launch aboard Multi-Service Launch System in FY 2000.
  - (U) Begin initial design of modifications to baseline MightySat II vehicle to accommodate experiments on autonomous navigation and control, autonomous decision-making, threat-warning component technologies, and a fly wheel-storage device.
  - (U) Begin the concept phase of the second integrated ground demonstration program.
  - (U) Continue the development of near-space capabilities and bus technologies for experiments requiring high altitudes, long durations, and guided recovery systems.
- (U) $31,263 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development PROJECT 8809

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	30,566	35,675	38,040	42,536	Cont
(U) Current Budget Submit/FY 1998 PB	30,567	53,513	28,469	31,263	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0602102F, Materials.
- (U) PE 0603302F, Space and Missile Rocket Propulsion.
- (U) PE 0603311F, Ballistic Missile Technology.
- (U) PE 0603401F, Advanced Spacecraft Technology.
- (U) PE 0603410F, Space Systems Environmental Interactions.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602602F Conventional Munitions

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	42,886	41,038	40,772	42,999	44,384	47,217	47,979	49,368	Continuing	Continuing
2068 Advanced Guidance Technology	16,832	14,385	15,025	17,265	16,584	17,694	17,977	18,501	Continuing	Continuing
2502 Ordnance Technology	26,054	26,653	25,747	25,734	27,800	29,523	30,002	30,867	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, Project 2543 has been combined with Project 2502. The total PE costs shown for FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This Applied Research program develops and establishes the feasibility of advanced technologies for air-to-air and air-to-surface conventional weapons to support non-nuclear Air Force missions. The program includes development and demonstration of: (1) advanced guidance component technology for low-cost precision adverse-weather autonomous seekers; (2) advanced navigation/control technologies for advanced air-to-ground munitions and highly agile air-to-air missiles; (3) fuze technology to reduce cost and increase supportability, safety, and performance; (4) affordable explosives for higher performance and lower sensitivity; (5) advanced analytical tools for calculating weapons effects to reduce development time and cost; (6) advanced weapon airframe and carriage technology for advanced air-to-ground munitions and highly agile air-to-air missiles; (7) advanced warhead development technologies and advanced kill mechanisms for target defeat; and (8) advanced analytical methods for predicting advanced weapons effectiveness. Note: Program for applied research of conventional weapons technology has been restructured to meet warfighter needs. Development of instrumentation technology for FY 1998 and out planned in this project has been zeroed.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	43,276	42,573	46,244	47,625	Cont
(U) Appropriated Value	44,954	42,573			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-897	-986			
b. SBIR	-529	-509			
c. Omnibus/Other Above Threshold Reprogrammings	-642	-40			
(U) Current Budget Submit/FY 1998 PB	42,886	41,038	40,772	42,999	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602602F Conventional Munitions		PROJECT: 2068

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2068 Advanced Guidance Technology	16,832	14,385	15,025	17,265	16,584	17,694	17,977	18,501	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops precision terminal guidance technologies for air-launched conventional weapons and technologies for midcourse guidance for advanced munitions. Project payoffs include: adverse-weather and "launch and leave" precision guidance capability; increased number of kills per sortie; increased aircraft survivability; improved reliability and affordability; reduced test costs; shorter development programs; and improved survivability and effectiveness of conventional air-to-air and air-to-surface weapons. Development of instrumentation technology for FY 1998 and out planned in this project has been zeroed.

(U) FY 1996 ($ in Thousands):

- (U) $8,918 Develop and demonstrate guidance component technology for low-cost precision adverse-weather, autonomous seekers.
  - (U) Flight-tested an optical correlator with a laser radar to investigate target identification in a severe clutter environment.
  - (U) Conducted in-house experiments on an adverse-weather, wide field-of-view, high resolution, passive, millimeter wave sensor for use in future covert seekers.
  - (U) Completed design of an electronic processor using image algebra for use in future missile systems.
  - (U) Completed the conformal antenna design for an air superiority missile to enable the design of a smaller diameter missile.
- (U) $4,810 Develop and demonstrate advanced navigation/control technologies for weapon airframes.
  - (U) Conducted initial design of a smaller, lighter, less expensive Global Position System/Inertial Navigation System that provides an improvement in accuracy over current technology to achieve an affordable future weapon designs.
  - (U) Completed design for an improved tactical-grade inertial measurement unit to investigate micro machined inertial sensor technology.
  - (U) Fabricated an inertial sensor utilizing silicon chip micro machining technology to allow for small and inexpensive inertial measurement units without sacrificing performance.
- (U) $3,104 Develop and demonstrate instrumentation for weapon guidance development and test.
  - (U) Conducted telemetry signal processing experiments to enhance transmission range and provide weapon in-flight time-space-position information.
  - (U) Completed telemetry instrumentation development system to provide expert system programming capability to weapons development and test community users of subminiature telemetry.
- (U) $16,832 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602602F Conventional Munitions — PROJECT: 2068

(U) FY 1997 ($ in Thousands):

- (U) $8,326 Develop and demonstrate guidance component technology for low-cost precision adverse-weather, autonomous seekers.
  - (U) Complete filter development for laser radar (LADAR) sensors; continue development of optical correlator technologies (i.e., high-speed, high resolution, multiple state-capable correlator hardware).
  - (U) Continue experiments on an adverse-weather, wide field-of-view, high resolution, passive, millimeter wave sensor for use in future covert seekers.
  - (U) Complete fabrication and integration of conformal array seeker breadboard for an air superiority missile that provides an instantaneously addressable wide field-of-regard.
  - (U) Complete construction of multichannel LADAR breadboard; utilize completed breadboard to continue technology base development to enhance capability of solid state LADAR (i.e., increase operating range, assess rapid scanning techniques, develop multichannel receiver capability, and develop longer wavelength technology).
  - (U) Continue development of technologies to support advanced imaging longwave infrared (IR) sensors; develop requirements for multicolor large format focal planes and polarization sensitive detectors.
  - (U) Complete construction of breadboard scene projector for solid state LADAR seekers.
  - (U) Develop sensor models for an autonomous LADAR guidance system in preparation for a multi-sensor laser/millimeter wave seeker system.
  - (U) Develop LADAR algorithms for high value targets in clutter and countermeasure environments.
- (U) $4,432 Develop and demonstrate advanced navigation/control technologies for advanced air-to-ground munitions and highly agile air-to-air missiles.
  - (U) Complete breadboard assembly and laboratory testing, and initiate preliminary design for an advanced jam resistant Global Position System/Inertial Navigational System that is 40 percent of the size and cost of FY 1995 technology.
  - (U) Complete fabrication of micro-machined inertial sensor and begin fabrication of a breadboard inertial measurement unit.
- (U) $1,627 Develop and demonstrate instrumentation for weapons guidance development and evaluation.
  - (U) Develop new subminiature telemetry chip-set functions and new packaging concepts for high-G usage.
  - (U) Develop and demonstrate spectrally efficient modulation and coding methods for telemetering wideband test data.
- (U) $14,385 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions
	PROJECT 2068

(U) FY 1998 ($ in Thousands):

- (U) $9,321 Develop and demonstrate guidance component technology for low-cost precision adverse-weather, autonomous seekers.
  - (U) Continue development of optical correlator technologies (i.e., high-speed, high resolution, multiple state-capable correlator hardware); provide filters to support optical processing enhanced laser radar experiments.
  - (U) Conduct phenomenology analysis of high resolution, passive, millimeter wave target background imagery for use in future adverse weather wide field of view covert seekers.
  - (U) Demonstrate/ground test a conformal antenna design for an air superiority missile that provides an instantaneously addressable wide field-of-regard.
  - (U) Develop and test laser radar (LADAR) techniques for penetrating adverse-weather; develop a flight-worthy LADAR modular brassboard; use multi-channel LADAR breadboard to assess component technologies and increased frame rate, assess longer wavelength utility and assess multi-channel receiver technology.
  - (U) Develop specifications for affordable, passive, electro-optical/infrared seekers sensitive to longwave infrared, multi-color, and polarization phenomena to provide improved autonomous terminal seekers.
  - (U) Develop requirements for advanced scene projector for solid state LADAR seekers.
  - (U) Develop sensor models for active infrared (IR) and passive millimeter wave (MMW) autonomous guidance.
  - (U) Validate LADAR algorithms for high value targets in a clutter and countermeasure environment.
  - (U) Complete validation of a four-channel pixel-registered active/passive IR/MMW synthetic scene generation code against range measured data.
- (U) $5,704 Develop and demonstrate advanced navigation/control technologies for advanced air-to-ground munitions and highly agile air-to-air missiles.
  - (U) Develop flight control software and simulations for a highly maneuverable air combat missile incorporating hybrid reaction jet/aerodynamic flight controls.
  - (U) Complete brassboard design and initiate fabrication and integration for an advanced Global Positioning System/Inertial Navigation System that is 40 percent of the size and cost of FY 1995 technology.
  - (U) Complete development, fabrication, and testing of the inertial measurement unit system breadboard and incorporate refinements into the brassboard design.
- (U) $15,025 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions
	PROJECT 2068

(U) FY 1999 ($ in Thousands):

- (U) $9,918 Develop and demonstrate guidance component technology for low-cost precision adverse-weather, autonomous seekers.
  - (U) Complete filter development for the optical processing enhanced laser radar (LADAR) experiments; develop processing hardware technology for advanced sensors; and, develop accompanying advanced filter concepts to include ultra high-speed processors for miniature electro-optical and radio frequency imaging sensors.
  - (U) Design for fabrication and assembly of a passive millimeter wave (MMW), captive flight test worthy imaging sensor.
  - (U) Conduct experiments, evaluate, and refine conformal antenna seeker breadboard for an air superiority missile that provides an instantaneously addressable wide field-of-regard.
  - (U) Utilize flight-worthy brassboard to assess LADAR; demonstrate long-range (>3Km) and adverse-weather penetration; utilize multi-wavelengths for discrimination; and demonstrate frequency agile LADAR.
  - (U) Design and fabricate an infrared spectral seeker.
  - (U) Fabricate advanced scene projector to support future LADAR seeker.
  - (U) Develop sensor fusion algorithms for active and passive MMW seeker for autonomous guidance.
  - (U) Develop solid state LADAR algorithms for air-to-air autonomous acquisition and tracking.
  - (U) Develop and evaluate an active/passive infrared air-to-air target/scene modeling capability for the design of autonomous target acquisition algorithms.
- (U) $7,347 Develop and demonstrate advanced navigation/control technologies for advanced air-to-ground munitions and highly agile air-to-air missiles.
  - (U) Develop a hardware-in-the-loop simulation environment and implement advanced highly maneuverable missile guidance and autopilot methodologies.
  - (U) Complete brassboard testing for an advanced Global Positioning System/Inertial Navigation System that is highly jam resistant, affordable, and readily useable in future tactical weapons.
  - (U) Complete development, fabrication, and testing of the inertial measurement unit system brassboard, and deliver and support two functioning inertial measurement units.
- (U) $17,265 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions
	PROJECT 2068

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	16,832	14,901	16,186	16,669	Cont
(U) Current Budget Submit/FY 1998 PB	16,832	14,385	15,025	17,265	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603601F, Conventional Weapons Technology.
- (U) PE 0604314F, Advanced Medium Range Air-to-Air Missile.
- (U) PE 0604940D, Central Test and Evaluation Improvement Program.
- (U) PE 0604604F, Submunitions Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602602F Conventional Munitions

PROJECT: 2502

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2502 Ordnance Technology	26,054	26,653	25,747	25,734	27,800	29,523	30,002	30,867	Continuing	Continuing

Note: Beginning in FY 1998, Project 2543 has been combined with Project 2502. The total PE costs shown for FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This project develops technologies for advanced weapon dispensers, submunitions, safe and arm devices, fuzes, explosives, and warheads for air-to-surface and air-to-air conventional weapons, and weapon airframe and carriage technology. The payoffs include: improved storage capability and transportation safety of fully assembled weapons; improved non-nuclear warhead and fuze effectiveness; improved submunition dispensing; selectable multimode kill capability; low-cost airframe/subsystem components and structures; and reduced aircraft/weapons drag and radar signature. Assesses the lethality and effectiveness of current and planned air-to-surface and air-to-air conventional weapons technology programs, and assesses the vulnerability of targets against which conventional weapons are designed. Project payoffs include more thoroughly tested weapon systems. Development of instrumentation technology for FY 1998 and out planned in this project has been zeroed.

(U) FY 1996 ($ in Thousands):

- (U) $4,021 Develop fuze technology to reduce cost and increase supportability, safety, and performance.
  - (U) Designed and initiated fabrication of ground penetrating radar fuze components for interrogation of target prior to penetration to improve weapon burst point selection and increased weapon effectiveness.
  - (U) Conducted trade studies to determine feasibility of fuze systems for a dual-role missile capable of defeating air-to-air and air-to-surface targets which will provide ordnance packages for improving effectiveness for defeating air targets and selected ground targets.
- (U) $396 Develop and demonstrate affordable explosives for higher performance and lower sensitivity.
  - (U) Installed explosive demilitarization equipment for technology evaluation and demonstration to provide low-cost, environmentally compatible methods for disposal, conversion, or recycling of explosives.
  - (U) Conducted sensitivity experiments of advanced penetrator explosive formulations to provide insensitive explosive fills which survive penetration while increasing blast performance.
- (U) $2,463 Develop and demonstrate advanced analytical tools for calculating weapons effects to reduce development time and cost.
  - (U) Completed study to verify optimum nose shape for penetrating weapons to increase penetration capability.
  - (U) Verified detonation shock dynamics methodology for tracking an explosive detonation as it propagates through weapon payload.
  - (U) Verified target/warhead interaction simulation to provide improved understanding of weapon kill mechanisms.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602602F Conventional Munitions — PROJECT: 2502

- (U) $476 Develop aeroballistic analysis tools to enhance and reduce the cost/schedule of weapons testing/certification.
  - (U) Developed and installed a high resolution, solid state, digital camera system to record flight data for the Aeroballistic Research Facility to maintain high experimentation rates while greatly decreasing cost.
  - (U) Studied applications of advanced flow field visualization instrumentation for collection of quantitative density information around a projectile in free flight to greatly enhance design process of new munitions.
- (U) $2,256 Develop advanced weapon airframe and carriage technology.
  - (U) Studied designs of affordable methods of external weapon carriage for future fighter aircraft.
  - (U) Investigated designs of compressed weapons to reduce the size of stores to improve weapon payload capability on aircraft.
- (U) $9,164 Develop and demonstrate advanced warhead development technologies and advanced kill mechanisms for materiel target defeat.
  - (U) Characterized candidate high strength penetrator warhead materials which will provide greater penetration capability/warhead survivability.
  - (U) Tested penetrator explosive mechanical survivability for identifying properties for enhancing future penetrator effectiveness.
  - (U) Conducted theoretical investigations into new warhead technology involving magnetically formed warheads which will provide additional kill methods for enhancing weapons effectiveness.
  - (U) Conducted design trades for improving fragmentation of warheads by combining explosives with advanced initiator techniques.
- (U) $1,466 Develop and demonstrate instrumentation for weapon test and evaluation.
  - (U) Integrated high-speed electronic imaging components and validate through laboratory tests.
  - (U) Developed techniques for holographic data reduction to provide improved warhead hydrocode test data.
- (U) $3,269 Develop and extend modular effectiveness vulnerability assessment code (MEVA) to increase accuracy of weapon effectiveness predictions against fixed hardened targets.
  - (U) Conducted MEVA code configuration management activities to ensure software changes are authorized, validated, documented, and distributed to user community; weapons of mass destruction software module completed.
  - (U) Analyzed embedded detonation data base and updated existing blast damage algorithms for detonation in burster slabs/thick walls.
  - (U) Conducted component vulnerability experiments, develop first set of fragility algorithms for integration into MEVA code, and conduct code validation experiments.
  - (U) Integrated modified source, transport, and diffusion codes to build a systems-level network for assessing weapon effectiveness against weapons of mass destruction storage, production, and logistic facilities and to predict potential for collateral damage.
- (U) $1,709 Develop and demonstrate analytical methods of predicting weapon effectiveness and the coupling of destructive energy into the target.
  - (U) Integrated high velocity penetration/advanced munitions case technology algorithms into systems-level weapon assessment codes.
  - (U) Developed weapon assessment methodologies to significantly reduce requirements for expensive lethality/vulnerability data collection experiments.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions
	PROJECT 2502

- (U) $834 Develop and demonstrate advanced weapons simulation capability.
  - (U) Adapted and extend existing analytical tools to enable efficient, one-time development of complex munition simulations.
  - (U) Developed a modular munition simulation taxonomy for interconnecting munition subsystem models.
  - (U) Developed munition-specific models to allow component trades for anti-jam Global Positioning System technologies.
  - (U) Conducted technology trade studies for antimateriel submunitions.
- (U) $26,054 Total

(U) FY 1997 ($ in Thousands):

- (U) $3,437 Develop and demonstrate fuze technology to reduce cost and increase supportability, safety, and performance.
  - (U) Fabricate and evaluate a proximity sensor for general purpose bomb fuzes; investigate implementations of high/low drag sensing methods.
  - (U) Conduct preliminary design studies of a hard target penetrating radar fuze to optimize burst point selection.
  - (U) Complete trade studies on an integrated ordnance package capable of defeating future air targets and surface-to-air missiles.
- (U) $3,083 Develop and demonstrate affordable explosives for higher performance and lower sensitivity.
  - (U) Conduct initial explosive experiments to provide low-cost technologies for demilitarization of weapon explosives.
  - (U) Continue sensitivity experiments of insensitive explosive fills which survive hard target penetration while increasing blast performance.
- (U) $1,423 Develop and demonstrate advanced analytical tools for calculating weapons effects to reduce development time and cost.
  - (U) Validate explosive shock wave interaction simulation for developing advanced multimode warheads.
  - (U) Initiate incorporation of unstructured grid methods into penetrator weapon design tools.
  - (U) Initiate development of next generation weapon design methods for hard target warheads incorporating heavy metals.
- (U) $4,015 Develop and demonstrate advanced weapon airframe and carriage technology for advanced air-to-ground munitions and highly agile air-to-air missiles.
  - (U) Develop flight control software and simulations for a highly maneuverable air combat missile incorporating hybrid reaction jet/aerodynamic flight controls.
  - (U) Continue development of initial system integration/design of a rapid response weapon for effectively engaging time-critical targets.
  - (U) Complete fabrication of selected fin folding and deployment mechanisms for compressed carriage.
  - (U) Continue installation of high resolution solid state, digital shadow-graph system to allow for quick and less expensive data collection, processing, and analysis to reduce time to evaluate projectile configurations.
- (U) $6,753 Develop and demonstrate advanced warhead development technologies and advanced kill mechanisms for target defeat.
  - (U) Complete experiments for coupling electrical energy into targets using antimateriel warhead.
  - (U) Perform subscale tests of advanced penetrator warhead materials for high velocity penetration.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions
	PROJECT 2502

– (U) $2,201	Develop and demonstrate munitions data acquisition technology. – (U) Complete weapons effects holography program; transition technology to munition development facilities. – (U) Fabricate and test brassboard automated holographic data reduction system to provide improved warhead hydrocode test data. – (U) Integrate and laboratory test high-speed, high resolution electronic imager.
– (U) $2,163	Develop and extend modular effectiveness vulnerability assessment code (MEVA) to increase accuracy of weapon effectiveness predictions against fixed hardened targets. – (U) Continue MEVA code configuration management activities to ensure software changes are authorized, validated, documented, and distributed to user community; weapons combined effects software module completed. – (U) Continue component vulnerability experiments, develop first set of fragility algorithms for integration in MEVA code, and complete code validation experiments. – (U) Develop algorithms and new functional modules for integration into MEVA to accurately predict the effectiveness of advanced munitions technology concepts. – (U) Complete development/integration of systems level lethality/vulnerability assessment methodologies into MEVA for buried/hardened targets, above ground structures, tunnels, linear targets, and weapons of mass destruction.
– (U) $2,163	Develop and demonstrate analytical methods of predicting weapon effectiveness and the coupling of destructive energy into the target, and the means to translate that information into advanced analytical methods for predicting weapon effectiveness. – (U) Complete development of weapon assessment methodologies that significantly reduce requirements for expensive lethality/vulnerability data collection experiments. – (U) Conduct initial phenomenology and weapon effects experiments to provide data for code deficiencies with respect to advanced munition concepts. – (U) Conduct experiments and analyses to investigate phenomena such as synergistic effects from blast and fragments, simultaneous detonations, and penetration dynamics through rock, rubble, and geological material of various hardness.
– (U) $665	Develop and demonstrate advanced weapons analytical methodologies. – (U) Validate antimateriel submunition analyses versus actual warhead arena and flight test data. – (U) Enhance and develop codes for hard target penetration and weapons of mass destruction munition technologies. – (U) Develop joint compatible models to allow evaluation of synthetic aperture radar seeker technology and infrared seeker technology in support of munition tools to make evaluation of munition performance with new technology a much faster, cheaper, and more effective process.
– (U) $750	Develop and demonstrate advanced munitions seeker analyses capability. – (U) Continue to validate four-channel pixel-registered active/passive infrared/millimeter wave (IR/MMW) synthetic scene generation code against measured data. – (U) Complete development of six-channel pixel-registered active/passive IR/MMW, visible, ultraviolet synthetic scene generation code.
– (U) $26,653	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions
	PROJECT 2502

(U) FY 1998 ($ in Thousands):

- (U) $4,933 Develop and demonstrate fuze technology to reduce cost and increase supportability, safety, and performance.
  - (U) Complete simulation of multi-point initiation systems which provide increased weapon flexibility and effectiveness.
  - (U) Complete fabrication of hard target penetrating radar fuze brassboard and continue analysis and test of hard target fuzes/components.
  - (U) Complete ground target clutter generator mod for target simulator.
  - (U) Complete design and proof-of-concept testing of target detection and imaging device for dual range air-to-air missile.
  - (U) Complete fabrication and testing of advanced monolithic microwave integrated circuit sensors.
- (U) $2,115 Develop and demonstrate affordable explosives for higher performance and lower sensitivity.
  - (U) Perform reclamation experiments on inventory explosives to determine best methods for recovering/disposing of explosives.
  - (U) Complete full-scale testing of candidate advanced penetrator explosive formulations which provide enhanced blast and fragmentation.
  - (U) Assess performance and sensitivity of composite explosives which use CL-20 as the primary energetic ingredient.
- (U) $2,559 Develop and demonstrate advanced analytical tools for calculating weapons effects to reduce development time and cost.
  - (U) Complete development of warhead/target interaction models for hard target penetrating weapons.
  - (U) Complete parallelization and supercomputer rehosting of design code for penetrating weapons.
- (U) $3,386 Develop and demonstrate advanced weapon airframe and carriage technology for advanced air-to-ground munitions and highly agile air-to-air missiles.
  - (U) Demonstrate through wind tunnel and radar cross section testing the ability to carry large loadouts of innovative compressed weapons in a low drag and survivable manner on advanced aircraft.
  - (U) Refine the initial design of a rapid response weapon for effectively engaging time-critical targets; develop design guidelines for applying the most promising technologies in future time critical target weapons.
- (U) $5,188 Develop and demonstrate advanced warhead development technologies and advanced kill mechanisms for target defeat.
  - (U) Validate detonation shock dynamics code capability against highly instrumented range experiments.
  - (U) Assess tantalum materials for application to multimode warheads.
  - (U) Complete explosive survivability modeling and testing.
  - (U) Evaluate performance of thermite systems for enhanced lethality.
  - (U) Characterize advanced casing and high explosive materials for structural survivability and enhanced target defeat.
  - (U) Perform technology and system trade studies on very high-speed penetrators.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions
	PROJECT 2502

- (U) $3,165 Develop and extend modular effectiveness vulnerability assessment code (MEVA) to increase accuracy of weapon effectiveness predictions against fixed hardened targets.
  - (U) Incorporate tunnel vulnerability module into MEVA architecture; conduct configuration management of MEVA to ensure software changes are authorized, validated, documented, and distributed to user community.
  - (U) Conduct component vulnerability experiments on target power generation and distribution equipment and develop corresponding fragility algorithms for enhanced energetic lethal mechanisms and synergistic damage effects.
  - (U) Integrate advanced munitions fragmentation algorithms into beta test versions of the MEVA lethality assessment methodology.
  - (U) Conduct development and validation activities to upgrade and support systems level lethality/vulnerability assessment methodologies to accommodate advanced kill mechanisms and improved survivability design features in new or existing targets.
- (U) $3,155 Develop and characterize the coupling of destructive energy into the target, and the means to translate that information into advanced analytical methods for predicting weapon effectiveness.
  - (U) Investigate means to reduce experimental requirements by coupling advanced physics-based modeling techniques with advanced computing architectures such as distributed and parallel processing.
  - (U) Conduct phenomenology and weapon effects experiments to provide data for code deficiencies with respect to heavy metal munitions.
  - (U) Develop lethality algorithms to accurately simulate blast and fragmentation and simultaneous detonation damage effects of heavy metal munitions.
- (U) $1,246 Develop and demonstrate advanced weapons analytical methodologies.
  - (U) Develop signal processing/jammer model simulations for the anti-jam Global Positioning System technology, and perform analyses for development and risk reduction on flight tests.
  - (U) Upgrade low-cost autonomous attack submunition six-degree-of-freedom simulations to perform assessments for the anti-materiel muniton integrating concept including preflight and postflight test risk reduction; conduct trade study to enable technology development planning.
  - (U) Provide six-degree-of-freedom missile simulation and subsystem component simulations for technology development, integration, and assessment of dual-range air-to-air missile concepts.
  - (U) Provide concept selection trade studies for smart soft target munition integrating concept, and develop detailed six-degree-of-freedom simulations to reduce risk for tests of the boosted hard target penetrator; evaluate component technology options for small smart bomb to identify optimum system concepts.
- (U) $25,747 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions
	PROJECT 2502

(U) FY 1999 ($ in Thousands):

- (U) $4,111 Develop and demonstrate fuze technology to reduce cost and increase supportability, safety, and performance.
  - (U) Develop advanced single and multi-point initiation systems which will provide increased weapon flexibility and effectiveness.
  - (U) Conduct analysis and testing of hard target ground penetrating radar fuzes/components.
  - (U) Complete design of a digitally driven radio frequency (RF) signal generator for proximity fuze applications.
  - (U) Complete fabrication and testing of advanced millimeter wave integrated circuit RF proximity sensors.
- (U) $2,796 Develop and demonstrate affordable explosives for higher performance and lower sensitivity.
  - (U) Conduct synthesis and performance evaluation of explosive fills with high density materials which enhance warhead penetration while maintaining weapon lethality.
  - (U) Conduct synthesis and performance evaluation of CL-20 based high explosive for enhancing blast and fragmentation of penetrator/general purpose warheads.
  - (U) Conduct subscale performance tests of nonconventional warhead payloads which offer potential for significant increases in explosive energy densities.
- (U) $2,487 Develop and demonstrate advanced analytical tools for calculating weapons effects to reduce development time and cost.
  - (U) Conduct modeling of heavy metals for increasing lethality of antimateriel and penetrator warheads.
  - (U) Complete modeling of penetrator warhead case fracture processes which enhance understanding of warhead survivability.
  - (U) Develop high strain case fragmentation models to determine best multimode techniques for developing fragmenting warhead cases.
- (U) $2,241 Develop and demonstrate advanced weapon airframe and carriage technology for advanced air-to-ground munitions and highly agile air-to-air missiles.
  - (U) Complete designs of innovative compressed wing designs for advanced small munitions to extend the range of weapons without sacrificing weapon loadout on aircraft.
  - (U) Generate detailed designs of time-critical target demonstration vehicle that can effectively engage time-critical targets; prepare test plans.
- (U) $6,586 Develop and demonstrate advanced warhead development technologies and advanced kill mechanisms for target defeat.
  - (U) Perform tests of antimateriel warhead design with insensitive explosives which do not degrade lethality.
  - (U) Develop tantalum liner materials for inclusion in antimateriel submunition warhead technology integrated design package.
  - (U) Complete testing of mechanically induced combustion of energetic materials used in penetrating weapons.
  - (U) Evaluate thermite energy storage systems.
  - (U) Conduct advanced casing and high explosive materials testing for structural survivability and enhanced target defeat.
  - (U) Complete initial technology and system trade studies and develop two programs to demonstrate enabling very high-speed penetrator technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions
	PROJECT 2502

- (U) $3,154 Develop and extend modular effectiveness vulnerability assessment code (MEVA) to increase accuracy of weapon effectiveness predictions against fixed hardened targets.
  - (U) Incorporate chemical/biological agent release module into MEVA architecture; conduct configuration management of MEVA to ensure software changes are authorized, validated, documented, and distributed to user community.
  - (U) Develop new computational modules and integrate into the MEVA architecture to accurately predict the effectiveness of advanced weapon concepts against targets containing chemical and/or biological materiel.
  - (U) Conduct component vulnerability experiments on weaponized munitions and storage vessels containing chemical/biological agents and develop corresponding fragility algorithms for the release of toxic material due to conventional damage mechanisms (blast and fragmentation).
- (U) $3,144 Develop and characterize the coupling of destructive energy into the target, and the means to translate that information into advanced analytical methods for predicting weapon effectiveness.
  - (U) Complete phenomenology and weapon effects experiments to provide code validation data for heavy metal munition lethality algorithms.
  - (U) Conduct phenomenology and weapon effects experiments to provide data for code deficiencies with respect to hypersonic weapon penetration mechanics.
  - (U) Develop physics-based modeling techniques with high speed distributed and parallel processing computer architectures to reduce new weapon research and development experimental requirements.
- (U) $1,215 Develop and demonstrate advanced weapons analytical methodologies.
  - (U) Provide post-flight test analysis for the anti-jam Global Positioning System (GPS) technology, and refine anti-jam detailed six-degree-of-freedom to include system improvements like Differential GPS, additional jammer threats, and GPS constellation/operational changes.
  - (U) Conduct pre-flight analysis for the anti-materiel munition integrating concept control flight tests and F-16 free flight tests; provide performance estimates for powered low-cost anti-armor submunition enabling test planning and technology transition analyses.
  - (U) Conduct seeker and fuze subsystem component assessments for dual range air-to-air missile integrating concept.
  - (U) Accomplish detailed effectiveness analyses for technology selection/refinement based on new six-degree-of-freedom flyout and lethality data for boosted penetrator technology.
  - (U) Develop agent defeat effectiveness methodology.
- (U) $25,734 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602602F Conventional Munitions — PROJECT: 2502

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	26,444	27,672	30,058	30,956	Cont
(U) Current Budget Submit/ FY 1998 PB	26,054	26,653	25,747	25,734	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603601F, Conventional Weapons Technology.
- (U) PE 0604314F, Advanced Medium Range Air-to-Air Missile.
- (U) PE 0604602F, Armament Ordnance Development.
- (U) PE 0604604F, Submunitions Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602702F Command,Control, and Communication (C3)

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	92,244	93,215	86,067	84,537	87,505	100,722	101,071	104,278	Continuing	Continuing
2338 Reliability Sciences Technology	10,751	10,537	8,619	5,697	5,341	12,248	12,384	12,882	Continuing	Continuing
4506 Surveillance Technology	16,065	16,308	15,562	15,349	15,605	16,529	16,830	17,391	Continuing	Continuing
4519 Communications Technology	11,886	12,300	11,550	10,964	10,886	12,514	12,009	12,360	Continuing	Continuing
4594 Information Technology	12,281	13,409	13,092	13,133	13,777	14,455	14,795	15,278	Continuing	Continuing
4600 Electromagnetic Technology	24,521	24,361	21,064	22,272	23,816	26,201	25,794	26,528	Continuing	Continuing
5581 Command and Control (C2) Technology	16,740	16,300	16,180	17,122	18,080	18,775	19,259	19,839	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification: This Applied Research program is the primary source of new concepts, feasibility demonstrations, and advanced technology for Air Force C3. Current developments include: increasing operational availability of C3 systems through improving reliability, diagnostic capability, and electromagnetic environmental performance; improving effectiveness and survivability through secure communications; improving surveillance range and detection capabilities against low-observable threats and enemy electronic countermeasures; and improving the timeliness and quality of data acquisition for decision making. The program addresses six technology areas: reliability sciences; surveillance; communications; information; electromagnetics; and command and control. Note: FY 1997 increase provides additional support costs which will be incurred as the laboratory assumes its stand-alone posture as directed by the 1993 Base Closure and Realignment Commission. Also, additional emphasis has been placed on C3 technology user-identified deficiencies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	93,056	96,615	98,847	99,115	Cont
(U) Appropriated Value	96,477	96,615			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-1,957	-2,227			
b. SBIR	-1,094	-1,082			
c. Omnibus/Other Above Threshold Reprogrammings	-1,182	-91			
d. Below Threshold Reprogrammings					
(U) Current Budget Submit/FY 1998 PB	92,244	93,215	86,067	84,537	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)	PROJECT 2338

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2338 Reliability Sciences Technology	10,751	10,537	8,619	5,697	5,341	12,248	12,384	12,882	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** The Air Force requires technology which increases reliability and diagnostic capability for electronic devices and systems while assessing electromagnetic environmental performance. Payoffs are increased system availability and lower life cycle costs. This effort focuses on technology to identify and eliminate design and fabrication characteristics that result in poor reliability. It develops equipment and system reliability and diagnostic techniques to be applied in development of military systems with improved operational readiness and supportability. Areas of emphasis include electronic technology reliability assessment, diagnostic development and integration, design for reliability, and system design and operational assurance.

(U) FY 1996 ($ in Thousands):

- (U) $3,588 Developed electronic reliability techniques to evaluate new devices/systems in an operational environment and recommend corrective action.
  - (U) Developed prediction, modeling, analysis, and tracking techniques to assess the reliability of electronic devices and systems operating in severe electrical, thermal, and dynamic environments throughout all phases of the system life cycle.
  - (U) Assessed the effects of metal oxide semiconductor degradation in deep sub-micron main operating system transistors to improve the reliability of ultra-large scale integrated circuits.
- (U) $3,558 Developed diagnostics technologies and integrated them into existing tools and techniques to address high-priority user requirements.
  - (U) Developed, evaluated, and demonstrated non-destructive injection and fault sampling techniques for digital systems.
  - (U) Developed test automation and internal diagnostic techniques for microcircuit devices that are tested algorithmically.
  - (U) Developed electromagnetic simulation, analysis, and measurement tools to predict susceptibility thresholds and radio frequency performance in operational environments.
- (U) $3,605 Developed reliability system design process enhancements to create tools, techniques, and guidelines to improve C3 devices.
  - (U) Improved design techniques for solid state monolithic microwave integrated circuit high-power amplifiers to meet high-power, low-cost, reliable, and energy efficient system requirements.
  - (U) Developed techniques for building reliability into the design of ultra-high density memory devices by evaluating the effects of decisions made early in the design process on reliability.
- (U) $10,751 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 2338

(U) FY 1997 ($ in Thousands):

- (U) $3,448 Develop electronic reliability techniques to evaluate new devices in an operational environment and recommend corrective action.
  - (U) Assess the quality, reliability, and electromagnetic effects performance of advanced electronic packaging concepts.
  - (U) Define performance of advanced microelectronics devices and measure their potential for system applications.
  - (U) Assess electromagnetic performance and reliability of microwave/millimeter-wave and optoelectronic devices for future systems.
- (U) $3,385 Develop diagnostics technologies and integrate them into existing tools and techniques to address high-priority user requirements.
  - (U) Develop design techniques that integrate computer-aided design with insertion of established built-in test modules.
  - (U) Develop electromagnetic analysis and measurement tools to predict susceptibility thresholds and radio frequency performance in operational environments.
- (U) $3,704 Develop reliability system design process enhancements to create tools, techniques, and guidelines to improve C3 devices.
  - (U) Improve systems reliability by characterizing the electrical, electromagnetic, and mechanical stress-inducing parameters of the aerospace operational environment.
  - (U) Develop computer-based reliability and maintainability tools and techniques for design of electronic circuits, devices, and systems.
- (U) $10,537 Total

(U) FY 1998 ($ in Thousands):

- (U) $2,834 Develop electronic reliability techniques to evaluate new devices in an operational environment and recommend corrective action.
  - (U) Develop a benchmark reliability and performance database on electronic devices in diverse environments for use in reliability prediction computer aided design tools and techniques.
  - (U) Demonstrate the performance of advanced microelectronics devices and their applicability for military systems.
  - (U) Evaluate electromagnetic performance and reliability of microwave/millimeter-wave and optoelectronic devices for future systems.
- (U) $2,720 Develop diagnostics technologies and integrate them into existing tools and techniques to address high-priority user requirements.
  - (U) Conduct detailed designs for techniques that integrate computer-aided design with insertion of established built-in test modules.
  - (U) Demonstrate electromagnetic analysis and measurement tools to predict susceptibility thresholds and radio frequency performance in operational environments.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 2338

- (U) $3,065 Develop reliability system design process enhancements to create tools, techniques, and guidelines to improve C3 devices.
  - (U) Develop integrated and miniaturized multiparameter environmental smart sensors, utilizing micro-electro-mechanical systems technology, which can be applied to military systems such as unmanned aerial vehicles to help support information operations requirements, logistics requirements and system health monitoring requirements.
  - (U) Demonstrate computer-based reliability and maintainability tools and techniques for design of electronic circuits, devices, and systems.
- (U) $8,619 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,863 Develop electronic reliability techniques to evaluate new devices in an operational environment and recommend corrective action.
  - (U) Validate the benchmark reliability and performance database concept for electronic devices in diverse environments for use in reliability prediction computer-aided design (CAD) tools and techniques
  - (U) Investigate the applicability of a virtual reality environment to improve system reliability and maintainability, and decrease life cycle costs.
  - (U) Demonstrate electromagnetic performance and reliability of microwave/millimeter-wave and optoelectronic devices for advanced systems.
- (U) $1,759 Develop diagnostics technologies and integrate them into existing tools and techniques to address high-priority user requirements.
  - (U) Demonstrate techniques that integrate computer-aided design with insertion of established built-in test modules
  - (U) Develop fault tolerant electronic systems where diagnostics are performed during the operational mission.
- (U) $2,075 Develop reliability system design process enhancements to create tools, techniques, and guidelines to improve C3 devices.
  - (U) Conduct preliminary designs of integrated and miniaturized multiparameter environmental smart sensors, utilizing micro-electro-mechanical systems technology, which can be applied to military systems such as unmanned aerial vehicles to help support information operations requirements, logistics requirements,and system health monitoring requirements.
  - (U) Develop CAD tools and integrated computational frameworks for the reliable design of military unique technologies and leading edge technologies.
- (U) $5,697 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 2338

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	10,751	11,221	11,527	12,064	Cont
(U) Current Budget Submit/FY 1998 PB	10,751	10,537	8,619	5,697	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603617F, C3 Applications.
- (U) PE 0603726F, C3 Subsystems Integration.
- (U) PE 0603728F, Advanced Computer Technology.
- (U) PE 0603789F, C3 Advanced Development.
- (U) PE 0604609F, Reliability and Maintainability Technology Insertion Program.
- (U) PE 0708026F, Producibility, Reliability, Availability, and Maintainability.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602702F Command,Control, and Communication (C3)** PROJECT **4506**

COST *($ In Thousands)*	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4506 Surveillance Technology	16,065	16,308	15,562	15,349	15,605	16,529	16,830	17,391	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: The Air Force requires advanced surveillance technologies to improve the performance and reduce the cost of Air Force surveillance systems. Major Applied Research areas of interest include: low-observable surveillance; passive surveillance; and advanced processing technologies. Technologies being developed include: advanced passive bistatic radar; spatial coordinate and time processing techniques; sensor and data fusion; signal generation; and advanced array antennas.

(U) FY 1996 ($ in Thousands):

- (U) $5,734 Developed, tested, and demonstrated processing technologies and algorithms to enhance small target detection in a complex electromagnetic background.
  - (U) Completed Phase 1 fabrication of multi-chip module wafer scale signal processor with a capability to perform five billion operations per second.
  - (U) Completed real-time, airborne spatial coordinate and time processing experiments using an embedded parallel processing computer.
  - (U) Demonstrated applicability of expert system constant false alarm rate technology in an operational airborne radar system.
  - (U) Analyzed and evaluated space-time processing algorithms using the multichannel airborne radar measurements test bed.
- (U) $5,090 Developed technologies and concepts for passive surveillance with emphasis on electronic support measures and bistatics for enhanced detection, track, and classification in severe clutter and jamming environments.
  - (U) Performed studies in support of the advanced airborne radar and bistatic fusion processing technology demonstrations, leading to a preliminary system design for the real-time, airborne, bistatic capability demonstration.
  - (U) Developed advanced airborne bistatic radar software; completed integration of 64-channel antenna/receiver into the static wing testbed; provided baseline test data for transition to the bistatic test integration experiment and the advanced airborne radar technology demonstration.
  - (U) Completed assessment of combining non-cooperative bistatic synthetic aperture radar techniques with electronic support measures and advanced parallel processing computer technology for high confident target identification. Integrated fusion algorithms into airborne sensor processor to provide enhanced detection capability.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4506

- (U) $4,241 Developed, tested, and demonstrated advanced multispectral/multisensor fusion techniques for enhanced target detection and tracking.
  - (U) Exploited fusion and artificial intelligence (AI) technologies to develop an "AI fusion black box" for enhanced target detection and tracking.
  - (U) Developed and demonstrated algorithms for a sensor level AI approach to multispectral, multisensor fusion.
- (U) $1,000 Designed, developed, and tested ultrahigh fidelity microwave electronics for radar applications.
  - (U) Developed and demonstrated wideband pre-selector technology for bistatic radar systems.
  - (U) Developed optically-based increased dynamic range radar array emulation hardware for test and evaluation of microwave components.
- (U) $16,065 Total

(U) FY 1997 ($ in Thousands):

- (U) $7,520 Develop, test, and demonstrate processing technologies and algorithms to enhance small target detection in a complex electromagnetic background.
  - (U) Develop knowledge-based adaptive processing for bistatic ground-to-air radar applications.
  - (U) Complete Phase 2 of the multi-chip module wafer scale signal processor with a capability to perform twenty billion operations per second.
  - (U) Evaluate embedded parallel processing architecture for integrating wafer scale signal processor chips for a real-time signal processor enhancement demonstration.
- (U) $4,928 Develop technologies and concepts for passive surveillance with emphasis on electronic support measures and bistatics for enhanced detection, track, and classification in severe clutter and jamming environments.
  - (U) Conduct a design evaluation of the advanced airborne radar technology demonstration.
  - (U) Complete data collection, hardware integration, and software development for the static wing testbed; conduct ground-based field test.
  - (U) Conduct extensive field tests and demonstrations using integrated electronic support measures and bistatic passive surveillance and imaging technology on board a small aircraft; enhance integrated passive surveillance and imaging technology capabilities through an airborne demonstration with a very broad frequency bandwidth controlled phase array.
- (U) $2,860 Develop, test, and demonstrate advanced multispectral/multisensor fusion techniques for enhanced target detection and tracking.
  - (U) Develop special purpose artificial intelligence machines for both "expert" and 'blackboard" systems.
  - (U) Develop and demonstrate graphical user interface software and platform-based displays; analyze, test, and demonstrate integrated knowledge-based fusion concepts.

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	PROJECT 4506

- (U) $1,000 Design, develop, and test ultrahigh fidelity microwave electronics for radar applications.
  - (U) Demonstrate optically-based increased dynamic range radar array emulation hardware for test and evaluation of microwave components.
  - (U) Develop high fidelity power conditioning system for active radar apertures.
  - (U) Incorporate digital preprocessing in the development of transmit and receive module technology for ground-to-air radar.
- (U) $16,308 Total

(U) FY 1998 ($ in Thousands):

- (U) $6,514 Develop, test, and demonstrate processing technologies and algorithms to enhance small target detection in a complex electromagnetic background.
  - (U) Demonstrate operational algorithm suites on embedded high performance computers.
  - (U) Evaluate and assess aircraft interaction algorithms for spatial coordinate and time adaptive processing.
  - (U) Continue development of multi-chip module wafer scale signal processor with a capability to perform twenty billion operations per second.
- (U) $4,923 Develop technologies and concepts for passive surveillance with emphasis on electronic support measures and bistatics for enhanced detection, track, and classification in severe clutter and jamming environments.
  - (U) Conduct initial advanced airborne surveillance program demonstration tests.
  - (U) Complete ground based field tests using the static wing testbed. Analyze effects of aircraft interactions on antenna sidelobe performance. Determine 64-channel receiver data degrees-of-freedom figure-of-merit baseline. Initiate transition of ground testbed to airborne bistatic testbed environment.
  - (U) Continue integrated electronic support measures and bistatic passive surveillance and imaging technology testing on board a small aircraft using a very broad frequency bandwidth phased array antenna. Initiate technology transition to unmanned aerial vehicle applications.
- (U) $3,243 Develop, test, and demonstrate advanced multispectral/multisensor fusion techniques for enhanced target detection and tracking.
  - (U) Demonstrate and assess special purpose artificial intelligence machines for both "expert" and "blackboard" systems.
  - (U) Continue development and demonstration of advanced graphical user interface software and platform based displays; analyze, test, and demonstrate integrated knowledge-based fusion concepts.
- (U) $882 Design, develop, and test ultrahigh fidelity microwave electronics for radar applications.
  - (U) Complete development of optically-based increased dynamic range radar array emulation hardware for test and evaluation of microwave components.
- (U) $15,562 Total

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	PROJECT 4506

(U) FY 1999 ($ in Thousands):

- (U) $6,070 Develop, test, and demonstrate processing technologies and algorithms to enhance small target detection in a complex electromagnetic background.
  - (U) Demonstrate power efficient signal processing accelerator utilizing high bandwidth fiber optic interconnects.
  - (U) Demonstrate multi-chip module wafer scale signal processor.
  - (U) Develop spatial coordinate and time adaptive processing parallelization techniques for large scale high performance computer applications.
- (U) $4,279 Develop technologies and concepts for passive surveillance with emphasis on electronic support measures and bistatics for enhanced detection, track, and classification in severe clutter and jamming environments.
  - (U) Develop enhanced target detection capabilities through innovative bistatic waveform designs.
  - (U) Complete the advanced airborne surveillance program demonstration tests.
  - (U) Transition ground testbed results to airborne bistatic testbed environment.
  - (U) Complete integrated electronic support measures and bistatic passive surveillance and imaging technology testing and transition technology to unmanned aerial vehicle applications.
- (U) $5,000 Develop, test, and demonstrate advanced multispectral/multisensor fusion techniques for enhanced target detection and tracking.
  - (U) Complete development and demonstration of advanced graphical user interface software and platform based displays; transition integrated knowledge-based fusion concepts to multi-platform applications.
  - (U) Develop real-time sensor resource management and multispectral fusion techniques.
- (U) $15,349 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4506

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	16,737	17,382	17,529	17,627	Cont
(U) Current Budget Submit/FY 1998 PB	16,065	16,308	15,562	15,349	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603726F, C3 Subsystems Integration.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602702F Command,Control, and Communication (C3)

PROJECT: 4519

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4519 Communications Technology	11,886	12,300	11,550	10,964	10,886	12,514	12,009	12,360	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** The Air Force requires technologies which will provide worldwide communications. The rapid application of air power via assured connectivity for timely, reliable, responsive, affordable transfer of information using all available communications media is essential to support rapid build-up of U.S. presence abroad. This program provides the technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques, such as spread spectrum and adaptive null steering; lightweight antennas and phased array antennas; and modular, programmable, low-cost radios and C3 across the electromagnetic and optical spectrums. It includes technologies for advanced processors and devices, advanced network protocols, artificial intelligent communications management and control, advanced algorithms, and enabling processing techniques.

(U) FY 1996 ($ in Thousands):

- (U) $3,518 Developed critical communications technologies employing programmable devices, processing technologies, and monolithic microwave integrated circuits to provide survivable radios and transceivers.
  - (U) Demonstrated commercially compatible switching concepts for ultra-high frequency (UHF) communications to aircraft and other systems; demonstrated applicability of commercial high capacity (45-155 megabits per second) trunk radio technology/equipment for military use.
  - (U) Developed modifications of state-of-the-art data compression techniques to emphasis their utility in a UHF communications environment.
  - (U) Upgraded the wideband communications extension and remoting capability for multimedia integrated services demonstration.
  - (U) Assessed supporting operations involving remote local area networks, voice, and slow scan/compressed video within the wideband communications for distributed computing environments.
- (U) $6,031 Developed technologies for improved security, survivability, timeliness, and reconstruction of communications networks.
  - (U) Assessed secure, survivable communications networking, multiple accessing, and radio networking to enhance implementation planning.
  - (U) Analyzed evolving components within the asynchronous switching infrastructure to support a distributed information system.
  - (U) Designed and implemented a peer-to-peer management interface for intelligent, survivable network management.

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- (U) $2,337 Developed advanced electronic and photonic processors, advanced network protocols, advanced algorithms, and processing technologies essential for survivable communications.
  - (U) Developed communications and control technologies applicable to of smart radios, including the use of spatial processing and adaptive antenna, parallel processors, field programmable gate arrays, and other high performance digital signal processors and devices.
  - (U) Demonstrated new "smart" adaptive communications signal processing techniques and wave forms.
- (U) $11,886 Total

(U) FY 1997 ($ in Thousands):

- (U) $3,826 Develop critical communications technologies employing programmable devices, processing technologies, and monolithic microwave integrated circuits to provide survivable radios and transceivers.
  - (U) Develop and demonstrate on-demand multiple access, packet switching, imagery compression, and reachback technologies.
  - (U) Design reduced weight, low-cost minimum-drag antenna solutions for airborne vehicle communications systems.
  - (U) Develop improved nulling algorithms, monolithic microwave integrated circuits, and packaging technologies for advanced ultra-high frequency and super-high frequency communications.
  - (U) Develop a joint high capacity trunk radio for tactical mobile and fixed nodes.
  - (U) Investigate joint military use of personal communications systems.
- (U) $5,996 Develop technologies for improved security, survivability, timeliness, and reconstruction of communications networks.
  - (U) Demonstrate selected multiple access and asynchronous switching protocols for theater applications.
  - (U) Conduct initial demonstration of standards-based, interactive, secure user services which optimally employ the underlying commercially compatible communications network.
  - (U) Demonstrate intelligent, survivable network management that provides secure, system-wide optimization of resource usage.
- (U) $2,478 Develop advanced electronic and photonic processors, advanced network protocol, advanced algorithms, and enabling processing technologies essential for survivable communications.
  - (U) Develop specifications for the next generation smart networking radio, incorporating proven smart adaptive signal processing multiple access and networking technologies.
  - (U) Develop and demonstrate potentially high payoff communications signal processing technologies applicable to future smart radio systems.
- (U) $12,300 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4519

(U) FY 1998 ($ in Thousands):

- (U) $3,450 Develop critical communications technologies employing programmable devices, processing technologies, and monolithic microwave integrated circuits to provide survivable radios and transceivers.
  - (U) Develop high frequency and super-high frequency on-board packet switching, advanced communications protocols, imagery and video transmission, and reachback technologies.
  - (U) Develop reduced weight, low-cost, minimum-drag subsystems for air vehicle communications systems.
  - (U) Design and breadboard improved nulling algorithms, monolithic microwave integrated circuits, and crosslink and packaging technology for satellite and unmanned aerial vehicle platforms.
  - (U) Demonstrate fixed high capacity trunk radio with Army.
  - (U) Specify required improvements to personal communications systems for military use.
- (U) $5,854 Develop technologies for improved security, survivability, timeliness, and reconstruction of communications networks.
  - (U) Develop intelligent interface or bridge between mobile wireless networks and wired/fiber network.
  - (U) Complete demonstration tests of standards-based, interactive, secure user services which optimally employ the underlying commercially compatible communications network.
  - (U) Demonstrate cooperation between network management entities to optimize information flow throughout the overall information system including a dynamic applications interface and user responsive security mechanisms.
  - (U) Demonstrate intelligent, survivable network management that provides secure, system-wide optimization of resource usage.
- (U) $2,246 Develop advanced electronic and photonic processors, advanced network protocol, advanced algorithms, and enabling processing technologies essential for survivable communications.
  - (U) Design, test and evaluate smart networking radio subsystems.
  - (U) Develop and demonstrate new adaptive communications signal processing and control technologies.
- (U) $11,550 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4519

(U) FY 1999 ($ in Thousands):

- (U) $3,289 Develop critical communications technologies employing programmable devices, processing technologies, and monolithic microwave integrated circuits to provide survivable radios and transceivers.
  - (U) Continue development of ultra-high frequency and super-high frequency on-board packet switching, advanced communications protocols, imagery and video transmission, and reachback technologies.
  - (U) Demonstrate reduced weight, low-cost, minimum-drag subsystems for air vehicle communications systems.
  - (U) Demonstrate highly efficient nullling algorithms, monolithic microwave integrated circuits, and crosslink and packaging technologies for advanced spacecraft antennas.
  - (U) Conduct joint demonstration of high capacity trunk radio.
  - (U) Evaluate 94 Gigahertz (GHz) and 120 GHz solid-state power amplifier, frequency synthesizer, and related component technologies to exploit extremely-high frequency resources.
- (U) $5,475 Develop technologies for improved security, survivability, timeliness, and reconstruction of communications networks.
  - (U) Demonstrate early intelligent interface capabilities between mobile wireless network and wired/fiber network.
  - (U) Augment cooperative network management system to include artificial intelligence based control mechanisms.
  - (U) Demonstrate intelligent, survivable network management that provides secure, system-wide optimization of resource usage.
- (U) $2,200 Develop advanced electronic and photonic processors, advanced network protocol, advanced algorithms, and enabling processing technologies essential for survivable communications.
  - (U) Demonstrate initial smart networking radio and subsystems.
  - (U) Transition smart networking radio and associated technologies to advanced development.
- (U) $10,964 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4519

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	11,886	13,100	13,470	13,373	Cont
(U) Current Budget Submit/FY 1998 PB	11,886	12,300	11,550	10,964	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603726F, C3 Subsystems Integration.
- (U) PE 0603728F, Advanced Computer Technology.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602702F Command,Control, and Communication (C3)

PROJECT: 4594

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4594 Information Technology	12,281	13,409	13,092	13,133	13,777	14,455	14,795	15,278	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** The Air Force requires technologies which improve and automate capabilities to process, manage, generate, fuse, exploit, interpret, and disseminate timely information. This project: improves recording, storage, and retrieval of high data-rate, large volume data; pursues speech processing technologies for signal exploitation, information deception, and exploiting unintentional emissions; develops technology for correlation and fusion of multisource data; develops natural language capabilities that can read text and extract data of interest; develops tools and techniques to build and manage a scaleable client server environment; provides advanced processing techniques for receipt, correlation analysis, and display of target reports from advanced sensors; supports advanced weapon systems through the exploration of multispectral, multisource imagery; and provides advanced techniques for mapping, charting, and geodesy data processing.

(U) FY 1996 ($ in Thousands):

- (U) $7,953 Developed processing technologies responsive to operational deficiencies by improving information timeliness, reliability, and accessibility.
  - (U) Developed three-dimensional (3-D) holographic read-only-memory optical disk for information storage and retrieval to provide higher capacity, faster throughput, and decreased access time for today's systems to provide timely imagery/information. Incorporated error correction and detection algorithms and developed first generation erasable 3-D materials.
  - (U) Developed processing techniques to analyze background sound to determine aircraft status and configuration.
  - (U) Developed techniques to support the release of beyond-visual-range weapons against high confidence air targets.
  - (U) Developed and assessed preliminary model abstraction and advanced data display techniques to exploit electronic imagery/information.
- (U) $2,090 Developed advanced information data handling techniques to automatically extract event data and update databases for prediction purposes.
  - (U) Developed techniques to rapidly assess situations and warn decision makers and warfighters.
  - (U) Developed message processing techniques which extract only pertinent information from free text and multimedia sources so decision makers and war planners have the most recent information available and on-line.
  - (U) Developed first generation techniques to configure and manage a scaleable distributed information computing environment.
- (U)$2,238 Developed sensor exploitation techniques for faster and more efficient imaging to support targeting, planning, and mission execution.
  - (U) Developed Phase 1 techniques to manage, query, and exploit digital imagery databases.
  - (U) Developed techniques to apply artificial neural networks to problems associated with finding objects in aerial imagery.
  - (U) Investigated applications of modeling technology to provide battle damage assessment.
- (U) $12,281 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4594

(U) FY 1997 ($ in Thousands):

- (U) $8,452 Develop processing technologies responsive to operational deficiencies by improving information timeliness, reliability, and accessibility.
  - (U) Integrate three-dimensional memory, error correction algorithms, and optical device technologies to develop enhanced storage and retrieval devices with reduced size, weight, and power requirements at lower cost; evaluate the first generation erasable media.
  - (U) Develop processing algorithms to automatically sort and route large volumes of communication signals to assist information analysts.
  - (U) Develop techniques that pro-actively correlate active radar signals with processing of non-cooperative signal emanations to support the release of beyond-visual-range weapons against high confidence air targets.
  - (U) Incorporate counter information technologies into the model abstraction and advanced data display techniques to enhance the exploitation of electronic imagery/information.
- (U) $2,452 Develop advanced information data handling techniques to automatically extract event data and update databases for prediction purposes.
  - (U) Develop techniques to build intelligent, single point, multimedia databases to provide the warfighter global awareness.
  - (U) Develop analytical tools which exploit message processing techniques to extract multimedia information for concise, efficient display to the warfighter.
  - (U) Integrate techniques to configure and manage a scaleable distributed information computing environment.
- (U) $2,505 Develop sensor exploitation techniques for faster and more efficient imaging to support targeting, planning, and mission execution.
  - (U) Develop Phase 2 techniques to improve the methodology required to manage and query imagery databases.
  - (U) Develop information currency techniques and data consistency techniques to support combat imagery/information systems.
  - (U) Apply modeling techniques which exploit aircraft mission video data to satisfy battle damage assessment requirements.
- (U) $13,409 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4594

(U) FY 1998 ($ in Thousands):

- (U) $8,342 Develop processing technologies responsive to operational deficiencies by improving information timeliness, reliability, and accessibility.
  - (U) Demonstrate read only three-dimensional memory configurations with error correction to develop enhanced storage and retrieval devices with reduced size, weight, and power requirements at lower cost; develop and assess second generation erasable media.
  - (U) Complete processing algorithm development to automatically sort and route large volumes of communication signals to assist information analysts.
  - (U) Develop processing technologies to exploit non-cooperative target attributes to support high confidence air target identification, continue development of pro-active fusion model for abstraction and inference of target identifications, continue developing techniques to correlate active radar tracks with passive signal identification techniques, develop advanced techniques for non-cooperative target identifications through the exploitation of target emissions.
  - (U) Evaluate and assess first generation model abstraction and advanced data display techniques which incorporate counter information technologies to enhance the exploitation of electronic imagery/information.
- (U) $2,350 Develop information data handling techniques to automatically extract event data and update databases for prediction purposes.
  - (U) Integrate advanced techniques to build intelligent, single point, multimedia databases to provide the warfighter global awareness.
  - (U) Integrate analytical tools which exploit message processing techniques to extract multimedia information for concise, efficient display to the warfighter.
  - (U) Evaluate machine learning techniques to configure and manage a scaleable distributed information computing environment.
- (U) $2,400 Develop sensor exploitation techniques for faster and more efficient imaging to support targeting, planning, and mission execution.
  - (U) Evaluate and assess Phase 2 imagery data base query developmental capability.
  - (U) Integrate information currency techniques and data consistency techniques to support combat imagery/information systems.
  - (U) Integrate modeling techniques which exploit aircraft mission video data to satisfy battle damage assessment requirements.
- (U) $13,092 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4594

(U) FY 1999 ($ in Thousands):

- (U) $8,332 Develop processing technologies responsive to operational deficiencies by improving information timeliness, reliability, and accessibility.
  - (U) Demonstrate write once, read many three-dimensional (3-D) optical memory capabilities; integrate 3-D memory to computer/workstations; demonstrate read/write/erase optical 3-D memory capability.
  - (U) Test and evaluate processing algorithms to automatically sort and route large volumes of communication signals.
  - (U) Develop processing technologies to exploit non-cooperative target attributes to support high confidence air target identification, demonstrate a pro-active fusion model for high confidence target identification, demonstrate techniques for active radar and passive signal identification correlation, develop non-cooperative target identification techniques through target emanation exploitation.
  - (U) Develop the model abstraction and advanced data display techniques which incorporates neural network technologies to enhance the exploitation of electronic imagery/information.
- (U) $2,377 Develop information data handling techniques to automatically extract event data and update databases for prediction purposes.
  - (U) Evaluate techniques to automatically optimize performance of intelligent, single point, multimedia databases to provide the warfighter near-real-time global awareness.
  - (U) Develop advanced analytical tools which apply machine learning techniques to message processing techniques to extract multimedia information from messages for concise, efficient display to the warfighter.
  - (U) Test, evaluate, and modify Phase 2 techniques to configure and manage a scaleable distributed information computing environment.
- (U) $2,424 Develop sensor exploitation techniques for faster and more efficient imaging to support targeting, planning, and mission execution.
  - (U) Conduct Phase 3 development of an imagery data base query system.
  - (U) Develop spatial data currency and consistency capability to support combat imagery/information systems.
  - (U) Develop parallel processing for video and other imagery exploitation in support of targeting.
- (U) $13,133 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4594

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	12,281	14,278	15,134	15,063	Cont
(U) Current Budget Submit/FY 1998 PB	12,281	13,409	13,092	13,133	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603726F, C3 Subsystems Integration.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4600

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4600 Electromagnetic Technology	24,521	24,361	21,064	22,272	23,816	26,201	25,794	26,528	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project consists of three subset technologies: electromagnetics; solid state sciences; and photonics. Future surveillance, communications, and imagery/information processing systems will require improved technology for the generation, control, processing, and radiation of electromagnetic and optical energy to reduce system cost, improve system sensitivity, and increase processing rates. Promising technologies for improving C3 systems are electromagnetic propagation and scattering (from targets and clutter), and monolithic microwave and millimeter-wave integrated components and antennas. This project develops: a technology base for electronic and photonic devices and device materials for C3 systems; optical technology for electronic data processing and storage; real-time target recognition and high-speed fiber optic interconnects; and control techniques for large phased array antennas. It also characterizes phenomena for low-observable surveillance.

(U) FY 1996 ($ in Thousands):

- (U) $7,452 Developed electromagnetic technologies for advanced surveillance and communications systems applications.
  - (U) Developed parallel processing algorithms for digital beamforming for antenna testbed; formulated new models of complex scattering mechanisms to improve radar cross-section codes.
  - (U) Developed "ducted" mode high frequency communications for super-long distance, covert links.
  - (U) Evaluated and refined hardware for infrared small target motion discriminator, and initiated hardware development for infrared spectral imager.
  - (U) Demonstrated concept of a semiconductor wideband short-pulsed source element array (spectrum shaping) for target tracking and recognition.
- (U) $6,110 Developed advanced materials and components capable of higher processing speeds at reduced power levels for telecommunications and survivable server applications.
  - (U) Designed, built, and tested monolithic transmit chip with integrated amplifier and phase shifter; integrated phase shifter and antenna feed network.
  - (U) Develop advanced chemical vapor deposition thin film crystal growth methods for high frequency, high data rate communications and radar devices.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4600

- (U) $10,959 Developed photonic components and related materials for insertion into core C3 programs.
  - (U) Analyzed optoelectronic integration on indium phosphide.
  - (U) Fabricated and tested multi-chip module interconnect technology in cooperation with commercial vendor.
  - (U) Developed design concepts for an ultra-high-speed multiple access testbed with specialized components for unique switching architecture, radar processors, and communications protocols.
  - (U) Developed design concepts for unique photonic signal processor brassboards to demonstrate optical logic and optical neural networks.
- (U) $24,521 Total

(U) FY 1997 ($ in Thousands):

- (U) $7,056 Develop electromagnetic technologies for advanced surveillance and communications systems applications.
  - (U) Conduct experimental assessment of techniques to improve bistatic signal-to-clutter ratios for low radar cross section target detection.
  - (U) Finalize algorithm and initiate hardware development for infrared small target spectral discriminator.
- (U) $6,039 Develop advanced materials and components capable of higher processing speeds at reduced power levels for telecommunications and survivable server applications.
  - (U) Design and fabricate brassboard, high-temperature transmit array; design, fabricate, and test monolithic low noise amplifier.
  - (U) Develop substrates for aluminum/gallium nitride for high-power, high temperature and optoelectronic applications, using new crystal growth methods.
- (U) $11,266 Develop photonic components and related materials for insertion into core C3 programs.
  - (U) Implement recursive tracking techniques for infrared focal plane arrays to exploit unique qualities of Schottky barrier technology.
  - (U) Develop optical sources, detectors, and modulators for high-speed analog fiber optic links.
  - (U) Develop 'smart' pixel optoelectronics technology for high-speed parallel signal processing.
  - (U) Conduct Phase 1 development of the ultra-high-speed multiple access testbed and associated components for unique switching architecture, radar processors, and communications protocols.
  - (U) Conduct Phase 1 development of unique photonic signal processor brassboards to demonstrate optical logic and optical neural networks.
  - (U) Demonstrate radio frequency optical beamforming and anti-jamming processors for radar and communication systems.
- (U) $24,361 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4600

(U) FY 1998 ($ in Thousands):

- (U) $6,295 Develop electromagnetic technologies for advanced surveillance and communications systems applications.
  - (U) Evaluate digital beamforming algorithms for multiple simultaneous beams; evaluate phased array correction algorithms; develop wide-bandwidth techniques for arrays of patch radiators; evaluate competing designs for coupling signals within multilayer antenna structures.
  - (U) Develop algorithms, based on bistatic adaptive polarimetry, to extract targets from clutter; develop propagation models for channel distortion on wideband communications and surveillance links.
- (U) $5,205 Develop advanced materials and components capable of higher processing speeds at reduced power levels for telecommunications and survivable server applications.
  - (U) Develop Generation II indium phosphide crystal growth apparatus based on experiment-based modeling and simulation.
  - (U) Develop nitride-based substrates for low-defect-density aluminum/gallium nitride films for high-power, high temperature, and optoelectronic applications.
  - (U) Evaluate low noise amplifier using strain free, high indium content channels on gallium arsenide; develop array techniques for evaluating photonically triggered, wide bandwidth microwave sources.
- (U) $9,564 Develop photonic components and related materials for insertion into core C3 programs.
  - (U) Develop a multiband, infrared imaging spectrometer capable of creating two-dimensional infrared data on a high value target.
  - (U) Fabricate optical sources, detectors and modulators for high-speed analog fiber optic links.
  - (U) Fabricate 'smart' pixel optoelectronics technology for high-speed parallel signal processing.
  - (U) Conduct Phase 2 development of the ultra-high-speed multiple access testbed and associated components for unique switching architecture, radar processors, and communications protocols.
  - (U) Conduct Phase 2 development of unique photonic signal processor brassboards to demonstrate optical logic and optical neural networks.
  - (U) Integrate radio frequency optical beamforming and anti-jamming processors for radar and communication systems.
- (U) $21,064 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4600

(U) FY 1999 ($ in Thousands):

- (U) $6,682 Develop electromagnetic technologies for advanced surveillance and communications systems applications.
  - (U) Compare parallel computer operation to single serial digital beamformer; demonstrate simultaneous near-field and far-field nulling; compare time-domain antenna analysis with frequency-domain techniques; demonstrate new computer code for predicting antenna performance in complex multi-layered dielectric environments.
  - (U) Evaluate new computer codes for fast and accurate prediction of the bistatic radar cross section of complex targets; develop model-based tools for channel distortion cancellation on wideband communications and surveillance links.
- (U) $5,573 Develop advanced materials and components capable of higher processing speeds at reduced power levels for telecommunications and survivable server applications.
  - (U) Evaluate Generation II indium phosphide crystal growth furnace, in preparation for its transition to Defense Industrial Base.
  - (U) Evaluate potential for electronic materials based on alloys of nitrides with arsenides and phosphides.
  - (U) Evaluate new low loss microwave films for high power applications; develop and verify new electromagnetic models of extremely-high frequency circuitry for advanced low noise amplifiers.
- (U) $10,017 Develop photonic components and related materials for insertion into core C3 programs.
  - (U) Fabricate and test optical sources, detectors, and modulators for high-speed analog fiber optic links.
  - (U) Complete fabrication and test 'smart' pixel optoelectronics technology for high-speed parallel signal processing.
  - (U) Test ultra-high-speed multiple access testbed and associated components for unique switching architecture, radar processors, and communications protocols.
  - (U) Fabricate unique photonic signal processor brassboards to demonstrate optical logic and neural networks for ultimate application to surveillance and communication systems.
  - (U) Demonstrate radio frequency optical beamforming and anti-jamming processors for radar and communication systems.
- (U) $22,272 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4600

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	24,661	23,263	23,702	23,657	Cont
(U) Current Budget Submit/FY 1998 PB	24,521	24,361	21,064	22,272	Cont

(U) Change Summary Explanation:

Funding: Changes in this project since the previous President's Budget are due to budget constraints and priorities within the Sciences and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603617F, C3 Applications.
- (U) PE 0603726F, C3 Subsystems Integration.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602702F Command,Control, and Communication (C3)

PROJECT: 5581

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
5581 Command and Control (C2) Technology	16,740	16,300	16,180	17,122	18,080	18,775	19,259	19,839	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Air Force Command and Control (C2) requires technologies which provide next generation battlefield commanders with improved processing and presentation of information for real-time battle management. Technologies being developed in this project will increase capability, quality, and reliability while reducing the cost of computer resources in C2 systems. Work in this project is focused on developing advanced C2 computer software systems capable of providing vast improvements in military decision making. It also develops software engineering analysis tools, software development methodologies, and software quality specification and assessment techniques. It develops: technology for distributed systems, data bases, and fault tolerance mechanisms; and knowledge-based technologies, systems, and data bases.

(U) FY 1996 ($ in Thousands):

- (U) $6,209 Developed intelligent information technologies for real-time battle management and C2 for time-critical air operations.
  - (U) Developed concept design approaches for initiative planning and approximate planning.
  - (U) Completed demonstration of dynamic backscattering search for generative planning.
- (U) $5,326 Developed software technologies to provide increased capability, quality, and reliability while reducing support cost.
  - (U) Completed enhancement of process controls and security for computer environments and certification of reusable software.
  - (U) Provided automated scenario generation for requirements engineering analysis environments.
  - (U) Developed benchmarks and specifications for parallel processing software usage on high-speed computers.
  - (U) Completed technology efforts to support learning; defined architectural improvements for the knowledge-based-software-assistant.
- (U) $5,205 Developed enabling technology for distributed computing and database technology using cluster techniques to allow secure processing and management of multimedia information by commanders at all echelons.
  - (U) Demonstrated feasibility of shared collaborative context workspace across a distributed computing environment.
  - (U) Completed feasibility demonstration of interactive datawall with non-tethered, interactive input devices.
  - (U) Completed feasibility demonstration of synthetic visualization environment to command center applications.
- (U) $16,740 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 5581

(U) FY 1997 ($ in Thousands):

- (U) $6,032 Develop intelligent information technologies for real-time battle management and command and control (C2) for time-critical air operations.
  - (U) Demonstrate integration of planning technology using autonomous software agents and mixed initiative scheduling toolbox.
  - (U) Develop and demonstrate dialog-based, man-machine integration planning task.
  - (U) Develop and demonstrate evaluation criteria for intelligent information systems.
- (U) $4,982 Develop software technologies to provide increased capability, quality, and reliability while reducing support cost.
  - (U) Develop Phase 1 of the high level requirements engineering language with scenario generation for the requirements engineering environment.
  - (U) Evaluate concept design approaches and visualization techniques for parallel processing systems, parallel object-oriented programming methods, and advanced techniques for real-time parallel processing analyses.
  - (U) Complete development of benchmarks for parallel processing software.
- (U) $5,286 Develop enabling technology for distributed computing and database technology using cluster techniques to allow secure processing and management of multimedia information by commanders at all echelons.
  - (U) Demonstrate asynchronous switching technology as a local interconnect mechanism for shared collaborative context workspace across a distributed computing environment.
  - (U) Demonstrate feasibility of an optical storage and retrieval mechanism for multimedia database management brassboard.
  - (U) Demonstrate feasibility application-based reconfiguration of multiple distributed computing clusters.
- (U) $16,300 Total

(U) FY 1998 ($ in Thousands):

- (U) $6,008 Develop intelligent information technologies for real-time battle management and command and control for time-critical air operations.
  - (U) Develop high performance computational mechanism for knowledge discovery/mining and information integration for massive knowledge-based systems.
  - (U) Develop fully autonomous planning technology for inclusion in software toolbox.
  - (U) Demonstrate full-dialog man-machine interface for integration into planning task.
  - (U) Apply evaluation criteria for high performance knowledge bases.
- (U) $5,002 Develop software technologies to provide increased capability, quality, and reliability while reducing support cost.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 5581

- (U) Continue development of the high level requirements engineering language with scenario generation for the requirements engineering environment and other advanced technologies for requirements elicitation, specification, and validation.
- (U) Develop architecture-directed synthesis technology and demonstrate the formal synthesis of high assurance software.
- (U) Develop technology to support modeling and analysis of evolvable software, including dynamic language support.
- (U) Develop concept design approaches and visualization techniques for parallel processing systems, parallel object-oriented programming methods, and advanced techniques for real-time parallel processing analyses.
- (U) Expand baseline set of benchmarks for parallel processing software to include provisions for real-time systems.

– (U) $5,170 Develop enabling technology for distributed computing and database technology using cluster techniques to allow secure processing and management of multimedia information by commanders at all echelons.

- (U) Evaluate asynchronous switching technology as a local interconnect mechanism for shared collaborative context workspace across a distributed computing environment.
- (U) Evaluate utility of optical storage multimedia database management brassboard.
- (U) Evaluate utility of application-based reconfiguration of multiple distributed computing clusters.

– (U) $16,180 Total

(U) FY 1999 ($ in Thousands):

– (U) $6,336 Develop intelligent information technologies for real-time battle management and command and control for time-critical air operations.

- (U) Demonstrate integration of planning technology for incremental plan refinement and synchronization of resources.
- (U) Demonstrate high performance knowledge base technology for coordination, cooperation, and negotiation.
- (U) Develop and demonstrate preplan-to-react planning technology.
- (U) Develop and demonstrate tools and techniques for collaborative intelligent systems including intelligent agents and knowledge bases.

– (U) $5,308 Develop software technologies to provide increased capability, quality, and reliability while reducing support cost.

- (U) Complete visualization techniques to provide software developers with the means to understand and visualize the design and implementation of parallel software systems.
- (U) Complete development of high level requirements engineering language with scenario generation for the requirements engineering environment and other advanced technologies for requirements elicitation, specification, and visualization.

– (U) $5,478 Develop enabling technology for distributed computing and database technology using cluster techniques to allow secure processing and management of multimedia information by commanders at all echelons.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 5581

- (U) Apply asynchronous switching technology as a local interconnect mechanism for shared collaborative context workspace across a distributed computing environment.
- (U) Integrate optical storage multimedia database management systems.
- (U) Develop and demonstrate brassboard application-based reconfiguration of multiple distributed computing clusters for command and control systems.

- (U) $17,122 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 5581

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	16,740	17,371	17,485	17,331	Cont
(U) Current Budget Submit/FY 1998 PB	16,740	16,300	16,180	17,122	Cont

(U) Change Summary Explanation:

Funding: Changes in this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603617F, C3 Applications.
- (U) PE 0603728F, Advanced Computer Technology.
- (U) PE 0603789F, C3 Advanced Development.
- (U) PE 0303401F, Communications-Computer Systems (C-CS) Security RDT&E.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603106F Logistics Systems Technology

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	16,372	17,467	15,338	17,775	20,535	21,342	21,729	22,420	Continuing	Continuing
2745 Logistics for Contingency Operations and Weapon Systems Support	4,858	5,703	4,450	5,948	6,869	7,140	7,269	7,501	Continuing	Continuing
2940 Technology for Design and Maintenance	5,310	5,848	4,970	5,935	6,855	7,125	7,254	7,484	Continuing	Continuing
2950 Improved Logistics and Maintenance Performance	6,204	5,916	5,918	5,892	6,811	7,077	7,206	7,435	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates cost-effective technologies to improve the design, acquisition, and supportability of current and future weapon systems. This program directly supports two of the six Air Force Core Competencies, Rapid Global Mobility and Agile Combat Support. It will also incorporate maintenance and support considerations into the weapon systems design process and will make engineering, product support, and maintenance data electronically available throughout weapon systems' life cycles. It will: provide more realistic logistics planning and combat capability assessment tools; provide critical risk reduction technology; and include test and diagnostics technologies, flight line and deployment support, critical aircraft battle/accident damage assessment and repair technology, military aircraft fire suppression agents, and other logistics technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	17,252	18,254	18,279	20,629	Cont
(U) Appropriated Value	17,960	18,254			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-348	-383			
b. SBIR	-360	-404			
c. Omnibus/Other Above Threshold Reprogrammings	-198				
d. Below Threshold Reprogrammings	-682				
(U) Current Budget Submit/FY 1998 PB	16,372	17,467	15,338	17,775	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603106F Logistics Systems Technology

PROJECT: 2745

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2745 Logistics for Contingency Operations and Weapon Systems Support	4,858	5,703	4,450	5,948	6,869	7,140	7,269	7,501	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**: This project develops, demonstrates, and transitions technology to improve the performance and supportability of Air Force weapon systems in peacetime and deployed wartime environments. This project will develop and demonstrate the technologies needed for more reliable aircraft support equipment, enhance our capability to rapidly return battle damaged aircraft to a combat ready status, and support rapid and flexible deployments.

(U) FY 1996 ($ in Thousands):

- (U) $2,135 Developed and demonstrated fire suppression/extinguishing technologies.
  - (U) Developed and flight tested gas generator extinguisher technology for aircraft.
  - (U) Developed inflatable bag fire extinguisher technology for aircraft fire suppression.
- (U) $1,993 Developed and demonstrated repair techniques for battle/accident damaged aircraft.
  - (U) Developed and evaluated technologies for repairing and electrically measuring battle damaged low-observable structures.
  - (U) Developed technologies for repairing battle damaged composite structures.
  - (U) Determined technology needs and select concepts for repairing battle damaged turbine engines.
- (U) $561 Developed needs assessment and technology for multi-purpose, easily deployable support equipment.
- (U) $169 Identified processes, models, technologies, and equipment to enhance contingency operations while decreasing the logistics footprint.
  - (U) Defined and evaluated configuration options for multi-function and modular aerospace ground equipment that reduce support costs and deployment footprint.
- (U) $4,858 Total

(U) FY 1997 ($ in Thousands):

- (U) $1,494 Develop and demonstrate fire suppression/extinguishing technologies.
  - (U) Complete testing on the gas generator technology for aircraft fire suppression systems and make available for transition.
  - (U) Further develop and flight test the inflatable bag extinguisher technology for aircraft fire suppression.
- (U) $1,529 Develop and demonstrate repair techniques for battle damaged/accident damaged aircraft.
  - (U) Field demonstrate and verify concepts for repairing and measuring battle damaged low-observable structures.
  - (U) Evaluate technologies for repairing battle damaged composite structures.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology
	PROJECT 2745

- (U) $2,680 Develop processes, models, technologies, and equipment to enhance contingency operations while decreasing the logistics footprint.
  - (U) Design and evaluate technologies for multi-function modular aerospace ground equipment that reduce support costs and deployment footprint.
  - (U) Design and evaluate technologies for improved supportability and operational efficiency of support equipment and materiel handling equipment.
- (U) $5,703 Total

(U) FY 1998 ($ in Thousands):

- (U) $ 1,286 Continue to develop repair technologies for battle and accident damaged aircraft.
  - (U) Field test, document, and transition composite and low-observable structure repair technologies.
  - (U) Compare and assess available commercial technologies to achieve minimized sound, thermal, and pollution signature and operational residuals.
- (U) $ 3,164 Continue to develop technologies to enhance rapid logistics contingency planning/operations directed towards rapid response, reduce footprint, and improve asset distribution management (place, time, materials, quantities) for logistics support.
  - (U) Develop advanced deployment/process planning analysis and execution tools; identify essential elements required to support rapid response forces with required initial and sustaining support elements.
  - (U) Fully define operational requirements for next generation highly reliable, reconfigurable, and easily deployable multi-function, modular support equipment.
  - (U) Continue technology development to reduce airlift requirements and on-site footprint for multifunction support equipment.
- (U) $4,450 Total

(U) FY 1999 ($ in Thousands):

- (U) $ 3,311 Continue development of technologies to enhance rapid contingency planning/operations directed towards rapid response, reduced footprint, and "just-in-time" logistics support.
  - (U) Field demonstrate advanced deployment planning and execution process planning and analysis tools; identify essential elements required to support rapid response forces with required initial and sustaining support elements.
  - (U) Preliminary demonstrations of integrated information/display technologies to improve command/control of asset distribution.
- (U) $ 2,637 Fully define operational requirements for next generation, multi-function, modular support equipment that is highly reliable, reconfigurable, and easily deployable.
  - (U) Demonstrate technologies that reduce airlift requirements and on-site footprint for multifunction support equipment.
- (U) $5,948 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology
	PROJECT 2745

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	4,858	5,960	6,041	6,888	Cont
(U) Current Budget Submit/FY 1998 PB	4,858	5,703	4,450	5,948	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0603721N, Integrated Diagnostic Support.
- (U) PE 0605801A, Pollution Prevention Research and Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603106F Logistics Systems Technology

PROJECT: 2940

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2940 Technology for Design and Maintenance	5,310	5,848	4,970	5,935	6,855	7,125	7,254	7,484	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops and demonstrates new technologies to enable design, procurement, repair, and modification of more supportable and affordable weapon systems. These technologies permit integration of design trade off decisions among survivability, producibility, and supportability, including development and use of analyses to assess impacts on system supportability while initiatives are still in the concept design stage.

(U) FY 1996 ($ in Thousands):

- (U) $1,717 Developed engineering design, analysis methods, and technologies to improve Air Force maintenance and address requirements for improved system reliability/maintainability.
  - (U) Developed technology to assess multiple maintenance tasks for improved maintainer interfaces early in the design cycle, including environmental conditions in a simulated work cell.
- (U) $2,531 Developed analysis tools to identify needs and improve aircraft repair/support methods and equipment effectiveness.
  - (U) Developed variable deployment readiness assessment methods, criteria, and metrics.
  - (U) Developed and verified methods to help Air Force logisticians more effectively support the analysis process.
- (U) $1,062 Developed and demonstrated engineering design trade off methods to make acquisition/support of Air Force systems more affordable.
  - (U) Developed analytic trade off methods to allow designers and users to assess affordability versus performance, support cost, risk, etc., in early development.
- (U) $5,310

(U) FY 1997 ($ in Thousands):

- (U) $1,806 Develop engineering design, analysis methods, and technologies to improve Air Force maintenance and address requirements for improved reliability/maintainability.
  - (U) Create and validate methods for documenting maintenance technician performance requirements for automatic insertion in the Logistics Support Analysis Record.
  - (U) Develop criteria/metrics for design engineering assessment of system deployment footprint, supportability, airlift/transportation requirements, and on-site support.
- (U) $2,626 Develop and demonstrate analysis methods to identify and meet Air Force logistics needs; improve aircraft repair/support methods.
  - (U) Build and demonstrate data collection and decision support technologies for operational logistics requirements.
  - (U) Test the flexibility and accuracy of this multi-user technology with commercial analytical methods.
  - (U) Define requirements for analytic tool suite to improve the efficiency and affordability of the wing/depot repair process.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology
	PROJECT 2940

- (U) $1,416 Completed development/demonstrated engineering design trade off methods and software tools to make acquisition support of Air Force systems more affordable.
- (U) $5,848 Total

(U) FY 1998 ($ in Thousands):

- (U) $2,634 Continue development of engineering design, analysis methods, and technologies to improve Air Force maintenance and support to improve reliability, maintainability, and deployability.
  - (U) Develop and transition advanced computer based maintainability assessment and support data generation using high fidelity human performance models and maintenance task simulations.
  - (U) Continue to develop analytic tool suites to improve the efficiency and affordability of the wing/depot repair process.
- (U) $2,336 Continue to develop/demonstrate analysis tools to ensure tight correlation between specific operational user requirements and system acquisition, repair, and modification.
  - (U) Develop and assess technologies to balance operational user requirements with affordability, reliability, and supportability requirements.
  - (U) Develop, assess, and demonstrate impact of collaborative technologies for distributed , multi-media, multi-user assessments, trade off, and coordination for consolidation and prioritization of operational logistics requirements.
- (U) $4,970 Total

(U) FY 1999 ($ in Thousands):

- (U) $ 3,234 Continue development of engineering design, analysis methods, and technologies to improve Air Force maintenance and support to improve reliability, maintainability, and deployability.
  - (U) Demonstrate analytical tools that facilitate streamlining of aircraft maintenance and repair operations for critical weapon system components.
  - (U) Demonstrate tools that are better integrate wing/depot logistics operations to increase the efficiency of depot maintenance and repair support to operational wings.
- (U) $2,701 Continue to develop/demonstrate analysis tools to ensure tight correlation between specific operational user requirements and system acquisition, repair, and modification.
  - (U) Complete the integration and testing of advanced requirements definition, optimization, and traceability techniques to manage and correlate operational weapon system requirements across the Air Force.
- (U) $5,935 Total

(U) B. Program Change Summary ($ in Thousands):

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology PROJECT 2940

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	6,186	6,111	6,159	6,836	Cont
(U) Current Budget Submit/FY 1998 PB	5,310	5,848	4,970	5,935	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0604740F, Computer Resource Management Technology.
- (U) PE 0708011F, Manufacturing Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603106F Logistics Systems Technology

PROJECT: 2950

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2950 Improved Logistics and Maintenance Performance	6,204	5,916	5,918	5,892	6,811	7,077	7,206	7,435	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project develops and demonstrates technologies that will improve logistics and maintenance support including: development and demonstration of technology essential to field and depot maintenance operations; implementation of near-term logistics technology to shorten the time between user requirement definition and usable product delivery; and development and demonstration of technologies for flightline and Air Logistics Center maintenance technicians.

(U) FY 1996 ($ in Thousands):

- (U) $3,480 Developed and demonstrated methodologies and technologies to evaluate the benefits of electronic technical data for planning and implementing various types of field and depot maintenance.
  - (U) Evaluated various software approaches for automatically converting aircraft drawings and technical orders into electronic formats.
  - (U) Completed requirements analysis for the Aircraft Battle Damage Assessment and Repair (ABDAR) aid demonstration system.
  - (U) Completed information requirements analysis for integrated technical information for the Air Logistics Centers.
- (U) $2,724 Developed and demonstrated technologies for improved logistics planning and deployed maintenance operations.
  - (U) Demonstrated advanced logistics planning technologies.
  - (U) Developed software technology tools for wing level logistics planners.
- (U) $6,204 Total

(U) FY 1997 ($ in Thousands):

- (U) $4,460 Develop and demonstrate methodologies and technologies to evaluate the benefits of electronic technical data for planning and implementing various types of field and depot maintenance.
  - (U) Develop aircraft battle damage assessment aid demonstration system..
  - (U) Design system to demonstrate integrated technical information for the Air Logistics Centers.
- (U) $1,456 Develop and demonstrate technologies for improved logistics planning and deployed maintenance operations.
  - (U) Complete information analysis required to develop technologies to improve wing level logistics planning environment.
- (U) $5,916 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology
	PROJECT 2950

(U) FY 1998 ($ in Thousands):

- (U) $5,281 (U) Continue to develop and demonstrate technologies to evaluate the benefits of electronic technical data for planning and implementing various types of field, depot, and deployed maintenance.
  - (U) Continue aircraft battle damage assessment aid demonstration system development.
  - (U) Continue to develop technology for automated generation of technical data from engineering design data base.
- (U) $637 (U) Continue to develop and demonstrate technologies for improved logistics planning and deployed maintenance operations.
  - (U) Complete initial design requirements for fully integrated wing level logistics planning information system.
- (U) $5,918 Total

(U) FY 1999 ($ in Thousands):

- (U) $5,892 (U) Continue to develop and demonstrate technologies to evaluate the benefits of electronic technical data for planning and implementing various types of field, depot, and deployed maintenance.
  - (U) Field test and demonstrate aircraft battle damage assessment aiding technology.
  - (U) Continue to develop technology for automated generation of technical data from engineering design data base.
- (U) $5,892 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology
	PROJECT 2950

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	6,208	6,183	6,079	6,905	Cont
(U) Current Budget Submit/FY 1998 PB	6,204	5,916	5,918	5,892	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0207219F, Advanced Tactical Fighter.
- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0603721N, Integrated Diagnostic System.
- (U) PE 0604708F, Generic Integrated Maintenance Diagnostics Systems.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603108F Integrated Data Systems (IDS)

PROJECT: 4427

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4427 Integrated Maintenance Data Systems (IMDS)	14,406	17,332	19,753	19,706	20,511	37,135	20,527	20,989	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification

The IMDS program is an evolutionary acquisition program to develop and field an AF standard maintenance information system. Congressional funds were provided in FY95 to conduct a demonstration to validate the Integrated Maintenance Information System (IMIS) technologies and capabilities; and in FY96 for IMDS program initiation. FY 97 and outyear funding provided in FY 97 POM. This program element integrates information systems supporting Air Force maintenance activities into a single open architecture, modern decision support system. This enhanced decision support system will increase operational production capability and support system efficiency, while decreasing mobility infrastructure requirements and cost of operations. This PE contains only the RDT&E portion of IMDS. Procurement and production funds are located within PE 0708611F. This program is in budget activity 3, Advanced Technology Development, due to Congressional direction and funding. The budget activity code is in the process of being revised to reflect engineering and manufacturing development as a result of the System Decision Memorandum (SDM), dated 3 Jan 96, directing the development and testing of the IMDS core capabilities (Increments 1&2).

(U) FY 1996

- (U) $6,000 IMDS System contract (Increments 1&2)- Develop standard graphical user interface; develop common interface to CAMS/REMIS; migrate TICARRS functionality, interfaces, and databases to IMDS; develop job data documentation repository, maintenance analysis reporting, and portable maintenance aid capabilities.
- (U) $2,581 Conduct Testbed Operations for developmental software and validation of increment 3 requirements
- (U) $275 Conduct Functional Economic Analysis (FEA)/Independent Cost Analysis (ICA)
- (U) $5,550 Support program office operations, engineering support, weapon system integration, and other program activities.
- (U) $14,406 Total

(U) FY 1997

- (U) $12,700 IMDS system contract - Complete development of graphical user interfaces for CAMS/REMIS; develop data warehouse for new and migrating data and fleet wide analysis reporting; develop a complete database federation of CAMS/REMIS; begin database conversion; develop interfaces to Joint Computer-aided Acquisition and Logistics Support (JCALS) System, Theater Battle Management Core System (TBMCS), and the Global Combat Support System-AF (GCSS-AF); and conduct testbed operations.
- (U) $4,632 Program office operations, engineering support, and other program activities.
- (U) $17,332 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603108F Integrated Data Systems (IDS)
	PROJECT 4427

(U) FY 1998 ($ in Thousands):
- (U) $14,868 Conduct OT&E for IMDS core capability. IMDS system contract - Increment 3.
- (U) $4,885 Program office operations, systems engineering, and other program activities.
- (U) $19,753 Total

(U) FY 1999 ($ in Thousands):
- (U) $15,161 Operational testing/assessment Increment 3. IMDS system contract - Increment 4.
- (U) $4,545 Program office operations, systems engineering, and other program activities.
- (U) $19,706 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY97 President's Budget	14,404	18,232	20,433	22,073	Continuing
(U) Appropriated Value	15,200	18,232			
(U) Adjustments to Appropriated Value					
a. Cong Reductions	-317	-456			
b. Small Business Innovative Research	-330	-444			
c. Omnibus/Other Above Threshold Reprogramming	-149				
d. Below Threshold Reprogramming	99				
e. Rescissions	-93				
(U) Adjustments to Budget Years Since FY 1997 PB	-4		-680	-2,367	
(U) FY 1998/1999 Biennial Budget	14,406	17,332	19,753	19,706	Continuing

(U) Change Summary Explanation:

Funding: FY98-FY99 reductions to fund higher priority requirements within the Science and Technology (S&T) program.

Schedule: Not applicable.

Technical: Not applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603108F Integrated Data Systems (IDS)

PROJECT: 4427

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Other Procurement (IMDS)			2,866	2,827	2,808	2,786	2,802	2,772	Cont	Cont
(U) O&M (IMDS)			970	966	1,936	2,092	1,939	2,157	Cont	Cont

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) IMDS System Contract Award (Inc 1&2)				X												
(U) Development of IMDS core capability				X	-----	-----	-----	-----	-----	-----	X					
(U) Testbed Development/Operations	-----	Ong	oing	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	---- >
(U) OT&E Core (Increments 1&2)											X	-----	X			
(U) IMDS System Contract (Inc 3)												X				
(U) IMDS System Contract (Inc 4)																X

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	29,817	25,136	20,596	21,429	23,184	23,444	23,622	24,347	Continuing	Continuing
2100 Laser Hardened Materials	11,037	9,419	10,133	11,215	12,092	12,222	12,311	12,672	Continuing	Continuing
3153 Non-Destructive Inspection Development	10,332	7,778	4,472	4,598	4,958	5,011	5,048	5,197	Continuing	Continuing
3946 Materials Transition	8,448	7,939	5,991	5,616	6,134	6,211	6,263	6,478	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program demonstrates materials technology options for application into Air Force weapon systems. Developing materials technologies for the broadband laser protection of aircrews and sensors from a variety of threats is a high priority of the Air Force. The Non-Destructive Inspection/Evaluation (NDI/E) techniques for fighter, bomber, and transport aircraft are critical to the logistics centers as well as the operational fleet as the service lives of these systems increase. This program provides critical data for prospective users to make engineering decisions on lightweight structural, electronic, optical, and non-structural materials for air and space. Reducing risk in materials technology improves the affordability, supportability, reliability, survivability, and operational performance of current and future warfighting systems. Note: Congress added $5 million in FY 1996 and $2.5 million in FY 1997 for metal fatigue monitoring technology plus an additional $2 million in FY1996 for infrared signature control which explains the perceived decrease across the Future Years Defense Plan (FYDP). In FYs 1998 and out, additional emphasis has been placed on improved materials and sustainment of aging aircraft.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	21,864	23,803	23,932	24,809	Cont
(U) Appropriated Value	30,283	26,303			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-587	-532			
b. SBIR	-632	-610			
c. Omnibus/Other Above Threshold Reprogrammings	-502	-25			
d. Below Threshold Reprogrammings	+1,255				
(U) Current Budget Submit/FY 1998 PB	29,817	25,136	20,596	21,429	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems

PROJECT: 2100

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2100 Laser Hardened Materials	11,037	9,419	10,133	11,215	12,092	12,222	12,311	12,672	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project develops new materials and concepts for protecting Air Force assets such as aircrews, munitions, sensors, transparencies, and structures against laser radiation. The goal is to ensure mission capability before, during, and after laser exposure. The world laser market is rapidly expanding with easy export to any nation. Survivability solutions must account for a variety of lasers facing a mission. Current protection schemes are activated by intensity or color and are only capable of countering a specific portion of the laser threat. To harden systems against all potential lasers, a combination of approaches is required. Concepts are demonstrated to provide hardening options for transition to Air Force systems.

(U) FY 1996 ($ in Thousands):

- (U) $1,599 Developed advanced materials technologies that enhance laser hardening for Air Force aircraft structures.
  - (U) Evaluated canopy protection technologies in preparation for hardened transparency demonstration.
  - (U) Investigated applicability of laser hardening technologies for missile and aircraft radomes.
- (U) $4,735 Developed advanced materials technologies that enhance laser hardening for Air Force aircrews.
  - (U) Completed program to provide laser eye protection for Military Airlift Command aircrews at night.
  - (U) Completed effort to develop holographic technologies for aircrew laser eye protection.
- (U) $4,703 Developed advanced materials technologies that enhance laser hardening for sensors, avionics, and components.
  - (U) Completed program to provide laser protection technologies for laser radars.
  - (U) Completed survivable, high performance optical sensor program.
- (U) $11,037 Total

(U) FY 1997 ($ in Thousands):

- (U) $1,426 Develop advanced materials technologies that enhance laser hardening for Air Force aircraft structures.
  - (U) Complete evaluation of structural materials laser susceptibility under various mission profiles.
  - (U) Fabricate sub-scale canopy for demonstration of canopy laser protection technologies.
- (U) $4,092 Develop advanced materials technologies that enhance laser hardening for Air Force aircrews.
  - (U) Evaluate demonstrated laser hardening approaches for application in helmet-mounted displays.
  - (U) Investigate the use of advanced protection coatings in night vision goggles.
- (U) $3,901 Develop advanced materials technologies that enhance laser hardening for sensors, avionics, and components.
  - (U) Complete hardened forward looking infrared (FLIR) system demonstration.
  - (U) Develop technologies to protect low light level television systems.
- (U) $9,419 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems PROJECT 2100

(U) FY 1998 ($ in Thousands):

- (U) $1,486 Develop advanced materials technologies that enhance laser hardening for Air Force aircraft structures.
  - (U) Develop high-power mid-wave infrared laser evaluation technologies for simulating continuous and pulsed wave threats.
  - (U) Characterize the laser hardness high temperature transparency materials for supersonic aircraft.
- (U) $4,350 Develop advanced materials technologies that enhance laser hardening for Air Force aircrews.
  - (U) Demonstrate wrap-around holographic spectacles for multi-band laser protection.
  - (U) Demonstrate fixed wavelength filter protection technology for night vision goggles.
- (U) $4,297 Develop advanced materials technologies that enhance laser hardening for sensors, avionics, and components.
  - (U) Demonstrate intrinsically hard infrared detector materials technology for advanced electro-optical sensors.
  - (U) Demonstrate hardened retrofit modules for forward looking infrared (FLIR) sensors.
- (U) $10,133 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,649 Develop advanced materials technologies that enhance laser hardening for Air Force aircraft structures.
  - (U) Investigate pulsed laser protection coatings for aircraft canopies.
  - (U) Demonstrate sub-scale laser hardened canopy for supersonic aircraft.
- (U) $4,812 Develop advanced materials technologies that enhance laser hardening for Air Force aircrews.
  - (U) Demonstrate tristimulus spectacles for interim agile (broad band) laser eye protection.
  - (U) Demonstrate narrow notch, angle insensitive rugate coatings for night vision goggle laser protection.
- (U) $4,754 Develop advanced materials technologies that enhance laser hardening for sensors, avionics, and components.
  - (U) Develop broad-spectrum limitors for protection of focal plan array (FPA) infrared detectors.
  - (U) Demonstrate optical limiter technologies for imaging infrared seekers.
- (U) $11,215 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems PROJECT 2100

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	10,078	9,859	10,247	10,233	Cont
(U) Current Budget Submit/FY 1998 PB	11,037	9,419	10,133	11,215	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0604706F, Life Support System.
- (U) Coordinated through the Tri-Service Laser Hardening Materials and Structures Working Group and the Joint Service Agile Laser Eye Protection Program.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems PROJECT 3153

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3153 Non-Destructive Inspection Development	10,332	7,778	4,472	4,598	4,958	5,011	5,048	5,197	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops and demonstrates advanced Non-Destructive Inspection/Evaluation (NDI/E) methods and procedures to monitor performance integrity and to detect failure causing conditions in weapon system components and materials. NDI/E capabilities greatly influence and/or limit many designs, manufacturing, and maintenance practices. Reduction in the number of fighter wings and the need for rapid sortie generation demand an ability to perform real-time NDI/Es faster than current capability. This project provides technology to satisfy critical Air Force requirements to extend lifetimes of current systems through increased reliability and cost-effectiveness at field and depot maintenance levels, as well as assuring manufacturing quality, integrity, and safety requirements.

(U) FY 1996 ($ in Thousands):
- (U) $7,883 Developed advanced technologies for improved capabilities in materials corrosion testing, monitoring, and inspection of aging aircraft.
  - (U) Continued to evaluate corrosion non-destructive evaluation data fusion to simplify inspection of aircraft structures.
  - (U) Developed corrosion detection systems for passive detection of aircraft structural corrosion.
- (U) $2,449 Developed advanced electromagnetic radiation (i.e., x-ray, gamma-ray, and laser) NDI/E technologies for improved capabilities in materials testing, monitoring, inspection, and maintenance.
  - (U) Developed high resolution, real-time radioscopy for digitized (filmless) inspection of aircraft structures.
  - (U) Developed man portable large area composite inspection technologies for inspection of aircraft wing and fuselage sections.
- (U) $10,332 Total

(U) FY 1997 ($ in Thousands):
- (U) $5,302 Develop advanced technologies for improved capabilities in materials corrosion testing, monitoring, and inspection of aging aircraft.
  - (U) Continue to develop corrosion detection systems for passive detection of aircraft structural corrosion.
  - (U) Develop technologies for detection of hidden flaws in complex aircraft structures.
- (U) $2,476 Develop advanced electromagnetic radiation (i.e., x-ray, gamma-ray, and laser) NDI/E technologies for improved capabilities in materials testing, monitoring, inspection, and maintenance.
  - (U) Evaluate the use of computed tomography for failure analysis of complex structures.
  - (U) Develop remote inspection microwave non-destructive evaluation techniques for aircraft structures.
- (U) $7,778 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems PROJECT 3153

(U) FY 1998 ($ in Thousands):

- (U) $2,418 Develop advanced technologies for improved capabilities in materials corrosion testing, monitoring, and inspection of aging aircraft.
  - (U) Demonstrate low frequency eddy current techniques for the detection of fatigue related cracks within aircraft structures.
  - (U) Develop advanced Non-Destructive Inspection/Evaluation (NDI/E) techniques for the inspection of turbine engine components.
- (U) $2,054 Develop advanced electromagnetic radiation (i.e., x-ray, gamma-ray, and laser) NDI/E technologies for improved capabilities in materials testing, monitoring, inspection, and maintenance.
  - (U) Develop a high temperature transducer for the non-destructive inspection of active turbine engine components.
  - (U) Demonstrate advanced NDI/E technologies for the inspection of stealth aircraft components.
- (U) $4,472 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,486 Develop advanced technologies for improved capabilities in materials corrosion testing, monitoring, and inspection of aging aircraft.
  - (U) Develop x-ray and neutron radioscopy techniques for the inspection of internal, complex aircraft structures.
  - (U) Demonstrate advanced NDI/E techniques for the inspection of turbine engine components.
- (U) $2,112 Develop advanced electromagnetic radiation (i.e., x-ray, gamma-ray, and laser) NDI/E technologies for improved capabilities in materials testing, monitoring, inspection, and maintenance.
  - (U) Develop in-process inspection methods to reduce scrap and related costs of advanced aerospace composites.
  - (U) Demonstrate pattern recognition of critical circuit board components for automated inspection of avionic components.
- (U) $4,598 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems PROJECT 3153

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	5,332	5,638	5,496	5,964	Cont
(U) Current Budget Submit/FY 1998 PB	10,332	7,778	4,472	4,598	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602102F, Materials.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems

PROJECT: 3946

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3946 Materials Transition	8,448	7,939	5,991	5,616	6,134	6,211	6,263	6,478	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops data to accelerate the time to scale-up new defense-related materials and achieve their acceptance by designers. The goal is to reduce risk, improve confidence, and reduce cost of the incorporation of new materials into weapons, airframes, engine, and space applications. Advanced materials and related processes that have matured beyond exploratory development are characterized and critical data is developed to reduce the risk of demonstrating these technologies in Air Force applications. Critical evaluations of materials in the proposed design environment are performed. This design and scale-up data provides confidence to transition new materials to upgrades and future Air Force systems as well as provide the initial incentive for their industrial development.

(U) FY 1996 ($ in Thousands):

- (U) $4,693 Developed defense-related materials technologies and data bases to facilitate timely transition of advanced structures, propulsion, and subsystems materials to warfighters, industry, and academia.
  - (U) Completed transition of high temperature organic matrix composite material to aircraft aft fuselage sections.
  - (U) Demonstrated affordable permanent mold casting technology for titanium.
- (U) $3,345 Developed technologies and data bases to facilitate timely transition of advanced electronics, optics, and survivability materials to warfighters, industry, and academia.
  - (U) Developed infrared (IR) countermeasures materials which will provide lasers with the capability to counter a variety of IR threat munitions.
  - (U) Developed high performance, very long wavelength IR detector materials for space applications.
- (U) $410 Developed technologies and data bases to facilitate timely transition of advanced materials for improved systems support and operational support to warfighters, industry, and academia.
  - (U) Continued to characterize the physical properties of advanced structural materials and provide design allowable data to designers.
  - (U) Evaluated improved materials and materials processes for potential use in aircraft systems.
- (U) $8,448 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems PROJECT 3946

(U) FY 1997 ($ in Thousands):

- (U) $2,979 Develop defense-related materials technologies and data bases to facilitate timely transition of advanced structures, propulsion, and subsystems materials to warfighters, industry, and academia.
  - (U) Scale-up and evaluate improved infrared signature reduction coatings for aircraft.
  - (U) Develop new wrought gamma titanium processes for application in advanced turbine engines.
- (U) $2,725 Develop technologies and data bases to facilitate timely transition of advanced electronics, optics, and survivability materials to warfighters, industry, and academia.
  - (U) Complete demonstration of durable infrared window materials and coatings for high temperature and debris environments.
  - (U) Develop thermal control coatings for space applications.
- (U) $565 Develop technologies and data bases to facilitate timely transition of advanced materials for improved systems support and operational support to warfighters, industry, and academia.
  - (U) Continue to characterize the physical properties of advanced structural materials and provide design allowable data to designers.
  - (U) Continue to evaluate improved materials and materials processes for potential use in aircraft systems.
- (U) $1,670 Develop and demonstrate engineering design trade off methods to allow designers and users to assess affordability versus performance, support cost, risk, etc. in early development.
- (U) $7,939 Total

(U) FY 1998 ($ in Thousands):

- (U) $2,429 Develop technologies and data bases to facilitate timely transition of advanced structures, propulsion, and subsystems materials to warfighters, industry, and academia.
  - (U) Demonstrate lightweight structural composite materials for spacecraft radiators and thermal control components.
  - (U) Demonstrate processing techniques for net shape, low-cost titanium turbine engine components.
- (U) $3,117 Develop technologies and data bases to facilitate timely transition of advanced electronics, optics, and survivability materials to warfighters, industry, and academia.
  - (U) Demonstrate two-color, infrared suppression coatings and treatment for advanced aircraft.
  - (U) Demonstrate a tough, durable, affordable window for infrared imaging sensors for advanced aircraft.
- (U) $445 Develop technologies and data bases to facilitate timely transition of advanced materials for improved systems support and operational support to warfighters, industry, and academia.
  - (U) Continue to characterize the physical properties of advanced structural materials and provide design data to designers.
  - (U) Continue to evaluate improved materials and materials processes for potential use in aircraft systems.
- (U) $5,991 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems PROJECT 3946

(U) FY 1999 ($ in Thousands):

- (U) $2,277 Develop technologies and data bases to facilitate timely transition of advanced structures, propulsion, and subsystems materials to warfighters, industry, and academia.
  - (U) Demonstrate thermal control coatings on advanced, high thermal conductivity composites for spacecraft thermal control.
  - (U) Demonstrate low-cost, wrought titanium aluminide alloys and processing techniques for advanced turbine engines.
- (U) $2,916 Develop technologies and data bases to facilitate timely transition of advanced electronics, optics, and survivability materials to warfighters, industry, and academia.
  - (U) Demonstrate zinc germanium phosphide (ZnGeP) as a tunable laser source for advanced infrared countermeasures.
  - (U) Demonstrate advanced processing techniques for the growth of mercury cadmium telluride infrared detector materials.
- (U) $423 Develop technologies and data bases to facilitate timely transition of advanced materials for improved systems support and operational support to warfighters, industry, and academia.
  - (U) Continue to characterize the physical properties of advanced structural materials and provide design data to designers.
  - (U) Continue to evaluate improved materials and materials processes for potential use in aircraft systems.
- (U) $5,616 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems PROJECT 3946

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	6,454	8,306	8,189	8,612	Cont
(U) Current Budget Submit/FY 1998 PB	8,448	7,939	5,991	5,616	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603202F, Aerospace Propulsion Subsystem Integration.
- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603202F Aerospace Propulsion Subsystem Integration

PROJECT: 668A

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
668A Aircraft Propulsion Subsystem Integration	31,111	27,031	30,564	31,434	32,390	33,553	33,959	34,932	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates gas turbine propulsion system technologies applicable to a broad range of aircraft. The Aircraft Propulsion Subsystem Integration (APSI) program includes demonstrator engines such as the Joint Technology Demonstrator Engine (JTDE) for manned systems and the Joint Expendable Turbine Engine Concept (JETEC) for cruise missile applications. These demonstrator engines apply the core technology developed under the Advanced Turbine Engine Gas Generator (ATEGG) program coupled with affordable and durable system component technology such as low pressure fans and low pressure turbines (LPT), engine controls, and nozzles developed as part of APSI. This program also focuses on system integration aspects of inlets, nozzles, engine/airframe compatibility, and low-observable technologies. APSI will provide aircraft with potential for longer range and higher cruise speed with lower specific fuel consumption; surge power for successful engagements; high sortie rates with reduced maintenance; reduced life cycle cost; and improved survivability resulting in increased mission effectiveness. The APSI program supports the demonstration of performance, cost, and durability goals of the Integrated High Performance Turbine Engine Technology (IHPTET) program. IHPTET is a three phase, totally integrated DOD, DARPA, NASA, and industry initiative focused on doubling turbine engine propulsion capabilities while reducing cost of ownership. The IHPTET program structure provides continuous technology transition for military turbine engine upgrades and derivatives and has the added benefit of enhancing the U.S. turbine engine industry's international competitiveness. Note: In FYs 1998 and out, additional emphasis has been placed on demonstration of IHPTET goals and on high cycle fatigue.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603202F Aerospace Propulsion Subsystem Integration PROJECT 668A

(U) FY 1996 ($ in Thousands):

- (U) $4,679 Designed, fabricated, and demonstrated fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology for turbofan/turbojet engines for current and future Air Force aircraft.
  - (U) Demonstrated low signature, lightweight axisymmetric nozzle.
  - (U) Designed and fabricated distributed and model-based engine controls.
  - (U) Designed and fabricated ceramic composite components for exhaust nozzles.
- (U) $22,363 Designed, fabricated, and tested technology demonstration engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports.
  - (U) Demonstrated a swept aerodynamic fan with hollow metal matrix composite blades.
  - (U) Demonstrated advanced low pressure turbine cooling technology.
  - (U) Designed and fabricated forward swept fan technology.
  - (U) Designed and fabricated Castcool and Internal Convective Enhancement (ICE) turbines.
  - (U) Designed and fabricated integration technologies including metal matrix composite shafts, hybrid ceramic bearings, and counterrotating vaneless turbine.
  - (U) Designed and fabricated variable cycle engine with fixed geometry, fluidic area control, and fluidic thrust vectoring exhaust nozzles.
- (U) $4,069 Designed, fabricated, and tested technology demonstration engines for expendable engines for missile applications.
  - (U) Demonstrated mixed flow turbine and ceramic matrix composite (CMC) turbine shroud on a very low fuel consumption propfan engine.
  - (U) Fabricated high pressure ratio, forward swept compressor stage.
  - (U) Fabricated efficient, lightweight lamilloy hot section with first use of high temperature capable MA754 sheet material for turbine nozzle.
  - (U) Fabricated low-cost, uncooled ceramic hot sections.
- (U) $31,111 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603202F Aerospace Propulsion Subsystem Integration PROJECT 668A

(U) FY 1997 ($ in Thousands):

- (U) $3,952 Design, fabricate, and demonstrate fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology for turbofan/turbojet engines for current and future Air Force aircraft.
  - (U) Complete fabrication and demonstrate distributed and model-based engine controls.
  - (U) Demonstrate ceramic composite components for exhaust nozzles.
- (U) $19,231 Design, fabricate, and test technology demonstration engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports.
  - (U) Complete fabrication and demonstrate forward swept fan technology.
  - (U) Complete fabrication and demonstrate Castcool and Internal Convective Enhancement (ICE) turbines.
  - (U) Complete fabrication and demonstrate integration technologies including metal matrix composite shafts, hybrid ceramic bearings, and counterrotating vaneless turbine.
  - (U) Complete fabrication and demonstrate variable cycle engine with fixed geometry, fluidic area control, and fluidic thrust vectoring exhaust technologies.
- (U) $3,848 Design, fabricate, and test technology demonstration engines for expendable engines for missile applications.
  - (U) Demonstrate high pressure ratio, forward swept compressor stage.
  - (U) Demonstrate efficient, lightweight lamilloy hot section with first use of high temperature capable MA754 sheet material.
  - (U) Demonstrate low-cost, uncooled ceramic hot section.
- (U) $27,031 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603202F Aerospace Propulsion Subsystem Integration PROJECT 668A

(U) FY 1998 ($ in Thousands):

- (U) $26,236 Design, fabricate, and test technology demonstration turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports.
  - (U) Demonstrate laser shock peening to increase durability of turbine engine components.
  - (U) Demonstrate advanced lightweight, high strength materials for turbine engine components.
  - (U) Demonstrate integration technologies including metal matrix composite shafts, hybrid ceramic bearings, and counterrotating vaneless turbine.
  - (U) Demonstrate variable cycle engine with a swirl augmentor and fixed geometry thermal and fluidic area control exhaust nozzle.
  - (U) Demonstrate model-based, distributed and active stability engine controls.
- (U) $4,328 Design, fabricate, and test technology demonstration engines for missile and uninhabited air vehicle applications.
  - (U) Design high temperature shrouded compressor.
  - (U) Design low-cost ceramic matrix composite (CMC) combustor.
  - (U) Design low-cost, high efficiency, uncooled carbon-carbon turbine.
  - (U) Design rich burn nozzle and controls for thrust augmentation.
  - (U) Design advanced engine components to increase affordability and high temperature operation with reduced cooling requirements.
- (U) $30,564 Total

(U) FY 1999 ($ in Thousands):

- (U) $26,105 Design, fabricate, and test technology demonstration engines for turbofan/turbojet engines for fighters, aircraft, bombers, and transports.
  - (U) Design, fabricate, and demonstrate advanced hot section cooling system.
  - (U) Design, fabricate, and demonstrate integral starter/generator.
  - (U) Design more affordable integration technologies including composite hot section components, advanced fan, and low-observable exhaust nozzles.
  - (U) Design fully distributed and active stability engine controls.
- (U) $5,329 Design, fabricate, and test technology demonstration engines for missile and uninhabited air vehicle applications.
  - (U) Fabricate high temperature shrouded compressor.
  - (U) Fabricate low-cost CMC combustor.
  - (U) Fabricate low-cost, high efficiency, uncooled carbon-carbon turbine.
  - (U) Fabricate rich burn nozzle and controls for thrust augmentation.
  - (U) Fabricate advanced engine components that are more affordable and capable of high temperature operation with reduced cooling requirements.
- (U) $31,434 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603202F Aerospace Propulsion Subsystem Integration
	PROJECT 668A

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	28,294	28,318	28,905	29,923	Cont
(U) Appropriated Value	29,818	28,318			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-578	-568			
b. SBIR	-654	-693			
c. Omnibus/Other Above Threshold Reprogrammings	-475	-26			
d. Below Threshold Reprogrammings	+3,000				
(U) Current Budget Submit/FY 1998 PB	31,111	27,031	30,564	31,434	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) PE 0602122N, Aircraft Technology.
- (U) PE 0603217N, Air Systems Advanced Technology Demonstration.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603203F Advanced Avionics for Aerospace Vehicles

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	29,432	27,475	26,507	28,206	29,470	32,039	32,680	33,736	Continuing	Continuing
665A Airborne Sensors Technology	13,190	11,326	12,380	11,314	12,466	14,183	14,744	15,170	Continuing	Continuing
69CK Advanced Electronics	3,363	3,368	1,532	3,078	3,097	3,269	3,288	3,496	Continuing	Continuing
69DF Target Attack and Recognition Technology	12,879	12,781	12,595	13,814	13,907	14,587	14,648	15,070	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification**: This Advanced Technology Development program provides technology to enable continued avionics superiority. Combat aircraft must defeat increasingly sophisticated active and passive countermeasures, destroy a wide variety of targets with precision, and reliably perform complex missions with less logistics support in a world of proliferating threats. This program responds to these needs by developing and demonstrating technologies and techniques for advanced radio frequency sensors (i.e., radar) and electro-optical sensors for airborne and ground targeting including: electronic counter-countermeasures; advanced electronics technologies for improvements in cost, weight, and reliability; fire control/weapon delivery; target identification and recognition technologies; and techniques for precision air and ground target kills. Emphasis is on detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets while providing the capability to adapt to changes in target signatures and background environments. These advanced avionics capabilities will provide for flexible, multi-function/multi-mission combat aircraft that can: safely penetrate threat areas; destroy multiple ground targets per pass; accurately detect and identify targets beyond-visual-range within a complex mix of look-alike friendly, neutral, and enemy aircraft; win aerial engagements; and return to fight again.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles

(U) B. **Program Change Summary ($ in Thousands)**:

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	30,577	28,691	29,944	31,753	Cont
(U) Appropriated Value	32,131	28,691			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-636	-585			
b. SBIR	-616	-605			
c. Omnibus/Other Above Threshold Reprogrammings	-811	-26			
d. Below Threshold Reprogrammings	-636				
(U) Current Budget Submit/FY 1998 PB	29,432	27,475	26,507	28,206	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary**: Not Applicable.

(U) D. **Schedule Profile**: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603203F Advanced Avionics for Aerospace Vehicles

PROJECT: 665A

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
665A Airborne Sensors Technology	13,190	11,326	12,380	11,314	12,466	14,183	14,744	15,170	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: Develops and demonstrates airborne sensor technologies, including electro-optical sensors, radars, and electronic counter-countermeasures (ECCM) for radars. This project provides the warfighter with the capability to precisely detect and target both airborne targets (conventional and low radar cross section) and ground-based, high-value, time-critical targets. Work includes developing both complete sensor capabilities as well as advanced component technologies. The desired warfighting capability includes the ability to detect and target in difficult background conditions, with emphasis on countering improvements in camouflage, concealment, and deception techniques that limit current detection and tracking capability for threats obscured by these means.

(U) FY 1996 ($ in Thousands):

- (U) $1,485 Develop a conformal, low-observable infrared search and track (IRST) window capable of meeting long-range detection requirements while minimizing adverse impacts to the aircraft platform. Integrate sensor, algorithm, and infrared phenomenology models into an IRST end-to-end simulation to evaluate sensor performance. Evaluate concepts for improving look-down performance and reducing IRST size, weight, and cost.
  - (U) Completed evaluation of aero-optical effects in a supersonic wind tunnel.
- (U) $1,530 Develop affordable air-to-air electro-optical sensor technology for long-range target detection and tracking to further reduce complexity, size, and cost of electro-optical sensors.
  - (U) Completed design of compact, affordable sensor for airborne weapon systems which require long-range passive target detection.
- (U) $1,334 Develop airborne, air-to-ground, wind profiling technologies to enhance first shot hit capability of gunships and improve precision air drops from cargo aircraft. This technology will decrease loiter time and increase operational altitude, thus, improving survivability.
  - (U) Demonstrated gunship performance enhancement with airborne wind profiler.
  - (U) Flight-tested wind profiling technologies with Warner Robins Air Logistics Command for application to gunship platforms.
  - (U) Completed fabrication of flight worthy, high-power, reliable laser transceiver for evaluation of wind profiling sensor system.
- (U) $928 Develop and demonstrate, through a multi-Service program, the electro-optical multi-spectral sensor and algorithm technology required to passively search large areas, detect, and target ground-based threats in an open or obscured environment. This is a cooperative effort between the Army, Navy, and Air Force. Passive search allows the user to remain covert.
  - (U) Performed multi-spectral imaging data collections to enable design of airborne sensor for generic reconnaissance platforms.
  - (U) Demonstrated passive targeting of ground-based targets at extended weapon stand-off ranges (>20 km from target).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 665A

– (U) $1,043	Develop, demonstrate, and evaluate advanced laser technologies that provide pilots with positive, timely, and reliable identification information that is compatible with existing identification/identify friend or foe techniques. This technology will be packaged for existing electro-optical systems and provides the multi-mission capability of supporting air-to-air missile launch at 60 km and air-to-ground weapon launch at 15-25 km. – (U) Demonstrated sensor capability at operationally useful ranges. – (U) Evaluated three-dimensional imaging technologies in simulations using tower data and compared to conventional imaging and range-only techniques.
– (U) $1,423	Develop and demonstrate radar electronic counter-countermeasure (ECCM) techniques capable of negating air intercept and synthetic aperture radar electronic countermeasure (ECM) threats. – (U) Developed, trained, and tested neural net algorithms to improve identification of possible jamming sources. – (U) Developed advanced synthetic aperture radar techniques and tested to evaluate susceptibility to jamming. – (U) Developed and evaluated digital radio frequency memory ECCM techniques to negate airborne ECM.
– (U) $1,328	Develop adaptive processing techniques to negate clutter and electromagnetic interference, both intentional and unintentional, for uninterrupted sensor performance and increased detection and targeting performance against sophisticated and low radar cross section targets. – (U) Developed and evaluated algorithms to reduce effects of terrain scattering and radome reflections/clutter and to improve target detection range. – (U) Defined data collection requirements and data analysis plan for selection of algorithms and techniques for advanced airborne radars. – (U) Performed data collection and data reduction/processing for adaptive processing algorithms.
– (U) $2,109	Develop and demonstrate, through an Air Force/Navy/Defense Advanced Research Projects Agency program, the sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques. – (U) Continued to collect data for algorithm development and selection. – (U) Developed real-time, concealed target detection algorithms.
– (U) $2,010	Develop technology required to achieve improved life cycle cost for current and future airborne radar apertures and systems. – (U) Designed radar subsystem interface improvements for affordability and reliability. – (U) Evaluated low-cost synthetic aperture radar motion compensation techniques derived from Global Positioning System technology.
– (U) $13,190	Total

(U) FY 1997 ($ in Thousands):

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 665A

– (U) $218	Develop affordable multi-function electro-optical sensor technology for long-range target detection and track/missile warning. This effort will combine the offensive and defensive functions into a single electro-optical sensor, reducing volume and cost of the overall system. – (U) Define multi-function sensor technologies for an integrated offensive and defensive sensor system.
– (U) $873	Develop airborne, air-to-ground, wind profiling technologies to enhance first shot hit capability of gunships and for greater precision air drops from cargo aircraft. This technology will decrease loiter time and increase operational altitude, thus, improving survivability. – (U) Complete evaluation and transition wind profiling system in cooperation with Warner Robins Air Logistics Command. – (U) Investigate technology issues related to improving cargo drop performance on aircraft utilizing wind profiling.
– (U) $873	Develop and demonstrate, through a tri-Service program, the multi-spectral electro-optical sensor and algorithm technology required to passively search large areas, detect, and target ground-based targets in the open and under cover. Passive search allows the user to remain covert. – (U) Verify multi-spectral targeting sensor performance using tower data for joint United Kingdom/France/U.S. Air Force/U.S. Navy advanced fire control development program.
– (U) $2,255	Develop, demonstrate, and evaluate advanced laser technologies that provide pilots with positive, timely, and reliable identification information that is compatible with existing reliable identification/identify friend or foe techniques. This technology will be packaged for existing electro-optical systems and provide the capability for air-to-air missile launch at 60 km and air-to-ground weapon launch at 15-25 km. – (U) Demonstrate three-dimensional imaging capability in a field test.
– (U) $1,703	Develop and demonstrate radar electronic counter-countermeasure (ECCM) techniques to negate air intercept and synthetic aperture radar electronic countermeasure threats. – (U) Evaluate synthetic aperture radar ECCM techniques that allow all-weather targeting of high-value ground targets while under severe jamming. – (U) Perform laboratory and roofhouse demonstrations of electronic protection techniques for transition to front-line fighters and bombers operating in harsh electronic countermeasure environments.
– (U) $1,703	Develop adaptive processing techniques to negate clutter and electromagnetic interference, both intentional and intentional, for uninterrupted sensor performance and increased detection and targeting performance against sophisticated and low radar cross section targets. – (U) Continue to develop innovative concepts to eliminate clutter and interference from other sensors on board and enable the maximum possible target detection and tracking range. – (U) Use airborne radar data to perform cost/performance trade studies of advanced clutter/interference mitigation techniques.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 665A

- (U) $1,932 Develop and demonstrate, through an Air Force/Navy/Defense Advanced Research Projects Agency program, the radio frequency sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques.
  - (U) Perform ground demonstration of real-time, automatic detection of concealed/camouflaged, high-value, time-critical targets.
  - (U) Develop sensor specification for an airborne, all-weather, concealed target detection sensor.
- (U) $1,769 Develop critical components required to lower life cycle cost of radar apertures for operational and future radar systems.
  - (U) Fabricate low-cost antenna aperture for improved performance of electronic scanned arrays.
  - (U) Perform experiments to evaluate aperture technology for performance and reliability under laboratory conditions and harsh operating environments.
  - (U) Develop radar aperture technology with life cycle cost reduction goal of 20-40%.
- (U) $11,326 Total

(U) FY 1998 ($ in Thousands):

- (U) $3,103 Develop integrated air-to-air and air-to-ground electro-optical sensor technologies to detect and identify targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. This technology will enable warfighters to engage mobile strategic targets.
  - (U) Complete collection of field test data for the design of a day/night multispectral sensor capable of detection of deep hide targets.
  - (U) Initiate a multi-national program to demonstrate affordable, real-time, air-to-ground and air-to-air precision targeting capability from survivable stand-off ranges (20 km).
- (U) $2,483 Develop airborne, air-to-ground wind profiling technologies to enhance accuracy of bomb drops and cargo delivery.
  - (U) Demonstrate modular wind profiler that shows four to ten times improvement in air drop capability from 28,000 feet.
  - (U) Complete design and begin fabrication of wind sensor system to improve unguided bombing accuracies.
- (U) $1,241 Develop and demonstrate radar electronic counter-countermeasure techniques to negate air intercept and synthetic aperture radar electronic countermeasures.
  - (U) Develop electronic protection techniques against emerging threats, including application of neural nets to identify and remove jamming waveforms, and use real radar imagery to assess improvements.
- (U) $3,103 Develop processing techniques to negate clutter and electromagnetic interference, both intentional and unintentional, for uninterrupted sensor performance and increased detection and targeting performance against sophisticated and low radar cross section targets.
  - (U) Refine advanced, integrated, air-to-air/air-to-ground, clutter/interference techniques to restore high performance radar capabilities in severe jamming and clutter environments. Demonstrate a four times improvement in acquisition range through adaptive processing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 665A

- (U) $1,117 Develop and demonstrate the radio frequency sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques.
  - (U) Demonstrate, through and Air Force/Army/Defense Advanced Research Projects Agency program, real-time automatic detection algorithms in unmanned aerial vehicle-sized radar hardware in preparation for flight demonstration of all-weather, obscured target detection.
- (U) $1,333 Develop critical components required to lower life cycle cost of current and future radar systems.
  - (U) Perform experiments to evaluate antenna technology for performance and reliability improvements under laboratory conditions; conduct flight test of an affordable replacement antenna suitable for unmanned aerial vehicles.
  - (U) Conduct flight tests of an advanced antenna for precision weapon delivery.
- (U) $12,380 Total

(U) FY 1999 ($ in Thousands):

- (U) $3,411 Develop integrated air-to-air and air-to-ground electro-optical (EO) sensor technologies to detect and identify targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. This technology will enable warfighters to engage mobile strategic targets.
  - (U) Evaluate integrated EO sensor system components and assess for automatic target recognition capability.
  - (U) Use field test data to fabricate an airborne EO sensor which can operate in day or night and across multiple optical bands.
  - (U) Complete design and initiate fabrication of a multi-national integrated EO sensor.
- (U) $1,705 Develop airborne, air-to-ground wind profiling technologies to enhance accuracy of bomb drops and cargo delivery.
  - (U) Demonstrate wind-corrected bomb drops using a B-52 as a test platform.
- (U) $1,137 Develop and demonstrate radar electronic counter-countermeasure techniques to negate air intercept and synthetic aperture radar electronic countermeasures.
  - (U) Continue to develop electronic protection techniques against emerging threats, including application of neural nets to identify and remove jamming waveforms, and use real radar imagery to assess improvements.
- (U) $2,842 Develop processing techniques to negate clutter and electromagnetic interference, both intentional and unintentional, for uninterrupted sensor performance and increased detection and targeting performance against sophisticated and low radar cross section targets.
  - (U) Conduct laboratory/rooftop demonstration of advanced clutter/interference mitigation techniques for restoring high performance air-to-air and air-to-ground radar capabilities in severe jamming and interference environments.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 665A

– (U) $1,251	Develop and demonstrate the radio frequency sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques. – (U) Evaluate automatic, real-time target detection algorithms for all-weather, obscured target detection radar.
– (U) $968	Develop critical components required to lower life cycle cost of current and future radar systems. – (U) Laboratory/rooftop test low-cost radar subsystem technology to demonstrate performance and reliability improvements.
– (U) $11,314	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 665A

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	13,826	11,833	13,243	14,047	Cont
(U) Current Budget Submit/FY 1998 PB	13,190	11,326	12,380	11,314	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603205F, Flight Vehicle Component and Subsystem Technology.
- (U) PE 0603707F, Weather Systems Advanced Development.
- (U) PE 062111N, Weapons Technology.
- (U) PE 062232N, Space and Electronic Warfare (SEW) Technology.
- (U) PE 0604249F, LANTIRN Night Precision Attack.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) A memorandum of agreement has been established between the Air Force Wright Laboratory and the Defense Advanced Research Projects Agency (DARPA) to jointly develop the technology required to detect high-value, time-critical targets in a variety of environments including deception, camouflage, concealment, and deep hide. This technology also has significant application in the civil sector. DARPA and the Air Force will collaborate with civil agencies where appropriate.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 69CK

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
69CK Advanced Electronics	3,363	3,368	1,532	3,078	3,097	3,269	3,288	3,496	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops and demonstrates military essential microelectronic devices, tools, and components that improve performance, reliability, and affordability of radar, communications, and electronic counter-countermeasure systems for both retrofit and new system applications. Results of the work provide the warfighter with increased sensor capabilities in terms of increased situational awareness, higher accuracy detection and tracking of targets/threats at longer ranges, more precise weapon employment, and increased affordability. This project develops electronics technologies unavailable from commercial sources and includes development of: monolithic solid state transmit/receive modules for airborne radar; high-speed analog-to-digital converters; high reliability electronics power distribution; and microwave/microelectronics packaging and interconnect techniques.

(U) FY 1996 ($ in Thousands):

- (U) $1,652 Develop advanced microelectronics component, power distribution, packaging, and interconnect technologies to provide for ten times reduction in power consumption, cost, weight, and volume of target detection electronics.
  - (U) Developed Phase II multichip assemblies under the integrated circuit encapsulation program.
  - (U) Developed new power architectures and devices for multi-function phased array systems containing analog and digital subsystems.
  - (U) Completed a functional design of a custom integrated circuit which can execute an algorithm for radar signature prediction.
  - (U) Built a graphics generator chip that will result in reduced pilot workload.
- (U) $875 Develop advanced component technologies to integrate multi-function microwave and millimeter wave circuits for reduced airborne sensor cost, weight, and volume, and improved reliability of radar and targeting electronics.
  - (U) Demonstrated the reproducibility and manufacturability of an advanced wide band klystron for applications such as the Airborne Warning and Control System (AWACS).
  - (U) Developed low band millimeter wave power module for interrogator, transponder, communications, and navigation applications.
- (U) $836 Develop advanced multi-function sensor electronics, including integrated analog/digital elements (both radio frequency and electro-optical), to increase reliability, improve performance, and decrease cost, weight, and volume in integrated airborne avionics.
  - (U) Fabricated and tested advanced multiplexers for transmit/receive modules for generic avionics applications.
  - (U) Completed initial component and circuit designs for highly integrated analog/digital microwave receivers which will move the digital interface closer to the antenna to reduce cost and improve performance.
- (U) $3,363 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 69CK

(U) FY 1997 ($ in Thousands):

- (U) $1,641 Develop advanced microelectronics component, power distribution, packaging, and interconnect technologies to provide for reduction in power consumption, cost, weight, and volume of target detection electronics.
  - (U) Demonstrate reliability of inorganic chip seal process that reduces size and cost of packaging for target detection electronics.
  - (U) Fabricate and test advanced power modules for improved efficiency and reliability in phased array radar systems.
- (U) $1,065 Develop advanced component technologies to integrate multi-function microwave and millimeter wave circuits for reduced airborne sensor cost, weight, and volume, and improved reliability of radar and targeting electronics.
  - (U) Demonstrate initial driver and booster amplifier designs; complete final design of low-band microwave power module.
- (U) $662 Develop advanced multi-function sensor electronics, including integrated analog/digital elements (both radio frequency (RF) and electro-optical), to increase reliability, improve performance, and decrease cost, weight, and volume in integrated airborne avionics.
  - (U) Select optimal analog/digital microwave receiver designs which offer greatest overall improvement in cost and performance and initiate development.
  - (U) Develop affordable high performance RF device and packaging technologies which minimize the number of components and size of transmit/receive modules for use in phased array multi-function sensors on manned and unmanned platforms.
- (U) $3,368 Total

(U) FY 1998 ($ in Thousands):

- (U) $627 Develop advanced microelectronics components, power distribution, packaging, and interconnect technologies to reduce power consumption, cost, weight, and volume of emerging military systems such as target detection and tracking electronics.
  - (U) Demonstrate a capability to apply advanced inorganic coatings for the encapsulation of integrated circuits to achieve a ten times reduction in packaging costs while realizing weight savings and performance improvements.
  - (U) Continue development of advanced power supplies with improved efficiency and reliability needed for both analog and digital components used in multi-function phased array radar systems.
- (U) $557 Develop advanced multi-function sensor electronics, including integrated analog/digital applications, to increase reliability, improve performance, and decrease cost, weight, and volume in integrated airborne avionics.
  - (U) Optimize very high-speed digital assemblies that can replace multiple analog assemblies in fighter aircraft radar applications to reduce system volume, complexity, and life cycle costs.
  - (U) Continue development of affordable, high performance RF circuits and packaging technologies for minimum size transmit/receive modules for use in phased array antenna multi-function RF sensors on manned and unmanned platforms.
  - (U) Demonstrate a miniature analog/digital microwave receiver with improved performance and reduced cost.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 69CK

- (U) $348 Develop advanced design automation tools and methods for creating complex electronics/avionics. These tools will significantly lower the development cost and subsequent support costs of all electronic systems.
  - (U) Demonstrate the speed of automated design tools by designing an integrated circuit board for fighter cockpit applications.
- (U) $1,532 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,377 Develop advanced microelectronics components, power distribution, packaging, and interconnect technologies to reduce power consumption, cost, weight, and volume of emerging military systems such as target detection and tracking electronics.
  - (U) Continue to evaluate inorganic coatings for the encapsulation of integrated circuits in multi-chip modules.
  - (U) Demonstrate advanced power supplies with the improved efficiency and reliability needed in both analog and digital components used in multi-function phased array radar systems.
- (U) $619 Develop advanced multi-function sensor electronics, including integrated analog/digital applications, to increase reliability, improve performance, and decrease cost, weight, and volume in integrated airborne avionics.
  - (U) Continue to develop very high-speed digital assemblies that can replace multiple analog assemblies in applications such as fighter aircraft radars to reduce system volume, complexity, and life cycle costs.
  - (U) Fabricate and test affordable, high performance radio frequency (RF) circuits and packaging technologies for minimum size transmit/receive modules used in phased array antenna multi-function RF sensors for manned and unmanned platforms.
- (U) $1,082 Develop advanced design automation tools and methods for creating complex electronics/avionics. These tools will significantly lower the development cost and subsequent support costs of all electronic systems.
  - (U) Employ advanced computer aided design tools to develop a custom integrated circuit that performs the Moving and Stationary Target Acquisition and Recognition (MSTAR) algorithm.
- (U) $3,078 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 69CK

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	3,363	3,515	3,414	3,613	Cont
(U) Current Budget Submit/FY 1998 PB	3,363	3,368	1,532	3,078	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) PE 0603739E, Electronic Manufacturing Technology.
- (U) PE 0603706E, Microwave/Millimeter Wave Integrated Circuits.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 69DF

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
69DF Target Attack and Recognition Technology	12,879	12,781	12,595	13,814	13,907	14,587	14,648	15,070	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition capabilities. The objective of this project includes developing and demonstrating integrated fire control techniques to provide for a capability of adverse-weather air-to-surface precision strike against multiple targets-per-pass and air-to-air engagement at maximum weapon launch range with cooperative launch deployment flexibility. Specific fire control technologies include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. These fire control developments will provide force multiplication and a reduction of exposure to hostile fire. The objectives of this project also include developing and demonstrating technologies to provide for positive, high confidence cueing, recognition, and identification of both airborne and ground-based, high-value, time-critical targets at ranges compatible with tactical air-to-air and air-to-surface weapons in bad weather, day or night, and in high-threat multiple target battle areas. Model-based vision algorithms and target signature development techniques are key to the identification and recognition solution and are pursued in this project in partnership with the Defense Advanced Research Projects Agency. The techniques developed are evaluated to support the Theater Missile Defense efforts in surveillance and attack. The fire control and recognition technologies developed and demonstrated in this project are high leverage in that they provide for significant advancements in operational capabilities largely through software improvements which can be readily transitioned to new and existing systems.

(U) FY 1996 ($ in Thousands):

- (U) $2,640 Develop synthetic signature capability for ground targets to train automatic target recognition algorithms.
  - (U) Developed and performed initial demonstration of camouflage and obscuration models for partially hidden targets.
  - (U) Demonstrated target models for use in training of automatic target recognition algorithms.
- (U) $2,047 Evaluate automatic target recognition algorithms, including model-based vision algorithms, for moving and stationary target acquisition and recognition and for Theater Missile Defense surveillance and attack efforts.
  - (U) Evaluated automatic target recognition algorithms, including moving and stationary target acquisition algorithms, using synthetic and measured data to assess maturity.
- (U) $1,372 Develop advanced hostile target identification technologies to provide a capability for beyond-visual-range, all aspect, high confidence classification and identification of airborne targets.
  - (U) Demonstrated turnkey synthetic signature generation capability to support hostile target identification program.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 69DF

- (U) $2,356 Develop advanced air-to-air engagement and weapon delivery technologies to provide a capability for beyond-visual-range detection, targeting, and weapon deployment against sophisticated and reduced observable airborne threats.
  - (U) Completed critical design for cooperative engagement system for fighter weapon systems.
  - (U) Conducted simulation and ground experiments of cooperative engagement and improved tracking accuracy for air-to-air weapons.
- (U) $564 Develop advanced information fusion technologies to increase air engagement situation awareness and lethality through: longer-range, high confidence identification; integration of offensive and defensive sensor technology; and exploitation of off-board targeting information.
  - (U) Integrated model-based vision algorithms into laboratory test environment to verify operational payoff.
  - (U) Evaluated advanced, multispectral radar fusion, model-based vision algorithms.
- (U) $1,536 Develop advanced tracking algorithms to increase detection range of conventional threats and maintain detection range against low cross section threats. This effort will also increase identification range of airborne threats.
  - (U) Integrated advanced tracking system into airborne data collection device.
  - (U) Collected airborne data and evaluated increase in identification range of advanced tracking algorithms compared to existing tracking systems.
- (U) $2,364 Develop technologies for targeting both moving and stationary ground-based targets utilizing both on-board and off-board targeting information. These technologies provide the targeting solution required to deploy air-to-surface weapons.
  - (U) Completed evaluation of real-time, off-board targeting solutions in support of precision synthetic aperture radar weapon systems.
  - (U) Evaluated off-board targeting schemes for real-time information in the cockpit study using laboratory and airborne data.
- (U) $12,879 Total

(U) FY 1997 ($ in Thousands):

- (U) $2,882 Develop synthetic signature capability for ground targets to train automatic target recognition algorithms.
  - (U) Demonstrate capability to rapidly insert synthetic signatures of new targets into automatic target recognition sensor algorithms.
  - (U) Evaluate tactical target models under camouflage and partial obscuration conditions.
- (U) $1,959 Evaluate algorithms, including model-based vision algorithms, for moving and stationary target acquisition and recognition and for theater missile defense surveillance and attack efforts.
  - (U) Demonstrate and evaluate maturity of end-to-end algorithms, including moving and stationary target acquisition, for insertion into theater missile defense demonstration efforts.
- (U) $1,418 Develop advanced hostile target identification technologies to provide a capability for beyond-visual-range, all aspect, high confidence classification and identification of airborne targets.
  - (U) Continue to demonstrate synthetic signature generation capability to support fielded automatic target recognition systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 69DF

- (U) $283 Develop advanced air-to-air engagement and weapon delivery technologies to provide for a beyond-visual-range detection, targeting, and weapon deployment capability against sophisticated and reduced observable airborne threats.
  - (U) Develop cooperative engagement subsystem technology for fighter weapon systems.
  - (U) Evaluate cooperative engagement and tracking accuracy development for air-to-air weapon deployment through continued simulation and ground-based experiments.
- (U) $591 Develop advanced information fusion technologies to increase air engagement situation awareness and lethality through: longer-range, high confidence identification; integration of offensive and defensive sensor technology; and exploitation of off-board targeting information.
  - (U) Complete ground-to-air testing at the Radar Test Facility of multispectral radar signal fusion techniques.
  - (U) Integrate multispectral radar signal fusion into airborne data collection system.
  - (U) Collect airborne data and analyze multispectral radar signature fusion technologies.
- (U) $2,679 Develop advanced tracking algorithms to increase detection range of conventional threats and maintain detection range against low cross section threats. This effort will also increase identification range of airborne threats.
  - (U) Continue to collect airborne data to evaluate the increase in identification range provided by advanced tracking algorithms versus existing tracking systems.
- (U) $2,969 Develop technologies for targeting both stationary and moving ground-based threats with precision, utilizing both on-board and off-board targeting information. These technologies provide the targeting solution required to release air-to-surface weapons.
  - (U) Complete performance evaluation of advanced targeting techniques using real-time, off-board information.
  - (U) Complete analysis of off-board targeting concepts and provide option to transition to operational aircraft.
- (U) $12,781 Total

(U) FY 1998 ($ in Thousands):

- (U) $3,788 Develop and demonstrate advanced air-to-air detection, tracking, identification, and engagement technologies to provide beyond-visual-range, all-aspect, high confidence classification, identification, targeting, and all-aspect weapon deployment against conventional and reduced-signature airborne threats.
  - (U) Complete development and transition of turnkey synthetic signature generation capability to support hostile airborne target identification program.
  - (U) Investigate the use of advanced sensor suites and off-board sources for long-range, high-confidence identification of airborne targets.
  - (U) Develop preliminary design for all-aspect fire control system based on integration of offensive and defensive sensors.
  - (U) Complete ground-to-air testing of radar fusion techniques for combining radar identification modes.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 69DF

- (U) $2,525 Develop and demonstrate advanced situation awareness technologies to increase air-to-ground engagement lethality and survivability through: integration of offensive and defensive sensor technology; exploitation of off-board threat and targeting information; and timely usage of Real-Time Information Out of the Cockpit (RTOC).
  - (U) Design a RTOC approach to improve operational battle damage assessment effectiveness.
  - (U) Demonstrate embedded multi-source fusion subsystem to integrate electronic intelligence information with synthetic aperture radar imagery at reconnaissance stations.
  - (U) Develop concept for real-time embedded multi-source fusion system to vastly improve tactical aircraft situational awareness.
- (U) $6,282 Develop and demonstrate innovative air-to-ground Automatic Target Recognition (ATR) and identification technologies to increase capacity to detect, identify, and target hostile ground forces.
  - (U) Develop an integrated ATR/fusion algorithm design testbed to enable multi-sensor ATR and identification for both reconnaissance/intelligence and strike platforms.
  - (U) Demonstrate and evaluate current algorithms for air-to-ground, high range resolution algorithm that supports the longer radar timelines of reconnaissance radar.
  - (U) Measure performance of air-to-ground ATR algorithms using enhanced radar, third generation forward-looking infrared (FLIR), and multi-spectral ATR data.
  - (U) Complete critical design of hardware and software modifications to a fire control radar needed for an advanced capability to identify friendly and hostile ground forces.
- (U) $12,595 Total

(U) FY 1999 ($ in Thousands):

- (U) $4,164 Develop and demonstrate advanced air-to-air detection, tracking, identification, and engagement technologies to provide beyond-visual-range, all-aspect, high confidence classification, identification, targeting, and all-aspect weapon deployment against conventional and reduced-signature airborne threats.
  - (U) Continue investigation of advanced sensor suites and off-board sources for long-range, high-confidence identification of airborne targets.
  - (U) Complete critical design for all-aspect fire control system based on integration of offensive and defensive sensors.
  - (U) Continue to develop radar fusion techniques for combining radar identification modes.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 69DF

– (U) $2,493	Develop and demonstrate advanced situation awareness technologies to increase air-to-ground engagement lethality and survivability through: integration of offensive and defensive sensor technology; exploitation of off-board threat and targeting information; and timely usage of Real-Time Information Out of the Cockpit (RTOC). – (U) Evaluate effectiveness of RTOC approach to improve operational battle damage assessment. – (U) Continue to demonstrate embedded multi-source fusion subsystem to integrate electronic intelligence information with synthetic aperture radar imagery at reconnaissance stations. – (U) Develop concept for real-time embedded multi-source fusion system to vastly improve tactical aircraft situational awareness.
– (U) $7,157	Develop and demonstrate innovative air-to-ground Automatic Target Recognition (ATR) and identification technologies to increase capacity to detect, identify, and target hostile ground forces. – (U) Continue to develop an integrated ATR/fusion algorithm design testbed to enable multi-sensor ATR and identification for both reconnaissance/intelligence and strike platforms. – (U) Select optimal algorithm for air-to-ground, high range resolution algorithm that supports the longer timelines of reconnaissance radar. – (U) Evaluate performance of air-to-ground ATR algorithms using enhanced radar, third generation forward-looking infrared (FLIR), and multi-spectral ATR data. – (U) Begin hardware and software modifications to a fire control radar to demonstrate advanced capability for identification of friendly and hostile ground forces.
– (U) $13,814	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Avionics for Aerospace Vehicles PROJECT 69DF

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	13,388	13,343	13,287	14,093	Cont
(U) Current Budget Submit/FY 1998 PB	12,879	12,781	12,595	13,814	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603253F, Advanced Avionics Integration.
- (U) PE 0603726E, Sensor and Guidance Technology
- (U) Theater Missile Defense System Program Office.
- (U) Low Altitude Night Targeting and Infrared Navigation (LANTIRN) System Program Office.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603205F Flight Vehicle Technology

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	10,034	8,052	5,766	6,442	7,218	7,245	7,423	7,908	Continuing	Continuing
2978 Flight Vehicle Technologies	7,400	5,920	4,484	4,276	5,792	5,957	6,220	6,426	Continuing	Continuing
4398 Air Base Technology	2,634	2,132	1,282	2,166	1,426	1,288	1,203	1,482	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates advanced vehicle subsystems, aerodynamic/flight controls, and vehicle-pilot integration technologies for improved performance, improved survivability, and reduced logistics support. This program also demonstrates technologies for fixed and bare base assets, including airfield pavements, energy systems, automation, air base survivability, air base recovery, protective systems, fire protection, and crash rescue. Note: FY 1998 decrease reflects reduced investments in aircraft tire, landing gear, and airbase operations technologies, while the increase in FY 1999 and out is to begin fabrication of a flight critical electric stabilator actuator needed for outyear flight tests.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	10,250	8,433	7,395	8,530	Cont
(U) Appropriated Value	10,793	8,433			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-209	-169			
b. SBIR	-234	-204			
c. Omnibus/Other Above Threshold Reprogrammings	-167	-8			
d. Below Threshold Reprogrammings	-149				
(U) Current Budget Submit/FY 1998 PB	10,034	8,052	5,766	6,442	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603205F Flight Vehicle Technology

PROJECT: 2978

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2978 Flight Vehicle Technologies	7,400	5,920	4,484	4,276	5,792	5,957	6,220	6,426	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program designs, develops, demonstrates, and integrates air vehicle technologies for improved performance, reliability, maintainability, and supportability while increasing affordability, survivability, and mission effectiveness. It is focused on exploiting advancements in air vehicle component and subsystem technologies, aerodynamic/flight control technologies, and vehicle-pilot integration technologies.

(U) FY 1996 ($ in Thousands):

- (U) $5,864 Develop and demonstrate advanced/integrated air vehicle component subsystems and cockpit technologies to reduce volume, weight, complexity, and cost of required spares through improved reliability, affordability, and maintainability.
  - (U) Completed design of a computational system to quantitatively predict life cycle environmental conditions for air vehicles and external stores. Demonstrated the benefits of predictive technology techniques in the field to the user.
  - (U) Conducted analysis and evaluation of an advanced fighter aircraft main tire compound and tread design suitable for today's fleet and for future aircraft upgrades which has significantly longer lifetime and reduced logistics/deployment requirements.
  - (U) Completed final design of a unique air vehicle tire wear assessment system which can simulate operational loads in a controlled environment.
- (U) $1,536 Develop and demonstrate advanced air vehicle and flight control concepts to provide a combat advantage for the next generation aircraft by increasing performance and survivability while decreasing both cost and supportability requirements.
  - (U) Completed the assessment and evaluation of the electromechanical actuator design for flight test demonstration.
  - (U) Conducted initial flight tests of the electrohydrostatic aileron actuator design on an F/A-18 aircraft which will establish a baseline for electric actuation technology as a primary method of flight control.
- (U) $7,400 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology
	PROJECT 2978

(U) FY 1997 ($ in Thousands):

- (U) $5,676 Develop and demonstrate advanced/integrated air vehicle component subsystems and vehicle-pilot integration technologies to reduce volume, weight, complexity, and cost of required spares through improved reliability, affordability, and maintainability.
  - (U) Complete development and demonstration of the computational system to quantitatively predict life cycle environmental conditions for air vehicles and external stores and make available for transition to System Program Office and Air Logistics Center users.
  - (U) Complete the development and demonstration of an advanced fighter aircraft main tire compound and tread design suitable for today's fleet and for future aircraft upgrades which has significantly longer lifetime and reduced logistics/deployment requirements.
  - (U) Correlate advanced analytical model predictions with realistic operational load measurements of tread wear obtained from the unique air vehicle tire wear assessment system; establish the baseline for using new tire design technology to obtain extended tire life.
  - (U) Develop and demonstrate advanced radial tire retreading technology for current and future fighter aircraft applications; establish the cost benefits and determine the reliability of retread tire technology for aircraft tire usage.
  - (U) Develop on-board software for automatic in-flight mission re-planning, trajectory generation, flight control coupling, and vehicle-pilot integration in order to reduce pilot workload when off-board information enters the cockpit.
- (U) $244 Develop and demonstrate advanced air vehicle and flight control concepts to provide a combat advantage for the next generation aircraft by increasing performance and survivability while decreasing both cost and supportability requirements.
  - (U) Complete flight tests of both the electrohydrostatic aileron actuator and the electromechanical aileron actuator design on an F/A-18 aircraft which will establish a baseline for totally eliminating hydraulic fluid from flight control actuation.
  - (U) Assess future fighter aircraft development requirements to identify design and test opportunities which can exploit the application of advanced electric flight control technologies to effectively reduce aircraft weight, ground support equipment, and maintenance while improving aircraft reliability.
- (U) $5,920 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology PROJECT 2978

(U) FY 1998 ($ in Thousands):

- (U) $2,923 Develop revolutionary Future Aircraft Technology Enhancements (FATE) by integrating high payoff air vehicle technologies that address and optimize synergistic benefits.
  - (U) Complete evaluation of enhanced fighter tire life through aircraft testing and correlation with unique air vehicle tire wear assessment system and analytical model predictions for current and future aircraft application.
  - (U) Continue developing on-board software for automatic in-flight mission re-planning, trajectory generation, flight control coupling, and vehicle-pilot integration.
  - (U) Develop software for multiple ship integrated control strategies to enable the safe and effective cooperative employment of manned and unmanned strike vehicles for air combat operations.
- (U) $1,561 Develop and demonstrate advanced integrated air vehicle subsystems to provide increased performance and survivability while decreasing both cost and supportability requirements.
  - (U) Develop a flight worthy electric stabilator actuator design for future flight demonstration testing that exploits advanced electric flight control technologies to effectively reduce aircraft weight, ground support equipment, and maintenance while improving aircraft reliability.
  - (U) Demonstrate structural integrity of injection molded frameless fighter aircraft windshields to improve aircraft range and optics performance while lowering cost. Make this technology available for further risk reduction and application to current and future fighter aircraft.
- (U) $4,484 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology PROJECT 2978

(U) FY 1999 ($ in Thousands):

- (U) $2,996 Develop revolutionary Future Aircraft Technology Enhancements (FATE) by integrating high payoff air vehicle technologies that address and optimize synergistic benefits.
  - (U) Integrate display designs for automatic in-flight mission re-planning, trajectory generation, flight control coupling, and cockpit controls in order to reduce pilot workload when off-board information enters the cockpit.
  - (U) Continue to develop algorithms for multiple ship integrated control strategies to enable the safe and effective cooperative employment of manned and unmanned strike vehicles for air combat operations.
  - (U) Develop conceptual design for low-cost advanced aerodynamic flight demonstrator
- (U) $1,280 Develop and demonstrate advanced integrated air vehicle subsystems to provide increased performance and survivability while decreasing both cost and supportability requirements.
  - (U) Fabricate a flight critical electric stabilator actuator for flight demonstration in an F/A-18 aircraft to enable advanced electric flight control technologies for reducing aircraft weight, ground support equipment, and maintenance while improving aircraft reliability.
- (U) $4,276 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology PROJECT 2978

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	7,614	6,200	5,325	6,142	Cont
(U) Current Budget Submit/FY 1998 PB	7,400	5,920	4,484	4,276	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0603216F, Aerospace Propulsion and Power.
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1997
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603205F Flight Vehicle Technology		PROJECT: 4398

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4398 Air Base Technology	2,634	2,132	1,282	2,166	1,426	1,288	1,203	1,482	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**: This project develops technologies for fixed and bare base operations, including airfield pavements, energy systems, air base survivability, air base recovery, protective systems, fire protection, and crash rescue.

(U) FY 1996 ($ in Thousands):

- (U) $1,041 Develop and demonstrate technologies for improved bare base and fixed site applications (e.g., survivable air base structures and durable or repairable airfield surfaces).
  - (U) Developed portable ground penetrating radar and user interface for rapid evaluation of bare base contingency runway conditions.
  - (U) Developed in-theater material hardening methods to protect contingency air base assets at 25-30% reduction in cost.
  - (U) Developed new air mobile structures and on-site hardening techniques to improve bare base and contingency site operations.
  - (U) Conducted field test on pavement repairs with non-standard, in-theater materials.
- (U) $1,593 Develop aircraft and air base fire fighting and power generation technologies (e.g., clean, environmentally-safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems; lightweight generator systems; and advanced fuel cells).
  - (U) Completed development of a combined fire fighting and hazardous materials ensemble, providing firefighters with a greater ability to operate in intense heat and hazardous environments.
  - (U) Developed advanced hypergolic vapor and fuel fire detection/suppression technologies.
  - (U) Completed development of lightweight generator system for bare base application, resulting in 30% decrease in weight and 40% decrease in size, and transitioned to Airbase Operability System Program Office.
  - (U) Developed a concept to reduce and stabilize bare base waste stream management by integrating treatment, incineration, and recycling.
  - (U) Developed technologies for improved fire fighting agents, equipment, and techniques to fight large frame aircraft fires, including interior and flowing fuel fires.
  - (U) Built brassboard for an advanced cycle mobile heat pump unit that eliminates the need for ozone-depleting refrigerants and is 30% more efficient than current air base units.
- (U) $2,634 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology
	PROJECT 4398

(U) FY 1997 ($ in Thousands):

- (U) $878 Develop and demonstrate technologies for improved bare base and fixed site applications (e.g., survivable air base structures, and durable or repairable airfield surfaces).
  - (U) Complete development of man-portable ground penetrating radar for bare base contingency runway conditions.
  - (U) Assess advanced hardening techniques and processes for upgrading existing air base buildings and assets.
  - (U) Complete development of protective systems using in-theater materials to harden critical air base assets in contingency operations.
  - (U) Demonstrate deployable pavement evaluation techniques for rapid assessment of bare base runway conditions.
- (U) $1,254 Develop aircraft and air base fire fighting and power generation technologies (e.g., clean, environmentally-safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems; lightweight generator systems; and advanced fuel cells).
  - (U) Continue development of advanced hypergolic vapor and fuel fire detection/suppression technologies.
  - (U) Demonstrate performance of environmentally acceptable aqueous film forming foam, a replacement agent for Halon.
  - (U) Complete large frame aircraft fire fighting program to aid in extinguishing external and internal fires of transport aircraft.
  - (U) Conduct field tests of brassboard for advanced cycle mobile heat pump.
  - (U) Complete development of control improvements in backup power generation systems.
  - (U) Develop vision enhancement technologies to assist firefighters in search and rescue operations.
  - (U) Develop advanced fire crash and rescue vehicle technologies to assist firefighters in search and rescue operations.
  - (U) Demonstrate conversion of bare base waste stream into an energy source.
- (U) $2,132 Total

(U) FY 1998 ($ in Thousands):

- (U) $1,282 Develop aircraft and air base fire fighting technologies (e.g., clean, environmentally-safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, fire fighter training systems) and air base operations technologies.
  - (U) Complete development of advanced streaming agent to replace Halon 1211.
  - (U) Complete development of biodegradable aqueous film forming foam replacement.
  - (U) Complete development of advanced rescue vision system for search and rescue operations.
  - (U) Complete development of enhanced fire crash and rescue technologies.
- (U) $1,282 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology
	PROJECT 4398

(U) FY 1999 ($ in Thousands):

- (U) $2,166 Develop aircraft and air base fire fighting technologies (e.g., clean, environmentally-safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, fire fighter training systems) and air base operations technologies.
  - (U) Develop an agent dispensing system to increase effectiveness of crash rescue vehicles.
  - (U) Demonstrate fire fighter technologies that provide realistic training and protect the environment by avoiding the use of hazardous fire fighting agents.
  - (U) Validate advanced aircraft hanger fire protection method.
- (U) $2,166 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology
	PROJECT 4398

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	2,636	2,233	2,070	2,388	Cont
(U) Current Budget Submit/FY 1998 PB	2,634	2,132	1,282	2,166	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0603307F, Air Base Operability Advanced Technology Development.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603211F Aerospace Structures

PROJECT: 486U

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
486U Advanced Aerospace Structures	12,033	9,945	15,032	17,745	16,629	15,471	16,980	17,570	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Starting in FY 1997, this Program Element consolidates work done under its two Projects (486U and 69CW) into a single Project (486U). In addition, the title of Project 486U changes from *Advanced Metallics* to *Advanced Aerospace Structures*. For clarity, FY 1996 funding reflects this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates affordable aircraft structures by utilizing innovative metallic and composite structures technologies to reduce the cost of airframe ownership. Innovative structural concepts integrate these two types of materials with design and monitoring techniques to develop and demonstrate solutions and repairs for corrosion fatigue, multi-site damage fatigue, and other damage to which aging aircraft are susceptible. The goal of this program is to develop technologies to restore structural integrity, extend life, and improve survivability of the current fleet. The results are less maintenance intensive, more durable, and more dependable structures for current aerospace systems. This yields lower cost of ownership (by delaying acquisition and by reducing support and maintenance costs), restored and improved sortie rates (due to durability, damage or threat tolerance, and design for supportability), and reduced observability (both radar cross section and infrared). Note: In FYs 1998 and out, additional emphasis has been placed on aerospace structures technology to meet user needs identified by the Air Force aging aircraft initiative to extend the life of existing operational aircraft.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Structures
	PROJECT 486U

(U) FY 1996 ($ in Thousands):

- (U) $2,092 Develop and assess processes for extending the structural life of aircraft.
  - (U) Completed fabrication and installation of a wing spar for replacement of corrosion-sensitive structural components in existing aircraft.
  - (U) Conducted full-scale test setup of a structural demonstration article for a fighter bulkhead with structural monitoring capability to automate the inspections for crack detection while decreasing maintenance, repair, and replacement requirements.
- (U) $3,094 Improve durability and performance of vehicle structures operating in extreme thermal and acoustic environments.
  - (U) Completed designs and fabricated small, metallic, exhaust-impinged aft fuselage subcomponents to overcome structural failures in components in severe thermal and acoustic environments.
  - (U) Conducted preliminary testing of an advanced wing box component for high-temperature military airframe applications.
  - (U) Developed concept for high-temperature aft fuselage section to reduce weight and increase performance.
- (U) $5,845 Develop advanced structural concepts and design methods for existing and future air vehicles.
  - (U) Completed preliminary design of a battle-damage resistant aircraft structural component to demonstrate increased aircraft survivability.
  - (U) Selected materials for employing sandwich structures in primary aircraft applications.
  - (U) Completed live fire test on bonded composite wing subcomponents to demonstrate survivability.
- (U) $1,002 Develop advanced airframe design concepts which integrate structures with distributed actuators and sensors.
  - (U) Completed fabrication of conformal, load bearing antenna structure, combining avionics and structural elements, to reduce cost, weight, and drag, improve low-observance characteristics, and provide new and improved antenna performance.
- (U) $12,033 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Structures PROJECT 486U

(U) FY 1997 ($ in Thousands):

- (U) $1,596 Develop and assess processes for extending the structural life of aircraft.
  - (U) Conduct ground testing of an installed wing spar for replacement of corrosion-sensitive components in an existing aircraft.
  - (U) Develop preliminary corrosion fatigue predictive models which incorporate observed corrosion phenomenon of operational aircraft structures to better assess structural integrity, life, and intervals of inspection for corrosion affected components in existing aircraft.
  - (U) Develop composite repair processes for damaged and cracked metallic components for existing aircraft applications.
  - (U) Demonstrate built-in structural health monitoring in a full-scale fighter bulkhead; evaluate for capability to automate crack growth inspections and, thereby, reduce structural maintenance, repair, and replacement costs.
- (U) $2,115 Improve durability and performance of vehicle structures operating in extreme thermal and acoustic environments.
  - (U) Complete laboratory testing of small metallic, exhaust-impinged aft fuselage subcomponents and fabricate a larger subcomponent to overcome structural failures of components in severe thermal and acoustic environments.
  - (U) Complete testing of an advanced wing box component on a military aircraft airframe subject to extreme, high temperatures and assess its impact on aircraft survivability.
  - (U) Complete preliminary design of an integrated aft fuselage and nozzle section structure to reduce weight and improve aircraft performance.
- (U) $5,783 Develop advanced structural concepts and design methods for future and existing air vehicles.
  - (U) Conduct detailed design of aircraft structural component to demonstrate significant increase in survivability of existing military aircraft.
  - (U) Complete detailed design of sandwich structures that reduce weight and cost in aircraft primary structure applications.
  - (U) Complete durability and damage testing of a composite fuselage structure which will reduce manufacturing costs by 50% and supportability costs by 25%.
  - (U) Complete preliminary design of a flexible wing that twists to control flight, significantly improving maneuverability and range, and reducing air vehicle structural weight.
  - (U) Complete detailed design of an advanced, affordable airframe that maximizes use of composite structures.
- (U) $451 Develop advanced airframe concepts which integrate structures with distributed actuators and sensors.
  - (U) Complete ground test of conformal, load bearing antenna structure which reduces cost, weight, drag, and enhances low-observable characteristics while providing new and improved antenna performance.
- (U) $9,945 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Structures PROJECT 486U

(U) FY 1998 ($ in Thousands):

- (U) $5,034 Develop and assess processes for extending the structural life of aircraft.
  - (U) Complete ground and flight tests of a wing spar to demonstrate replacement of corrosion-sensitive components in an existing aircraft.
  - (U) Conduct element and component testing for corrosion fatigue predictive models, assess their utility in predicting structural integrity, life, and required intervals of inspection for corrosion affected components in existing aircraft.
  - (U) Develop composite repair processes for damaged and cracked components in existing aircraft.
  - (U) Develop predictive model and repair techniques for widespread fatigue damage in existing aircraft.
- (U) $3,002 Improve durability and performance of vehicle structures operating in extreme thermal and acoustic environments.
  - (U) Complete laboratory testing of a large metallic, exhaust-impinged aft fuselage subcomponent to overcome structural failures in severe thermal and acoustic environments.
  - (U) Complete detailed design of an integrated aft fuselage and nozzle section structures to reduce weight and improve aircraft performance.
- (U) $6,996 Develop advanced structural concepts and design methods for future and existing air vehicles.
  - (U) Complete fabrication of sandwich structure component that reduces weight and cost in aircraft primary structure applications.
  - (U) Complete development of flight computer software for flight demonstration of a flexible wing that twists to control flight, significantly improving maneuverability, increasing range, and reducing air vehicle structural weight.
  - (U) Fabricate 65%-scale advanced airframe designed to reduce life cycle costs by maximizing use of composite structures.
- (U) $15,032 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Structures PROJECT 486U

(U) FY 1999 ($ in Thousands):

- (U) $4,607 Develop and assess processes for extending the structural life of aircraft.
  - (U) Continue to develop corrosion fatigue predictive model to assess structural integrity, life, and intervals of inspection for corrosion affected components in existing aircraft.
  - (U) Continue to develop composite repair process for damaged and cracked components in existing aircraft.
  - (U) Develop predictive model for widespread fatigue damage in existing aircraft.
- (U) $4,517 Improve durability and performance of vehicle structures operating in extreme thermal and acoustic environments.
  - (U) Complete laboratory testing of a metallic, exhaust-impinged aft fuselage subcomponent to overcome structural failures of components in severe thermal and acoustic environments.
  - (U) Complete fabrication of an integrated aft fuselage and nozzle section structures to reduce weight and improve aircraft performance.
  - (U) Conduct subscale wind tunnel tests of noise suppression techniques to reduce structural damage and missile and store separation problems in weapons bays of existing aircraft.
- (U) $8,621 Develop advanced structural concepts and design methods for future and existing air vehicles.
  - (U) Fabricate a full-scale structural component to demonstrate significant increase in survivability of existing military aircraft.
  - (U) Complete ground testing of sandwich structural component that reduces weight and cost in aircraft primary structure applications.
  - (U) Complete modification of an aircraft for flight demonstration of a flexible wing that twists to control flight, significantly improving maneuverability and range, and reducing air vehicle structural weight.
  - (U) In preparation for joint program, complete fabrication of a 65%-scale advanced airframe designed to reduce life cycle costs by maximizing use of composite structures.
- (U) $17,745 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Structures	PROJECT 486U

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	12,615	10,423	17,111	17,931	Cont
(U) Appropriated Value	13,269	10,423			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-257	-210			
b. SBIR	-277	-258			
c. Omnibus/Other Above Threshold Reprogrammings	-202	-10			
d. Below Threshold Reprogrammings	-500				
(U) Current Budget Submit/FY 1998 PB	12,033	9,945	15,032	17,745	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY
3 - Advanced Technology Development

PE NUMBER AND TITLE
0603216F Aerospace Propulsion and Power Technology

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	39,365	36,506	37,014	39,836	41,516	43,338	44,677	45,891	Continuing	Continuing
2480 Aerospace Fuels and Atmospheric Propulsion	6,811	4,025	1,625	2,145	2,305	2,276	3,256	3,387	Continuing	Continuing
3035 Aerospace Power Systems Technology	2,589	2,605	3,682	3,467	3,917	4,073	4,319	4,519	Continuing	Continuing
681B Advanced Turbine Engine Gas Generator	29,965	29,876	31,707	34,224	35,294	36,989	37,102	37,985	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, Project 2480, Aerospace Fuels Technology, and Project 2697, Atmospheric Propulsion Concepts, are combined into a single project, Project 2480, Aerospace Fuels and Atmospheric Propulsion. The total PE costs shown for FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates affordable turbine engine high pressure core components, advanced airbreathing engine concepts, high heat sink and thermally stable fuels, and power technology for aerospace vehicles. Anticipated technology advances include turbine engine improvements providing a 33% reduction in aircraft takeoff gross weight for tactical fighter aircraft and a 100% increase in aircraft range/loiter; ducted rocket improvements that increase missile average and terminal velocity by 50% and range by 100% for enhanced lethality; higher temperature fuels for propulsion and thermal management; an aircraft battery with a 20-year maintenance-free life expectancy; and electric aircraft power components projected to provide a two- to five-fold improvement in reliability and maintainability, a 20% reduction in power system weight, and enhanced survivability. Note: In FYs 1998 and out, additional emphasis has been placed on demonstrating Integrated High Performance Turbine Engine Technology (IHPTET) goals. Also, increases across the Future Years Defense Plan (FYDP) reflect demonstration of the aircraft electric power distribution system. Starting in FY 1998, all high-speed propulsion efforts in Project 2480 are terminated.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	39,632	38,264	39,282	41,279	Cont
(U) Appropriated Value	41,779	38,264			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-810	-765			
b. SBIR	-934	-957			
c. Omnibus/Other Above Threshold Reprogrammings	-658	-36			
d. Below Threshold Reprogrammings	-12				
(U) Current Budget Submit/FY 1998 PB	39,365	36,506	37,014	39,836	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: High-speed propulsion efforts terminated as of FY 1998.

Technical: High-speed propulsion efforts terminated as of FY 1998.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT: 2480

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2480 Aerospace Fuels and Atmospheric Propulsion	6,811	4,025	1,625	2,145	2,305	2,276	3,256	3,387	Continuing	Continuing

Note: Beginning in FY 1998, Project 2480, Aerospace Fuels Technology, and Project 2697, Atmospheric Propulsion Concepts, are combined into a single project, Project 2480, Aerospace Fuels and Atmospheric Propulsion. The total PE costs shown for FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** Develops and demonstrates new thermally stable and high heat sink fuels and advanced fuel system components that minimize cost, reduce maintenance, and improve performance of aircraft and missiles. Emphasis is on demonstrating the effects/benefits of 1) JP-8+100 on current systems, and 2) advanced high temperature fuel system designs and components on upgraded and advanced systems. Demonstrates unconventional airbreathing propulsion subsystems such as ramjets, air turborockets, dual-mode ramjets, and combined/advanced-cycle engines to assure future propulsion options for high-speed missiles. Currently, the Variable Flow Ducted Rocket (VFDR) concept is being developed as an improved propulsion system for current missile upgrades or future missile systems developments. Note: Starting in FY 1998, all high-speed propulsion efforts in Project 2480 are terminated.

(U) FY 1996 ($ in Thousands):

- (U) $1,637 Demonstrated thermally stable JP-8+100 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.
  - (U) Completed demonstration of JP-8+100 effects on turbine materials and on fuel gauging systems.
  - (U) Demonstrated effects/benefits of JP-8+100 in component and engine stand tests of F110, TF34, and J85 engines.
- (U) $674 Demonstrated advanced fuel system designs and high temperature components that permit utilization of the increased cooling capacity of JP-8+100 and high heat sink fuels.
  - (U) Designed and fabricated a reduced-scale fan bleed-air/fuel heat exchanger, designed as an aircraft upgrade that will eliminate recirculation of hot fuel through a less efficient ram air/fuel heat exchanger.
  - (U) Continued analysis of fuel system design/hardware to permit utilization of the higher cooling capacity of JP-8+100.
- (U) $4,405 Developed VFDR for airbreathing missile applications. This effort transitions technology to current and future tactical missiles providing longer range, higher velocities, and increased maneuverability, resulting in improved overall missile effectiveness.
  - (U) Performed rocket-to-ramjet mode transition testing to demonstrate technology maturity for missile propulsion applications.
  - (U) Completed ramburner performance testing.
  - (U) Completed fabrication of flightweight engines for rocket-to-ramjet transition and performance documentation testing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology PROJECT 2480

- (U) $95 Developed high-speed propulsion systems for manned and unmanned applications. This effort provides technology for future missile systems, where time-to-target is critical, and technology for next generation reconnaissance/strike vehicles and airbreathing boosters.
  - (U) Planned design/development of dual-mode ramjet engines for high-speed missiles for destroying high value, time-critical targets.
  - (U) Planned design/development of combined/advanced-cycle engines for manned and unmanned high-speed vehicles applicable to reconnaissance/strike missions.
- (U) $6,811 Total

(U) FY 1997 ($ in Thousands):

- (U) $1,561 Demonstrate thermally stable JP-8+100 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.
  - (U) Demonstrate effects/benefits of JP-8+100 in component and engine stand tests of T64, F101, and TF53 engines.
  - (U) Demonstrate reduced fuel system maintenance in aircraft (T-37, T-38, C-130) by conducting field trial of JP-8+100 at selected bases.
- (U) $253 Demonstrate advanced fuel system designs and high temperature components that permit utilization of the increased cooling capacity of JP-8+100 and high heat sink fuels.
  - (U) Demonstrate high heat sink fuel capacity of JP8+100 in a reduced-scale fuel/air heat exchanger designed to replace less efficient ram air/fuel heat exchangers for engine cooling in upgraded systems.
- (U) $2,111 Develop Variable Flow Ducted Rocket (VFDR) for airbreathing missile applications. This effort transitions technology to current and future tactical missiles providing longer range, higher velocities, and increased maneuverability, resulting in improved overall missile effectiveness.
  - (U) Complete rocket-to-ramjet mode transition and performance documentation testing to demonstrate technology maturity for advanced missile propulsion applications.
  - (U) Complete ground technology demonstration of VFDR technology and document results.
- (U) $100 Develop and demonstrate the design and construction of critical high-speed propulsion components/structures for manned and unmanned applications. This effort provides technology at lowered risk for future missile systems where time-to-target is critical and provides technology for next generation reconnaissance/strike vehicles and airbreathing boosters.
  - (U) Plan design/development of dual-mode ramjet engines for high-speed missiles for destroying high value, time-critical targets.
  - (U) Plan design/development of combined/advanced-cycle engines for manned and unmanned high-speed vehicles applicable to reconnaissance/strike missions.
  - (U) Complete preliminary scramjet critical loads assessment.
- (U) $4,025 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology PROJECT 2480

(U) FY 1998 ($ in Thousands):

- (U) $1,265 Demonstrate thermally stable JP-8+100 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.
  - (U) Demonstrate effects/benefits of second JP-8+100 thermal stability additive package in component and engine stand tests.
  - (U) Demonstrate reduced fuel system maintenance in B-1 and C-141 aircraft and in HH-53, H-1, and HH-60 helicopters by conducting field trials of JP-8+100 at selected bases.
- (U) $360 Demonstrate advanced fuel system designs and high temperature components that permit utilization of the increased cooling capacity of JP-8+100 and high heat sink fuels.
  - (U) Complete design and evaluation of upgraded F-15 fuel system modifications that permit utilization of increased cooling capacity of JP-8+100.
- (U) $1,625 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,468 Demonstrate thermally stable JP-8+100 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.
  - (U) Demonstrate effects/benefits of JP-8+100 in Integrated High Performance Turbine Engine Technology (IHPTET) Phase II demonstrator.
  - (U) Complete field trials of JP-8+100.
- (U) $677 Demonstrate advanced fuel system designs and high temperature components that permit utilization of the increased cooling capacity of JP-8+100 and high heat sink fuels.
  - (U) Design high heat sink fuel/air heat exchanger suitable for incorporation into IHPTET Phase III demonstrator.
- (U) $2,145 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology PROJECT 2480

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	6,811	4,219	3,501	3,540	Cont
(U) Current Budget Submit//FY 1998 PB	6,811	4,025	1,625	2,145	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program. Starting in FY 1998, all high-speed propulsion efforts in Project 2480 are terminated.

Schedule: High-speed propulsion efforts terminated as of FY 1998.

Technical: High-speed propulsion efforts terminated as of FY 1998.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602203F, Aerospace Propulsion.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT: 3035

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3035 Aerospace Power Systems Technology	2,589	2,605	3,682	3,467	3,917	4,073	4,319	4,519	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: Develops and demonstrates aircraft and ground power systems including engine starters, auxiliary power units, and electrical power distribution systems. The principal focus is to provide a two- to five-fold improvement in reliability and maintainability and significantly reduced cost of ownership for aircraft and ground power systems. This will be accomplished by replacing fluid-powered (hydraulics/bleed air) accessories with electrically-powered systems. Representative improvements include increased reliability (8-18%); improved maintainability (9-12%); and reduced vulnerability (12-14%).

(U) FY 1996 ($ in Thousands):

- (U) $1,989 Designed, fabricated, and tested components supporting a demonstrator aircraft electrical distribution system. The electrical distribution system ensures fault tolerant architecture, improving aircraft reliability and survivability.
  - (U) Completed hardware fabrication of fault tolerant 270 Volts direct current (Vdc) aircraft electrical power system to demonstrate a two-fold increase in reliability and a 40% weight reduction for the secondary power system.
  - (U) Completed detailed design of an advanced motor controller for aircraft offering a 50% improvement in power density and reliability.
- (U) $600 Designed, fabricated, and tested a demonstrator aircraft on-board Integrated Power Unit (IPU). The IPU is critical for aircraft engine starting, auxiliary power, and emergency power.
  - (U) Generated specifications and requirements for aircraft on-board IPU hardware for demonstration testing.
- (U) $2,589 Total

(U) FY 1997 ($ in Thousands):

- (U) $2,015 Design, fabricate, and test components supporting a demonstrator aircraft electrical distribution system. The electrical distribution system ensures fault tolerant architecture, improving aircraft reliability and survivability.
  - (U) Test fault tolerant 270 Vdc power system demonstrating fault tolerance and a 40% reduction in weight.
  - (U) Fabricate and test advanced motor controller for aircraft demonstrating a 50% improvement in power density.
- (U) $590 Design, fabricate, and test a demonstrator aircraft on-board IPU. The IPU is critical for aircraft engine starting, auxiliary power, and emergency power.
  - (U) Complete preliminary design of aircraft on-board IPU hardware which will demonstrate the integration of auxiliary and engine electrical starting power functions providing a two- to three-fold increase in reliability and a two-fold reduction in weight.
- (U) $2,605 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology
	PROJECT 3035

(U) FY 1998 ($ in Thousands):

- (U) $1,562 Design, fabricate, and test components supporting a demonstrator aircraft electrical distribution system. The electrical distribution system ensures fault tolerant architecture, improving aircraft reliability and survivability.
  - (U) Complete testing of a 270Volts direct current (Vdc) power system demonstrating fault tolerance and a 40% reduction in weight.
  - (U) Complete test of advanced motor controller for aircraft demonstrating a 50% improvement in power density.
- (U) $2,120 Design, fabricate, and test a demonstrator aircraft on-board Integrated Power Unit (IPU). The IPU is critical for aircraft engine starting, auxiliary power, and emergency power.
  - (U) Complete detailed design of aircraft on-board IPU hardware which will demonstrate the integration of auxiliary and engine electrical starting power functions providing a two- to three-fold increase in reliability and a two-fold reduction in weight.
- (U) $3,682 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,699 Develop an aircraft electrical power generation and distribution system for test validation and flight demonstration. The electrical distribution system ensures fault tolerant architecture, improving aircraft reliability and survivability.
  - (U) Develop an advanced aircraft electrical power generation and distribution system. The advanced electrical power system provides a two- to three-fold improvement of system reliability.
  - (U) Develop an Internal Starter Generator (I S/G) for in-engine test for More Electric Engine Demonstration. The I S/G is critical for engine start and for providing the high-power requirements for a more electric aircraft.
- (U) $768 Design, fabricate, and test a demonstrator aircraft on-board IPU. The IPU is critical for aircraft engine starting, auxiliary power, and emergency power.
  - (U) Fabricate components for aircraft on-board IPU which will demonstrate the integration of auxiliary and engine electrical starting power functions providing a two- to three-fold increase in reliability and a two-fold reduction in weight.
- (U) $3,467 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology PROJECT 3035

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	2,589	2,731	5,408	5,404	Cont
(U) Current Budget Submit/FY 1998 PB	2,589	2,605	3,682	3,467	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT: 681B

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
681B Advanced Turbine Engine Gas Generator	29,965	29,876	31,707	34,224	35,294	36,989	37,102	37,985	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops turbine engine gas generator technology to meet the requirements of current and future aircraft propulsion systems. The objective is to provide the continued evolution of technologies into an advanced gas generator in which the performance, cost, durability, repairability, and maintainability aspects can be assessed in a real engine environment. The gas generator, or core, is the basic building block of the engine and it consists of a compressor, a combustor, and a high pressure turbine. Experimental core engine testing enhances early, low-risk transition of key engine technologies into engineering development where they can be applied to derivative and/or new systems. These technologies are applicable to a wide range of military and commercial systems including aircraft, missiles, land combat vehicles, and ships. The Advanced Turbine Engine Gas Generator project supports the Integrated High Performance Turbine Engine Technology (IHPTET) program. IHPTET is a three phase, totally integrated DoD, DARPA, NASA, and industry program focused on doubling turbine engine propulsion capabilities while reducing cost of ownership. The IHPTET program structure provides continuous technology transition for military turbine engine upgrades and derivatives and has the added benefit of enhancing the U.S. turbine engine industry's international competitiveness and demonstrates affordable turbine engine high pressure core components.

(U) FY 1996 ($ in Thousands):

- (U) $29,143 Designed, fabricated, and tested technology demonstration core engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
  - (U) Fabricated turbofan/turbojet core engine hardware (flexible, variable cycle core; high temperature metal matrix composite compressor rotor; low-cost, cast-cooled turbine blade) in support of performance core engine testing.
  - (U) Completed fabrication of turbofan/turbojet core engine hardware (titanium aluminide (TiAl)) compressor blades; supercooled turbine components; lamilloy turbine vanes) in support of durability core engine testing.
- (U) $822 Designed, fabricated, and tested technology demonstration core engines for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.
  - (U) Tested turboprop/turboshaft cores with a goal of 25% reduction in fuel consumption and a 60% increase in power-to-weight ratio (relative to 1986 baseline).
  - (U) Fabricated turboprop/turboshaft core engine hardware in support of core engine testing.
- (U) $29,965 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology PROJECT 681B

(U) FY 1997 ($ in Thousands):

- (U) $28,232 Design, fabricate, and test technology demonstration core engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
  - (U) Test turbofan/turbojet core engines demonstrating a 60% increase in thrust-to-weight ratio, a 20% reduction in manufacturing cost, and a 20% reduction in maintenance costs.
  - (U) Conduct a high temperature durability test of turbofan/turbojet core engine demonstrating critical technology potential life characteristics.
- (U) $1,644 Design, fabricate, and test technology demonstration core engines for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.
  - (U) Test a turboprop/turboshaft core engine demonstrating a 30% reduction in fuel consumption and an 80% increase in power-to-weight ratio.
- (U) $29,876 Total

(U) FY 1998 ($ in Thousands):

- (U) $30,007 Design, fabricate, and test technology demonstration core engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
  - (U) Conduct cyclic durability testing of a turbofan/turbojet core engine demonstrating critical technology potential life characteristics.
  - (U) Fabricate hardware (high temperature metal matrix composite compressor rotor, dual alloy turbine disk) and assemble a core engine for high compressor exit temperature testing (30% reduction in fuel consumption).
  - (U) Design and fabricate core engine hardware (high stage loading compressor, dual-web turbine disk, air to fuel heat exchanger) in support of core engine testing to provide a 40% reduction in fuel consumption, a 100% increase in thrust-to-weight ratio, a 35% reduction in manufacturing cost, and a 35% reduction in maintenance cost.
- (U) $1,700 Design, fabricate, and test technology demonstration core engines for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.
  - (U) Test a turboprop/turboshaft core engine demonstrating a 30% reduction in fuel consumption, a 100% increase in power-to-weight ratio, a 20% reduction in manufacturing cost, and a 20% reduction in maintenance cost.
  - (U) Initiate the design of a turboprop/turboshaft core engine with a 40% reduction in fuel consumption, a 120% increase in power-to-weight ratio, a 35% reduction in manufacturing cost, and a 35% reduction in maintenance cost.
- (U) $31,707 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology PROJECT 681B

(U) FY 1999 ($ in Thousands):

- (U) $32,224 Design, fabricate, and test technology demonstration core engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
  - (U) Conduct high compressor exit temperature testing (30% reduction in fuel consumption) of an advanced core engine with a high temperature metal matrix composite compressor rotor and a dual alloy turbine disk.
  - (U) Design and fabricate core engine hardware and conduct initial core engine testing of an advanced core engine with a high stage loading compressor, dual web turbine disk, and air to fuel heat exchanger to provide an initial assessment of these critical technologies required to provide a 40% reduction in fuel consumption, a 100% increase in thrust-to-weight ratio, a 35% reduction in manufacturing cost, and a 35% reduction in maintenance cost.
- (U) $2,000 Design, fabricate, and test technology demonstration core engines for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.
  - (U) Design and fabricate a turboprop/turboshaft core engine with a 40% reduction in fuel consumption, a 120% increase in power-to-weight ratio, a 35% reduction in manufacturing cost, and a 35% reduction in maintenance cost.
- (U) $34,224 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology
	PROJECT 681B

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	30,232	31,314	30,373	32,335	Cont
(U) Current Budget Submit/FY 1998 PB	29,965	29,876	31,707	34,224	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603202F, Aircraft Propulsion Subsystem Integration.
- (U) PE 0602122N, Aircraft Technology.
- (U) PE 0603210N, Aircraft Propulsion.
- (U) PE 0603003A, Aviation Advanced Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603227F Personnel, Training, and Simulation Technology

PROJECT: 2743

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2743 Advanced Combat Aircrew Training/Manpower and Force Management	8,509	7,420	6,147	7,182	6,442	7,642	7,834	8,101	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, the three projects in this Program Element (Project 2743, Combat Aircrew Training Technology; Project 2922, Manpower and Force Management; and Project 2949, Advanced Training Technology) have been combined into a single project (Project 2743, Advanced Combat Aircrew Training, Manpower, and Force Management). The total PE costs shown for FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates improved operational readiness and combat training through Manpower, Personnel, and Training (MPT) technologies. MPT includes: systems to write computer-based training programs; decision-aiding systems to optimize personnel use; job performance measurement technologies; analytical tools to better consider MPT in systems design; and realistic aircrew combat training. Develops, demonstrates, and evaluates simulator-based air combat training technology as an affordable, effective, and realistic adjunct to flight-based training. Provides a technology testbed for examining aircrew skills, cognitive functions, behaviors, and instructional strategies contributing to combat success. Evaluates technologies for long-distance computer networking to enhance current methods for joint-Service training. Develops technologies to improve weapon system life cycle manpower estimates, joint job structures and classification, and aircrew selection. This project includes technologies to analyze MPT factors early in weapon systems design and acquisition to ensure the factors are supportable and to enable trade offs to accommodate MPT limitations and costs. This project also includes research to ensure that Air Force as well as other Service jobs are structured in such a way as to maximize job performance and the effective use of personnel during contingency planning, as well as identify comparable occupational skills for joint deployment. Develops and demonstrates computer-based intelligent tutoring technology for representative tasks in high-technology jobs and software enabling Air Force training developers to rapidly and affordably build intelligent computer-assisted training systems which continually interact with students for effective individualized training.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603227F Personnel, Training, and Simulation Technology PROJECT 2743

(U) FY 1996 ($ in Thousands):

- (U) $2,659 Developed and demonstrated aircrew training devices and associated technologies for personnel training.
  - (U) Performed training utility evaluation of a joint-Service distributed multi aircraft close air support training testbed
  - (U) Developed, integrated, and evaluated existing joint-Service training environments for distributed mission training.
  - (U) Intiated development of microlaser technology to provide high resolution visual displays for combat training.
  - (U) Designed, developed, and initiated first ever real-time multi-level security system.
  - (U) Defined functional requirements for the squadron training environment for the next century.
  - (U) Leveraged existing design philosophy to develop high fidelity low cost A-10 and C-130 full mission deployable training devices.
- (U) $2,410 Developed and demonstrated night vision goggle (NVG) training guidelines to meet Air Force mission requirements.
  - (U) Designed conceptual architecture for NVG image generation capability.
  - (U) Developed low cost terrain board lighting system, saving $25,000 dollars per system.
  - (U) Developed specifications for AN/AVS-9 NVGs.
  - (U) Evaluated modified Class B heads up display (HUD) for the Chief of Staff, Air Force.
  - (U) Conducted test and evaluation of AN/AVS-9 NVG test articles for acquisition decision.
- (U) $937 Delivered technology to link the design and procurement of new weapon systems and major systems modifications to personnel capabilities and training factors.
- (U) $291 Developed the plans for a joint-Service occupational classification technology for manpower planning and support of wartime missions.
  - (U) Continued to develop situational awareness aircrew selection test technology.
- (U) $1,724 Developed and demonstrated software and authoring tools for intelligent tutors.
  - (U) Delivered authoring technology to Air Force customers.
  - (U) Continued to develop and evaluate virtual environment-based Intelligent Tutor System authoring technology.
- (U) $310 Developed career field training decision support software for personal computer use.
  - (U) Developed and delivered operator and analyst training programs for the training impacts decision technology.
  - (U) Evaluated training impacts on decision technology in the field.
- (U) $178 Developed advanced instructional design advisor technology to reduce the cost and time to design and develop interactive courseware.
- (U) $8,509 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603227F Personnel, Training, and Simulation Technology PROJECT 2743

(U) FY 1997 ($ in Thousands):

- (U) $2,115 Develop, demonstrate, and evaluate aircrew training devices and associated technology for air warrior training.
  - (U) Demonstrate low-cost, high fidelity, deployable C-130 simulator.
  - (U) Design simulated threat system to encompass a full range of electronic threat environments for air-to-air, air-to-ground, and communication jamming applications.
  - (U) Integrate mission planning tools with distributed mission training.
  - (U) Define High Level Architecture (HLA) requirements for application to fighter level operations.
  - (U) Demonstrate integrate virtual and constructive environments for distributed mission training.
  - (U) Define information requirements for deployable mission support station.
- (U) $2,091 Develop and demonstrate Night Vision Goggle (NVG) training and guidelines to meet Air Force requirements.
  - (U) Develop NVG mishaps lessons learned courseware.
  - (U) Demonstrate real-time simulation of incompatible lighting effects in NVG imagery.
  - (U) Develop evaluation techniques for aircraft external lighting for NVG operations.
  - (U) Develop and evaluated low-cost visual display suitable for NVG simulator-based training.
  - (U) Update introductory NVG courseware.
  - (U) Develop metrics to assess NVG simulation quality.
- (U) $1,048 Develop technologies to structure Air Force and DoD jobs and classify personnel to maximize individual and organizational personnel readiness, job performance, and mission accomplishment.
  - (U) Develop an inter-Service occupational classification technology for manpower planning.
  - (U) Conduct independent validation and verification of Manpower, Personnel, and Training Decision Support System.
- (U) $238 Evaluate a learning sample approach to aircrew selection.
- (U) $957 Develop and demonstrate software and authoring tools for intelligent tutors.
  - (U) Continue to develope virtual environment authoring technology.
  - (U) Develop and evaluated advanced intelligent tutors for application to formal technical training programs and on-the-job training.
- (U) $474 Deliver career field decision support software for personal computer use to Air Force customers.
  - (U) Complete field assessment of the training impacts decision technology.
  - (U) Make available for transition to operational Air Force training impacts decision technology.
- (U) $497 Develop advanced instructional design advisor technology to reduce the cost and time to design and developed interactive courseware.
  - (U) Integrate functional and procedural instructional design guidance into authoring design demonstrations.
  - (U) Develop field assessment plan to evaluate new authoring technology.
- (U) $7,420 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603227F Personnel, Training, and Simulation Technology PROJECT 2743

(U) FY 1998 ($ in Thousands):

- (U) $1,902 Develop and demonstrate Night Vision Goggle (NVG) training guidelines to meet Air Force requirements.
  - (U) Field test distance estimation training module.
  - (U) Develop specification for NVG gain.
  - (U) Develop specification for external lighting for NVG operation.
  - (U) Develop recommendations for enhanced multi-spectral database.
  - (U) Demonstrate proof of concept of enhanced NVG simulation.
- (U) $2,656 Develop, demonstrate, and evaluate aircrew training devices and associate technologies for air warrior training.
  - (U) Evaluate high resolution microlaser projector for full combat mission training.
  - (U) Develop simulated command and control model.
  - (U) Demonstrate four aircraft testbed capability for distributed mission training.
  - (U) Update functional specification for multi-level security networked simulation environment.
  - (U) Demonstrate mobile, interactive, air and ground threat environment.
  - (U) Preliminary implementation of High Level Architecture (HLA) in four aircraft testbed environment.
- (U) $1,174 Develop and demonstrate software authoring tools for producing adaptive training systems.
  - (U) Demonstrate virtual environment-based adaptive training system.
  - (U) Demonstrate adaptive training system delivered over distributed networks.
- (U) $415 Continue to develop advanced instructional design advisor technology to reduce the cost and time to design and develop interactive courseware.
  - (U) Continue integration of functional and procedural instructional design guidance into authoring design demonstrations.
  - (U) Implement field assessment plan to evaluate new authoring technology.
  - (U) Integration of instructional design support tools with a Canadian knowledge domain analysis and curriculum structuring system.
- (U) $6,147 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603227F Personnel, Training, and Simulation Technology PROJECT 2743

(U) FY 1999 ($ in Thousands):

- (U) $3,485 Develop, demonstrate, and evaluate aircrew training devices and associated technologies for air warrior training.
  - (U) Integrate Unmanned Aerial Vehicle (UAV) simulation into virtual combat environments.
  - (U) Fully implement High Level Architecture (HLA) into distributed mission training testbed.
  - (U) Develop user friendly semi-automated air defense simulation system.
  - (U) Use eye tracking technology to develop optimized visual scan training to enhance situation awareness in multi-ship combat training.
  - (U) Integrate advanced visualization tools for squadron level electronic classroom.
  - (U) Define run-time instructional tools.
  - (U) Implement and evaluate automated performance measures for crew debrief.
- (U) $ 1,884 Develop and demonstrate Night Vision Goggle (NVG) training guidelines to meet Air Force requirements.
  - (U) Develop and evaluate optimized perceptual training guidelines for NVG use.
  - (U) Evaluate real-time NVG imagery.
  - (U) Develop advanced weapon system specific NVG courseware.
  - (U) Evaluate training implications of advanced fused sensor technology.
- (U) $ 1,381 Develop and demonstrate software authoring tools for producing adaptive training systems.
  - (U) Continue development of authoring tools for producing adaptive training systems via distributed networks.
  - (U) Demonstrate an adaptive training system which uses intelligent agents to instruct individual students.
- (U) $ 432 Develop advanced instructional design advisor capability to support team-based instructional design.
  - (U) Integrate wide area network capability into advanced instructional design advisor.
  - (U) Field test in both the Air Force and Canadian Department of National Defense settings the integrated knowledge analysis/curriculum structuring / design advising / courseware generation system.
- (U) $7,182 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603227F Personnel, Training, and Simulation Technology PROJECT 2743

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	8,574	7,761	6,778	7,955	Cont
(U) Appropriated Value	8,930	7,761			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reduction	-173	-165			
b. SBIR	-182	-176			
c. Omnibus/Other Above Threshold Reprogrammings	-63	0			
d. Below Threshold Reprogrammings	-3	0			
(U) Current Budget Submit/FY 1998 PB	8,509	7,420	6,147	7,182	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602202F, Armstrong Lab Exploratory Development.
- (U) PE 0604227F, Flight Simulator Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603231F Crew Systems & Personnel Protection Technology

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	21,684	21,442	17,204	17,966	18,780	19,792	19,814	20,382	Continuing	Continuing
2830 Crew Workstations, Life Support, and Escape	15,419	14,696	9,967	12,129	12,789	13,502	13,526	13,921	Continuing	Continuing
3257 Helmet-Mounted Sensory Technologies	6,265	6,746	7,237	5,837	5,991	6,290	6,288	6,461	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, three projects (Project 2829, Crew-Centered Cockpit Design; Project 2830, Advanced Life Support; and Project 2868, Crew Escape) are combined into a single project (Project 2830, Crew Workstations, Life Support, and Escape). The total project costs for Project 2830 shown in FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification**: This Advanced Technology Development program develops and demonstrates technologies to protect and enhance the performance of Air Force personnel in operational environments. Specific projects within this PE advance and integrate human factors technologies into crew workstation, life support, and protective equipment designs. These technologies encompass the development and demonstration of high-speed escape system flight control and life protection devices for high-speed, adverse attitude flight regimes to include those derived from the Russian ejection seat (U.S. - Russian cooperation). Improves life support technologies principally focused on protecting aircrew from effects of altitude and G-forces in high performance aircraft, adjusting specifications of existing equipment to accommodate the increasing operational envelope, and a more diversified population of aircrew members. Using models of human perception and knowledge of cognitive function, and performance in high workload environments, technologies will be developed that will incorporate advanced helmet-mounted capability tracker and displays for the target detection, identification, sighting, and weapons firing. Improved helmet mounted night vision device capability and laser eye protection capability will be incorporated to address the operational limitations of fighting at night in a hazardous laser environment. Additionally, advanced on-board oxygen generation systems will be developed to alleviate the logistics burden of current liquid oxygen systems that require ground-based oxygen generation plants. Note: Congress added $3 million in FY 1996 and $5 million in FY 1997 for crew escape/ejection seats which explains the perceived decrease in FYs 1998 and out.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	20,852	17,969	16,833	17,637	Cont
(U) Appropriated Value	21,953	22,969			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-426	-467			
b. SBIR	-463	-538			
c. Omnibus/Other Above Threshold Reprogrammings	-373	-22			
d. Below Threshold Reprogrammings	+993	-500			
(U) Current Budget Submit / FY 1998 PB	21,684	21,442	17,204	17,966	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology PROJECT 2830

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2830 Crew Workstations, Life Support, and Escape	15,419	14,696	9,967	12,129	12,789	13,502	13,526	13,921	Continuing	Continuing

Note: Beginning in FY 1998, three projects (Project 2829, Crew-Centered Cockpit Design; Project 2830, Advanced Life Support; and Project 2868, Crew Escape) are combined into a single project (Project 2830, Crew Workstations, Life Support, and Escape). The total project costs for Project 2830 shown in FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This project improves combat performance, develops rigorous, traceable human-centered design; protects aircrews from physiological stresses such as high altitude, high G-forces, high temperature, and aerodynamic forces; and reduces aircrew fatalities and major injuries in emergency ejections at high-speed and at low altitude, adverse attitude flight conditions, while improving supportability and accommodating the full range of the pilot population.

(U) FY 1996 ($ in Thousands):

- (U) $2,620 Developed and demonstrated technologies for improved protective equipment for aircrew and support personnel.
  - (U) Developed advanced technology for an improved aircrew oxygen mask for high-G and high altitude operations.
  - (U) Developed personal protective equipment technology to provide improved protection in hostile environments for female aviators.
  - (U) Developed and transitioned laser eye protection technology that protects aircrews from laser rangefinders and designators, and first generation anti-personnel laser weapons.
  - (U) Developed and transitioned to the Air Force Information Warfare Center (AFIWC) the Laser Threat Analysis System (LTAS) version 1.0 for eye-safe threat engagement.
- (U) $1,920 Developed and demonstrated life support technologies for integration into aircraft to improve aircrew safety and reduce logistical burdens.
  - (U) Continued to develop advanced hybrid oxygen technologies to replace current liquid oxygen systems for transport aircraft and aeromedical applications.
  - (U) Continued laboratory demonstration of personal environmental cooling technology for aircrew.
- (U) $349 Developed and demonstrated technologies to protect and sustain Air Force personnel operating in hazardous environments.
- (U) $1,057 Developed and demonstrated human-centered software tools for design modification of operator stations.
  - (U) Demonstrated utility of crew-centered process and tools for dissimilar platforms/mission types.
  - (U) Performed beta test program of crew-centered design and evaluation tools with industry and government.
  - (U) Developed design and evaluation database integration architecture to support streamlined acquisition.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology PROJECT 2830

- (U) $835 Developed operator station design and evaluation process overlay to support advanced distributed simulation.
  - (U) Demonstrated test planning, analysis, and evaluation system tools adapted to simulated environments.
- (U) $2,782 Developed and demonstrated escape system flight control and life protection devices for high-speed escape.
  - (U) Coded and verified flight control software.
  - (U) Modified demonstration test ejection seats and fabricated demonstration test flight computer.
  - (U) Designed, fabricated, and tested life protection devices.
- (U) $2,297 Developed and demonstrated technologies for controlled ejection seat flight from high-speed/adverse attitudes using rocket thrust vectoring.
  - (U) Fabricated components for ejection seat propulsion system demonstration tests.
  - (U) Conducted demonstration tests of advanced ejection seat propulsion technologies using high-speed test track.
- (U) $3,559 Evaluated the accommodation of small occupants in existing ejection seats.
  - (U) Designed ejection test manikin to represent small occupants.
  - (U) Performed small occupant restraint and seat adjustability trade studies.
  - (U) Initiated demonstration program to assess ability of existing Air Force and Navy ejections seats to accommodate of lower weight female crewmembers.
- (U) $15,419 Total

(U) FY 1997 ($ in Thousands):

- (U) $866 Develop and demonstrate technologies for improved protective equipment for aircrew and support personnel.
  - (U) Continue development and demonstration of advanced aircrew oxygen mask technology for high-G and high-altitude operations.
  - (U) Demonstrate personal protective equipment technology to provide improved protection in hostile environments for female aviators.
  - (U) Develop and transition to the Air Force Information Warfare Center (AFIWC) the Laser Threat Analysis System (LTAS) version 2.0 for eye damage and Night Vision Goggles (NVG)/Maverick vulnerability.
  - (U) Demonstrate compatibility of single-line, visible wavelength laser-eye protection (LEP) with heads up display and F-15E avionics displays.
- (U) $1,355 Develop and demonstrate life support technologies for integration into aircraft to improve aircrew safety and reduce logistical burdens.
  - (U) Demonstrate advanced hybrid oxygen technologies for aeromedical operations.
  - (U) Complete laboratory demonstration of personal environmental cooling technology for aircrews.
- (U) $1,369 Conclude verification testing and beta testing of human-centered software tools for design and modification of operator stations.
  - (U) Transition human-centered evaluation technology to DoD and industry.
  - (U) Conclude field demonstration program with final test of the crew-centered design and evaluation technology, showing ability to correlate human/system-related measures of performance to lethality, survivability, and operability.
- (U) $459 Conduct human-centered design studies to support advanced distributed simulation.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology PROJECT 2830

- (U) Assess human performance models to make valid predictions within operational context.
- (U) Develop analytical techniques to link human measures of performance to system level measures of effectiveness.

– (U) $4,240 Develop a demonstrator to evaluate life-saving capabilities of an escape system using technologies including those derived from the Russian K-36 ejection seat (U.S. - Russian cooperation).
- (U) Establish ejection seat performance baseline.
- (U) Conduct preliminary design studies of the demonstration system.
- (U) Design demonstration system for accommodation of the expanded aircrew population.
- (U) Integrate U.S. life support equipment with demonstration system to minimize life support equipment redevelopment and implementation costs.

– (U) $2,700 Demonstrate controlled ejection seat flight from high-speed and from adverse ejection attitudes.
- (U) Complete high-speed/adverse-attitude ejection seat testing.
- (U) Analyze data and document escape system technology demonstration program results.

– (U) $3,707 Develop technologies to address small occupant requirements for current operational ejection seats.
- (U) Fabricate a small female test manikin.
- (U) Test flightweight, high-speed inertial reel to improve ejection seat restraint system.
- (U) Demonstrate technology to upgrade existing ejection seats to accommodate small occupants.
- (U) Demonstrate accommodation of lower weight female crew members.

– (U) $14,696 Total

(U) FY 1998 ($ in Thousands):

– (U) $ 297 Continue to develop and demonstrate technologies for improved protective equipment for aircrew and support personnel.
- (U) Complete development and demonstration of advanced oxygen mask technology for high-G and high-altitude operations.

– (U) $1,555 Develop and demonstrate life support technologies for integration into aircraft to improve aircrew safety and reduce logistical burdens.
-
- (U) Develop advanced hybrid oxygen technologies, allowing replacement of current liquid oxygen systems for aircrews.

– (U) $ 944 Develop and demonstrate human-centered design technology to support advanced distributed simulation.
- (U) Demonstrate interoperability of legacy models with the human model integration architecture.
- (U) Develop and demonstrate distributed data integration architecture to support distributed design.

– (U) $ 660 Develop and demonstrate human-centered evaluation technology to support advanced distributed simulation.
- (U) Develop and demonstrate ability to extract human performance data from simulations to support weapon system evaluations.
- (U) Develop and demonstrate human performance analysis tools for distributed weapon system evaluations.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology PROJECT 2830

- (U) $ 4,304 Develop a demonstrator and evaluate advanced escape technologies incorporating Russian technology.
  - (U) Conduct detailed designs of lightweight ejection seat.
  - (U) Fabricate demonstration ejection seats for adverse attitude/high-speed ejection seat tests.
  - (U) Conduct ejection seat tests to demonstrate seat performance and life saving capacity.
  - (U) Analyze data and document lightweight ejection seat demonstration program results.
- (U) $ 1,940 Develop, evaluate, and demonstrate technologies to assure affordability, reliability, and supportability of advanced ejection seats.
  - (U) Define manufacturing concepts and technologies for production in the U.S.
  - (U) Assess ejection seat interfaces with aircraft cockpits.
  - (U) Explore low-cost ballistic cartridges and propulsion systems as a joint effort with the U.S. Navy.
  - (U) Analyze life cycle and logistics support concept improvements.
- (U) $ 267 Demonstrate technologies to address small occupant requirements for current ejection seats.
  - (U) Test small female, biofidelic test manikin.
  - (U) Demonstrate flightweight, high-speed inertial reel to improve ejection seat restraint system.
- (U) $9,967 Total

(U) FY 1999 ($ in Thousands):

- (U) $ 2,608 Continue to develop and demonstrate life support technologies for integration into aircraft to improve aircrew safety and reduce logistical burdens.
  - (U) Demonstrate advanced hybrid oxygen technologies to replace current liquid oxygen systems for aircrews in transport aircraft.
- (U) $ 952 Demonstrate design technology concept to ensure crew-centered design integration in mission operational context.
  - (U) Demonstrate operator-in-the-loop requirements.
  - (U) Develop and demonstrate projection models that track human performance from early concept to fielded system.
- (U) $ 1,184 Define an operator integration testbed that interacts with the Air Force Battle Labs within an advanced distributed simulation environment.
  - (U) Define operator integration testbed links to distributed simulation exercise and assess crew contribution to system performance.
  - (U) Demonstrate extrapolating human performance data to campaign-level simulations and quantifying human performance impacts on systems effectiveness.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology PROJECT 2830

- (U) $ 7,385 Develop lightweight ejection seat, aircraft, and crew interface technologies.
  - (U) Develop preliminary design for aircraft canopy clearance technologies to assure crew safety during through-the-canopy escape.
  - (U) Define human exposure criteria for ejection through high strength aircraft canopies.
  - (U) Assess automatic emergency detection and ejection technologies for vertical take-off and landing flight conditions.
  - (U) Verify functionality of aircraft/seat/crew electronic interface software and hardware.
- (U) $12,129 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	14,582	10,909	10,346	12,501	Cont
(U) Current Budget Submit / FY 1998 PB	15,419	14,696	9,967	12,129	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0604703F, Aeromedical/Casualty Care Systems Development.
- (U) PE 0604706F, Life Support Systems.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology PROJECT 3257

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3257 Helmet-Mounted Sensory Technologies	6,265	6,746	7,237	5,837	5,991	6,290	6,288	6,461	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project develops and demonstrates advanced helmet-mounted subsystem technologies to improve mission effectiveness and pilot situational awareness during day and night missions in all-weather conditions. Through the development of advanced helmet-mounted tracker and display technologies (HMT/D), pilots will be able to detect, identify, target, and launch weapons faster and more accurately. This project also develops technology for improved night vision goggles (NVG) to enhance combat capabilities at night.

(U) FY 1996 ($ in Thousands):

- (U) $5,530 Developed and demonstrated Helmet Vehicle Interface (HVI) and subsystems technologies for HMT/D.
  - (U) Demonstrated advanced HMT/D for tactical air-to-air missions in a simulator.
  - (U) Developed new image source for HMT/D that will provide color symbology capability.
  - (U) Evaluated new subsystem technologies for HMT/D.
  - (U) Assessed anthropometric technology issues for fit of NVG and HMT/D on full pilot population
- (U) $735 Developed and demonstrated advanced night vision technologies for Air Force-specific aircrew requirements.
  - (U) Evaluated improved NVG technologies.
- (U) $6,265 Total

(U) FY 1997 ($ in Thousands):

- (U) $5,304 Develop and demonstrate HVI and subsystems technologies for HMT/D.
  - (U) Develop design for new HMT/D with color symbology display.
  - (U) Demonstrate advanced HMT/D on two operational fighters and transition to the Air Force/Navy Joint Helmet-Mounted Cueing System.
  - (U) Evaluate advanced HVI designs.
  - (U) Continue evaluation of anthropometric technology issues for fit of HMT/D on full pilot population.
- (U) $1,442 Develop and demonstrate advanced night vision and laser-eye protection technologies for DoD aircrew requirements.
  - (U) Evaluate improved NVG technologies.
  - (U) Develop new image intensifier tube technology for NVG.
  - (U) Demonstrate concept for Panoramic Night Vision Goggles (PNVG) with expanded field-of-view.
- (U) $6,746 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology PROJECT 3257

(U) FY 1998 ($ in Thousands):

- (U) $3,712 Continue to develop and demonstrate helmet-mounted tracker and display technologies (HMT/D) and subsystem technologies.
  - (U) Demonstrate HMT/D with color symbology display in simulator.
  - (U) Assess component improvements for HMT/Ds for fighters.
  - (U) Continue evaluation of anthropometric technology issues for fit of HMT/D on full pilot population.
- (U) $ 303 Develop and demonstrate advanced laser eye protection (LEP) technologies and laser susceptibility models.
  - (U) Develop and transition to the Air Force Information Warfare Center (AFIWC) the Laser Threat Analysis Systems (LTAS) version 3.0 for aircraft structures and anti-personnel air-to-air engagements.
  - (U) Initiate early operational assessment of single-line, visible wavelength LEP in A-10, F-16, and F-15E.
- (U) $2,918 Continue to develop and demonstrate advanced night vision technologies for DOD aircrew requirements.
  - (U) Demonstrate passive night vision goggles (NVG) with dynamic symbology overlay
  - (U) Assess improved image intensifier tube technology for NVGs.
- (U) $ 304 Initiate early operational assessment of single-line, visible wavelength laser-eye protection in aircraft.
- (U) $7,237 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,929 Continue to develop and demonstrate HMT/D and subsystem technologies.
  - (U) Demonstrate HMT/D with color symbology display in aircraft.
  - (U) Assess component improvements for HMT/Ds for fighter.
  - (U) Continue evaluation of anthropometric technology issues for fit of HMT/D on full pilot population.
- (U) $606 Develop and demonstrate advanced LEP technologies and susceptibility models.
  - (U) Integrate LTAS into the Distributed Interactive Simulation (DIS) as the Directed Energy Warfare (DEW) server for laser and broadband optical threats.
  - (U) Demonstrate compatibility of LEP visor technology with HMT/Ds.
  - (U) Complete early operational assessment flight demonstrations of single-line, visible wavelength laser eye protection.
- (U) $2,302 Continue to develop and demonstrate advanced NVG and LEP technologies for DOD aircrew requirements
  - (U) Demonstrate passive NVG with imagery overlay.
- (U) $5,837 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology
	PROJECT 3257

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	6,270	7,060	6,487	5,136	Cont
(U) Current Budget Submit / FY 1998 PB	6,265	6,746	7,237	5,837	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602202F, Armstrong Lab Exploratory Development
- (U) PE 0603238F, Global Surveillance and Communications.
- (U) PE 0604706F, Life Support Systems.
- (U) PE 0604201F, Common Avionics Planning/Development.
- (U) PE 0207130F, F-15 Squadrons.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603245F Flight Vehicle Technology Integration

PROJECT: 2568

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2568 Flight Vehicle Technology Integration	11,379	6,132	7,795	9,828	10,123	11,195	10,820	11,102	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program integrates and demonstrates advanced flight vehicle technologies that will improve the performance and supportability of existing and future aircraft. System level integration brings together the air vehicle technologies along with avionics, propulsion, and weapon systems to flight demonstrate them in a near-realistic operational environment. Integration and flight test demonstrations reduce the risk and time required to transition technologies into operational aircraft. This program provides proven flight vehicle technologies for all-weather, day or night operations, and technologies for improved affordability. Note: FY 1997 decrease reflects the funding needed to finish flight test reports for efforts completed in FY 1996. In FYs 1999 and out, additional emphasis has been placed on flight testing of a tailless aircraft and on analyzing the flight control forces and moments of the Variable Stability In-flight Simulation Test Aircraft.

(U) FY 1996 ($ in Thousands):

- (U) $5,131 Develop and demonstrate advanced aeromechanics and flight control technologies for evaluation of increased combat effectiveness.
  - (U) Completed design of forebody vortex control hardware for a conventional fighter aircraft to demonstrate compatibility with existing radome designs, elimination of "hung-stalls," improved stability in extreme attitudes, and overall operational utility. Hardware has been made available to the user.
  - (U) Ground tested high-authority propulsive flight control systems for demonstration of increased range, elimination of loss of control, and improved supersonic maneuvering.
  - (U) Completed initial design of an exhaust flow control nozzle that reduces radar cross section and improves aircraft performance yet significantly reduces parts count and simplifies engine removal.
- (U) $6,248 Develop and demonstrate advanced subsystem technologies and technology integration for evaluation of increased supportability and combat effectiveness.
  - (U) Conducted initial development/fabrication of a long-life, all-envelope, integrated flight and propulsion control subsystem for the Variable Stability In-flight Simulation Test Aircraft for evaluation of the impact of advanced maneuvering capabilities on air-to-air and air-to-ground combat.
- (U) $11,379 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603245F Flight Vehicle Technology Integration
	PROJECT 2568

(U) FY 1997 ($ in Thousands):

- (U) $1,154 Develop and demonstrate advanced aeromechanics and flight control technologies for evaluation of increased combat effectiveness.
  - (U) Flight test high-authority propulsion flight control systems for demonstration of increased range, elimination of loss of control, and improved supersonic maneuvering up to Mach 2.0.
- (U) $4,978 Develop and demonstrate advanced subsystem technologies and technology integration for evaluation of increased supportability and combat effectiveness.
  - (U) Perform static and sub-scale testing of three next-generation nozzle concepts to determine fluidic control effectiveness in improving stealthiness and performance while simplifying design.
  - (U) Complete aircraft modification for long-life, all-envelope, integrated flight and propulsion control subsystem for the Variable Stability In-flight Simulation Test Aircraft (VISTA) to evaluate impact of advanced maneuvering capabilities for air-to-air and air-to-ground combat.
  - (U) Complete installation and integration flight testing of programmable head-up display and helmet-mounted display capabilities.
- (U) $6,132 Total

(U) FY 1998 ($ in Thousands):

- (U) $3,414 Develop, integrate, and demonstrate advanced aeromechanics, propulsive, and flight control technologies for increasing combat effectiveness.
  - (U) Modify the high-authority propulsive flight control systems to remove vertical tail surface area for demonstration of increased range, elimination of loss of control accidents, and improved supersonic maneuvering.
  - (U) Complete detailed design and initiate fabrication of selected critical components required for next generation simplified nozzle and airframe structural integration.
  - (U) Initiate development of control strategies to extend range, ensure safe operation, and allow precision close operations of mixed manned and unmanned aircraft.
- (U) $4,381 Develop, integrate, and demonstrate advanced subsystem technologies and technology integration for evaluation of significant improvement in air-to-air combat effectiveness.
  - (U) In preparation for joint program with the National Aeronautics and Space Administration, complete detailed design of a full-envelope maneuver load-controller to reduce load on and weight of an active aeroelastic wing.
  - (U) Develop methodology to analyze the effect of unique control forces and moments on VISTA's structural integrity.
- (U) $7,795 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603245F Flight Vehicle Technology Integration
	PROJECT 2568

(U) FY 1999 ($ in Thousands):

- (U) $4,661 Develop, integrate, and demonstrate advanced aeromechanics, propulsive, and flight control technologies for increasing combat effectiveness.
  - (U) Flight test the high-authority propulsive flight control systems, with removed vertical tail surface area, to demonstrate and assess improvements in range, survivability, and structural integrity while maintaining subsonic and supersonic maneuverability.
  - (U) Complete fabrication of selected next-generation flow control exhaust nozzle and airframe structural critical components.
  - (U) Complete development and flight test control strategies to extend range, ensure safe operation, and allow precision close operations of mixed manned and unmanned aircraft.
- (U) $5,167 Develop, integrate, and demonstrate advanced subsystem technologies and technology integration for evaluation of significant improvement in air-to-air combat effectiveness.
  - (U) In preparation for joint program with the National Aeronautics and Space Administration, complete fabrication and ground tests of a full-envelope maneuver load-controller for an active aeroelastic wing.
  - (U) Complete development of methodology to analyze the effect of unique control forces and moments on VISTA's structural integrity.
  - (U) Develop flight test units of electric actuator stabilators for reducing weight while increasing affordability of control actuators.
- (U) $9,828 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603245F Flight Vehicle Technology Integration
	PROJECT 2568

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	11,857	6,423	10,260	10,032	Cont
(U) Appropriated Value	12,491	6,423			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-242	-129			
b. SBIR	-271	-156			
c. Omnibus/Other Above Threshold Reprogrammings	-377	-6			
d. Below Threshold Reprogrammings	-222				Cont
(U) Current Budget Submit/FY 1998 PB	11,379	6,132	7,795	9,828	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603106F, Logistics Systems Technology.
- (U) PE 0603205F, Flight Vehicle Technology.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0604237F, Variable Stability In-Flight Simulation Test Aircraft.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile**: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603253F Advanced Avionics Integration

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	16,636	14,809	12,716	14,218	14,145	15,608	15,495	15,986	Continuing	Continuing
2735 Avionics Integration Technology	7,398	6,682	6,125	6,062	6,004	6,668	6,618	6,832	Continuing	Continuing
3833 Integrated Avionics for Aging Aircraft	2,526	3,268	2,526	3,227	3,292	3,503	3,481	3,579	Continuing	Continuing
666A Reference and Information Transmission Technology	6,712	4,859	4,065	4,929	4,849	5,437	5,396	5,575	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification**: This Advanced Technology Development program develops and demonstrates aircraft communications, navigation, identification, and cockpit display integration technologies and techniques for improved aircraft performance, reduced pilot workload, and reduced avionics support costs. This program develops and improves: advanced solid state inertial guidance units and Global Positioning System receivers; technologies for low probability of detection communications between aircraft to improve aircrew situation awareness; highly reliable and maintainable avionics architectures and advanced processors; integration techniques to reduce aircraft electronic emissions to improve aircraft hostile airspace penetration capability; and affordable avionics technologies to extend the useful life of aging aircraft.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Avionics Integration

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	16,749	15,488	15,539	16,628	Cont
(U) Appropriated Value	17,621	15,488			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-342	-313			
b. SBIR	-360	-351			
c. Omnibus/Other Above Threshold Reprogrammings	-279	-15			
d. Below Threshold Reprogrammings	-4				
(U) Current Budget Submit/FY 1998 PB	16,636	14,809	12,716	14,218	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Avionics Integration PROJECT 2735

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2735 Avionics Integration Technology	7,398	6,682	6,125	6,062	6,004	6,668	6,618	6,832	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops and demonstrates technologies that provide for robust implementation and exploitation of offensive and defensive sensors; reduced avionics support costs, weight, and volume; and improved reliability. These advanced technologies provide the avionics integration capability that enables improved cockpit systems management, information display, and weapons targeting and tracking and includes integrated avionics architectures, information integration involving on-board and off-board sensors, and sensor management technologies.

(U) FY 1996 ($ in Thousands):

- (U) $3,856 Develop advanced modular, sharable radio frequency (RF) sensor processing technologies to provide for avionics cost and weight savings, improved reliability, and increased sensor data fusion opportunities. Modularity will allow for retrofits that reduce avionics support costs.
  - (U) Validated the integrated sensor system architecture for future and aging aircraft avionics.
  - (U) Performed detailed design of the integrated sensor system common RF modules and initiated design of embedded control and application software.
  - (U) Completed integrated sensor system demonstration plan.
- (U) $1,522 Develop advanced sensor integration technologies and algorithms that augment the performance of individual sensors and improve fault tolerance and situation awareness.
  - (U) Continued development and demonstration of solutions for selective denial protection of current and future Global Positioning System receivers.
  - (U) Developed and demonstrated affordable, improved anti-jam filter/adaptive aircraft antenna electronics.
- (U) $2,020 Develop integrated avionics architecture components which leverage prior technology demonstration developments and incorporate additional user requirements for multi-platform commonality, open system architecture compliance, standard high-level software language, affordability, and expandability features.
  - (U) Developed laboratory model of advanced terrain following/terrain avoidance/threat avoidance technology for low-level missions.
  - (U) Integrated hardware components, portable real-time Ada operating system, and low-level algorithms to enable pilot-in-the-loop avionics demonstration in the low-level mission environment.
- (U) $7,398 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Avionics Integration PROJECT 2735

(U) FY 1997 ($ in Thousands):

- (U) $3,824 Develop advanced modular, sharable radio frequency (RF) sensor processing technologies to provide for avionics cost and weight savings, improved reliability, and increased sensor data fusion opportunities. Modularity will allow for retrofits that reduce avionics support costs.
  - (U) Fabricate integrated sensor system module types and unit test the embedded application and control software.
- (U) $960 Develop advanced sensor integration technologies and algorithms to provide the capability to augment the performance of individual sensors which will enable improved fault tolerance and situation awareness.
  - (U) Continue to develop and demonstrate affordable, improved anti-jam filter/adaptive aircraft antenna electronics.
- (U) $1,898 Develop integrated avionics architecture components which leverage prior technology demonstration developments and incorporate additional user requirements for multi-platform commonality, open system architecture compliance, standard high-level software language, affordability, and expandability features.
  - (U) Develop and implement high performance, three-dimensional terrain/threat avoidance display generation technology for the low-level avionics mission environment.
- (U) $6,682 Total

(U) FY 1998 ($ in Thousands):

- (U) $4,283 Develop and demonstrate advanced modular, sharable RF sensor processing technologies to provide for avionics cost and weight savings, improved reliability, and increased sensor data fusion opportunities. Modularity will allow for retrofits that reduce avionics support costs.
  - (U) Integrate components and perform laboratory demonstration of an integrated sensor system which simultaneously performs radar, electronics warfare, communication, navigation, and identification functions.
- (U) $1,228 Develop integrated avionics architecture components which leverage prior technology developments and incorporate additional user requirements for multi-platform commonality, open system architecture compliance, standard high-level software language, affordability, and expandability.
  - (U) Flight demonstrate a low-level covert penetration capability using common/open system processing hardware and portable real-time Ada operating system in a simulated threat environment; analyze cost/performance benefits of this capability for special operations aircraft mission rehearsals.
  - (U) Demonstrate improved threat location using off-board intelligence data integrated with on-board sensor information to improve low-level covert penetration capability for special operations aircraft.
- (U) $614 Develop architectural components required to convert RF functions (radar, electronic warfare, communications) from bulky, analog electronics to more compact, reliable digital technology. Applicable to future and aging aircraft, all-digital RF technology will provide significant cost/performance payoffs via commonality across RF subsystems.
  - (U) Develop preliminary architectural framework and assess leveraging opportunities in commercial developments.
- (U) $6,125 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Avionics Integration PROJECT 2735

(U) FY 1999 ($ in Thousands):

- (U) $3,016 Develop and demonstrate advanced modular, sharable radio frequency (RF) sensor processing technologies to provide for avionics cost and weight savings, improved reliability, and increased sensor data fusion opportunities. Modularity will allow for retrofits that reduce avionics support costs.
  - (U) Perform integration and application specific demonstrations to ease transition to currently fielded as well as future systems.
- (U) $1,218 Develop integrated avionics architecture components which leverage prior technology developments and incorporate additional user requirements for multi-platform commonality, open system architecture compliance, standard high-level software language, affordability, and expandability.
  - (U) Provide an integrated, on-board, all-source, on-the-fly mission demonstration for special operations aircraft.
- (U) $1,828 Develop architectural components required to convert RF functions (radar, electronic warfare, communications) from bulky, analog electronics to more compact, reliable digital technology. Applicable to future and aging aircraft, all-digital RF technology will provide significant cost/performance payoffs via commonality across RF subsystems.
  - (U) Develop preliminary design requirements for cost-effective digital signal conversion and conditioning for electronic warfare, communication/navigation/identification, and radar subsystems.
- (U) $6,062 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Avionics Integration
	PROJECT 2735

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	7,507	6,989	7,068	7,553	Cont
(U) Current Budget Submit/FY 1998 PB	7,398	6,682	6,125	6,062	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603204F, Aerospace Avionics.
- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0603270F, Electronic Warfare Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile**: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603253F Advanced Avionics Integration / PROJECT: 3833

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3833 Integrated Avionics for Aging Aircraft	2,526	3,268	2,526	3,227	3,292	3,503	3,481	3,579	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops and demonstrates affordable avionics technology to extend the useful life of Air Force aging aircraft and provide the flexibility and supportability needed to support worldwide operations with reduced force structure. This project focuses on technologies to support transition of modular avionics, commercially available products, and commercial open system standards for cost-effective retrofit of user-required upgrades to existing avionics systems.

(U) FY 1996 ($ in Thousands):

- (U) $2,526 Develop and demonstrate programmable integrated communications, navigation, and identification hardware/software modules for upgrading currently fielded aircraft identification friend or foe systems and providing real-time information in the cockpit. Provide a baseline for fleet wide logistics commonality, attendant economies of scale, and increased platform availability.
  - (U) Designed and developed brassboard technology required to maintain data security and integrate modular communications, navigation, and identification components with existing platform-specific interfaces, hardware, software, and backplanes.
- (U) $2,526 Total

(U) FY 1997 ($ in Thousands):

- (U) $2,471 Develop and demonstrate programmable integrated communications, navigation, and identification hardware/software modules for currently fielded aircraft applications to provide fleet wide commonality, attendant economies of scale, and increased platform availability.
  - (U) Develop and evaluate technology required to maintain data security and integrate modular communications, navigation, and identification components with existing platform-specific interfaces, hardware, software, and backplanes.
- (U) $797 Develop hardware and software technologies to support re-use of existing avionics software with newly developed Ada software in a common, real-time, embedded core avionics environment and to provide a cost-effective incremental upgrade capability.
  - (U) Develop hardware/software technology necessary for simultaneous execution of existing 16-bit avionics software written in many languages with new 32-bit Ada application and control software to reduce the life cycle cost of upgrading and adding software to existing weapon systems.
- (U) $3,268 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Avionics Integration PROJECT 3833

(U) FY 1998 ($ in Thousands):

- (U) $404 Develop and demonstrate programmable integrated communications, navigation, and identification hardware/software modules for currently fielded aircraft applications to provide fleet wide commonality, attendant economies of scale, and increased platform availability.
  - (U) Demonstrate and transition the technology required to integrate modular communications, navigation, and identification components into existing platforms while maintaining data security.
- (U) $1,516 Develop and demonstrate technologies to support maximum use of existing avionics software in concert with newly developed software in a real-time avionics environment and, thereby, provide a cost-effective incremental upgrade capability.
  - (U) Continue development of technology necessary for simultaneous execution of existing 16-bit avionics software written in many languages with new 32-bit Ada application software to reduce the life-cycle cost of upgrading and maintaining existing weapon systems.
- (U) $606 Develop avionics integration technologies to enable commercial-off-the-shelf components to function reliably in a combat aircraft environment for cost-effective modernization of aging avionics.
  - (U) Determine feasibility of inserting commercial products into an avionics open system architecture.
  - (U) Define candidate open system interfaces to enable competitive development for architectural components.
  - (U) Establish a collaborative engineering capability which links together non-colocated Air Force resources to provide a comprehensive virtual environment for avionics development, eliminating the need for expensive and duplicative hardware and facilities.
- (U) $2,526 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,092 Develop and demonstrate technologies to support maximum use of existing avionics software in concert with newly developed software in a real-time avionics environment and, thereby, provide a cost-effective incremental upgrade capability.
  - (U) Perform optimization testing of hardware/software technology necessary for simultaneous execution of existing 16-bit avionics software with new 32-bit application software to reduce the life cycle cost of upgrading and maintaining existing weapon systems.
- (U) $1,135 Develop avionics integration technologies to enable commercial-off-the-shelf components to function reliably in a combat aircraft environment for cost-effective modernization of aging avionics.
  - (U) Define avionics architectural hardware and software elements needed to connect to selected open system interfaces.
  - (U) Continue development of a collaborative engineering capability which links together non-colocated Air Force resources to provide a comprehensive avionics virtual technology development environment.
- (U) $3,227 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Avionics Integration
	PROJECT 3833

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	2,526	3,416	3,407	3,643	Cont
(U) Current Budget Submit/FY 1998 PB	2,526	3,268	2,526	3,227	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands):

(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0602301E, Intelligence System Program.
- (U) PE 0602232N, Navy Command, Control, and Communications (C3) Technology.
- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0604201F, Common Avionics.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603253F Advanced Avionics Integration

PROJECT: 666A

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
666A Reference and Information Transmission Technology	6,712	4,859	4,065	4,929	4,849	5,437	5,396	5,575	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Develops and demonstrates advanced, high-speed reference and information transmission technologies and techniques to improve overall aircrew situation awareness. These technologies will also reduce the electromagnetic signatures of navigation and communications systems, increasing aircraft survivability. The focus is on incorporating jam-resistant, low probability of detection transceivers, inertial components, navigation systems technology and techniques into air vehicles and on developing techniques for exploiting the capabilities of the Global Positioning System (GPS) to provide highly accurate reference information. Technologies demonstrated under this project are needed for real-time information in the cockpit, stealth operations, precision targeting and strike, timely bomb damage assessment, force multiplication through multi-platform shared resources, and affordable/supportable weapon systems.

(U) FY 1996 ($ in Thousands):

- (U) $746 — Develop advanced inertial reference technology and architectures to improve robustness of reference functions and weapon/sensor boresight accuracy.
  - (U) Developed techniques for dynamic airframe flexure compensation and navigation system fault detection/isolation to meet precision targeting and weapon delivery requirements.
- (U) $2,418 — Develop jam-resistant, short-range voice and low-data-rate transmission capability to provide for cooperative, low probability of detection operations.
  - (U) Completed system design of integrated avionics and discrete system brassboards for a low-cost, real-time adaptive, highly covert, jam-resistant voice and data transfer capability.
- (U) $876 — Develop enhancements to GPS user equipment and system integration techniques to maximize position accuracy and jam resistance, and exploit the benefits of GPS to improve offensive and defensive combat capabilities at reduced costs.
  - (U) Developed and demonstrated GPS-based techniques to rapidly locate and then counter enemy emitters for an enhanced, low-cost suppression of enemy air defenses capability for tactical fighters.
- (U) $2,672 — Develop multi-user, medium to high capacity, jam-resistant airborne network to provide for low probability of detection exchange of time-critical threat, sensor, and cooperative operations information between aircraft.
  - (U) Completed design and initiated fabrication of technology for 1.544 million bits per second data transfer capability for secondary dissemination of reconnaissance/intelligence data and imagery to support real-time precision targeting and strike.
- (U) $6,712 — Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Avionics Integration PROJECT 666A

(U) FY 1997 ($ in Thousands):

- (U) $936 Develop advanced inertial reference technology and architectures to improve robustness of reference functions and accuracy of weapon/sensor boresights.
  - (U) Integrate techniques and plan flight experiments for dynamic airframe flexure compensation and navigation fault detection/isolation to meet precision targeting and weapon delivery requirements.
- (U) $1,069 Develop enhancements to Global Positioning System (GPS) user equipment and system integration techniques to maximize position accuracy and jam resistance and exploit the benefits of GPS to improve offensive and defensive combat capabilities at reduced costs.
  - (U) Complete ground experiments and initiate flight experiments of GPS-based techniques to rapidly locate and then counter enemy emitters for an enhanced, low-cost suppression of enemy air defenses capability for tactical fighters.
- (U) $2,854 Develop multi-user, medium to high capacity, jam-resistant airborne network to provide for low probability of detection exchange of time-critical threat, sensor, and cooperative operations information between aircraft.
  - (U) Complete fabrication and demonstration of technology for high-speed, high-bandwidth data transfer capability for secondary dissemination of reconnaissance/intelligence data and imagery to support real-time precision targeting and strike.
- (U) $4,859 Total

(U) FY 1998 ($ in Thousands):

- (U) $2,435 Develop enhancements to GPS user equipment and system integration techniques to maximize position accuracy and jam resistance and exploit the benefits of GPS to improve offensive and defensive combat capabilities at reduced costs.
  - (U) Complete flight experiments of GPS-based techniques to rapidly locate and then counter enemy emitters for an enhanced, low-cost suppression of enemy air defenses capability for tactical fighters.
  - (U) Develop optimum anti-jam techniques to fully exploit all-digital GPS user equipment architectures.
  - (U) Develop techniques for more accurate precision attack using anti-jam, all-digital GPS user equipment and improved GPS signals.
  - (U) Fabricate affordable, integrated spatial/temporal anti-jam filter and adaptive antenna electronics for GPS.
- (U) $1,630 Develop multi-user, medium to high capacity, jam-resistant airborne network technology to provide for low probability of detection exchange of time-critical threat, sensor, and other information between aircraft and cooperative assets.
  - (U) Complete design and initiate fabrication of integrated avionics and discrete system brassboards for a low-cost, real-time adaptive, jam-resistant voice and data transfer capability.
  - (U) Complete ground testing of technology for high-speed, high-bandwidth data transfer capability for secondary dissemination of reconnaissance/intelligence data and imagery to support real-time precision targeting.
  - (U) Begin design of advanced radio frequency filtering and switching devices to reduce signal component losses for multi-band, multi-frequency airborne networks and, thereby, permit use of more affordable, lower-power transmitters.
- (U) $4,065 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Avionics Integration PROJECT 666A

(U) FY 1999 ($ in Thousands):

- (U) $2,948 Develop enhancements to Global Positioning System (GPS) user equipment and system integration techniques to maximize position accuracy and jam resistance and exploit the benefits of GPS to improve offensive and defensive combat capabilities at reduced costs.
  - (U) Continue to develop optimum anti-jam techniques to fully exploit all-digital GPS user equipment architectures.
  - (U) Continue to develop techniques to provide higher accuracy for precision attack using anti-jam, all-digital GPS user equipment and improved GPS signals.
- (U) $1,981 Develop multi-user, medium to high capacity, jam-resistant airborne network technology to provide for low probability of detection exchange of time-critical threat, sensor, and other information between aircraft and cooperative assets.
  - (U) Complete fabrication and evaluation of integrated avionics and discrete system brassboards for a low-cost, real-time adaptive, jam-resistant voice and data transfer capability.
  - (U) Continue evaluation of technology for high-speed, high-bandwidth data transfer capability for secondary dissemination of reconnaissance/intelligence data and imagery to support real-time precision targeting.
  - (U) Continue design of advanced radio frequency filtering and switching devices to reduce signal component losses for multi-band, multi-frequency airborne networks and thereby permit use of more affordable, lower-power transmitters.
- (U) $4,929 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Avionics Integration
	PROJECT 666A

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	6,716	5,083	5,064	5,432	Cont
(U) Current Budget Submit/FY 1998 PB	6,712	4,859	4,065	4,929	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0602782A, Command, Control, and Communications (C3) Technology.
- (U) PE 0602232N, Navy C3 Technology.
- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0603270F, Electronic Warfare Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603270F Electronic Combat (EC) Technology

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	21,301	26,414	25,621	26,765	27,282	28,272	28,641	29,486	Continuing	Continuing
2432 Defensive System Fusion Technology	11,467	7,702	6,222	7,315	7,159	6,582	7,984	8,642	Continuing	Continuing
431G Radio Frequency (RF) Warning and Countermeasures	5,153	5,773	8,873	10,099	8,968	8,007	9,169	9,306	Continuing	Continuing
691X Electro-Optical/Infrared (EO/IR) Warning and Countermeasures	4,681	12,939	10,526	9,351	11,155	13,683	11,488	11,538	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 1998 and out, several projects in this PE have been combined and/or reorganized. Project 2754, Suppression of Enemy Air Defenses, and the former Project 2432, Defensive System Fusion, have been consolidated within Project 2432, Defensive System Fusion Technology. The radio frequency countermeasures efforts from the former Project 691X, On-board Countermeasures, have moved into Project 431G, Radio Frequency Warning and Countermeasures. Project 2222, Expendable Countermeasures, and the infrared missile warning efforts from the former Project 431G, Threat Alert, have been combined within Project 691X, Electro-Optical/Infrared (EO/IR) Warning and Countermeasures. In addition, precision location and identification efforts (conducted until FY 1997 in the former Project 2432, Defensive System Fusion,) are now reported as part of Project 431G, Radio Frequency Warning and Countermeasures. For clarity, both the FY 1996 and FY 1997 portions of this exhibit have used the new project structure.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program expands the EC technology base by proving design concepts and demonstrating technologies to support critical Air Force EC requirements. The projects are categorized by the development of components, subsystems, and technologies that have potential application to satisfy combat, special operations, and airlift EC requirements and to reduce acquisition and life cycle costs of EC systems. The program develops and demonstrates: radio frequency; infrared; electro-optic; and command, control, and communications countermeasure technologies. Technology demonstrations include flyable brassboards against validated threat simulators. In addition, the program develops and demonstrates technologies and concepts for signature reduction, advanced electronic warfare transmitters, receivers, and power management. This program ensures a strong EC technology base to provide demonstrated counters to current and future threat capabilities. Note: FY 1997 increase is due to the additional emphasis which has been placed on advanced countermeasures to protect aircraft from prevalent infrared threat missiles based on strong warfighter support. In FYs 1999 and out, additional emphasis has been placed on advanced countermeasures to protect fighter aircraft from radar-guided missiles based on strong warfighter support.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	21,464	25,202	27,357	28,891	Cont
(U) Appropriated Value	22,579	27,602			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-444	-552			
b. SBIR	-452	-611			
c. Omnibus/Other Above Threshold Reprogrammings	-360	-25			
d. Below Threshold Reprogrammings	-22				
(U) Current Budget Submit/FY 1998 PB	21,301	26,414	25,621	26,765	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to funding constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology PROJECT 2432

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2432 Defensive System Fusion Technology	11,467	7,702	6,222	7,315	7,159	6,582	7,984	8,642	Continuing	Continuing

Note: In FY 1998 and out, former Project 2754, Suppression of Enemy Air Defenses, and former Project 2432, Defensive System Fusion, have been combined into this project. For clarity, both the FY 1996 and FY 1997 portions of this exhibit have used the new project structure. In addition, precision location and identification efforts (previously conducted in this project until FY 1997) are now reported as part of Project 431G, Radio Frequency Warning and Countermeasures.

(U) A. **Mission Description and Budget Item Justification:** This project develops and demonstrates techniques and technologies for sensor and system fusion and integration. It also develops the advanced algorithms and assessment techniques necessary to cope with the projected multi-spectral threat and countermeasure environments for combat aircraft. Transferred from Project 2754 are those technology efforts required for command and control warfare, standoff jamming, and support countermeasures for denial, disruption, and suppression of adversary air defense operations. Included in these are: 1) advanced components and techniques needed to jam enemy radar; 2) novel electronic collection methods to inform the field commander of changes in the electronic environment; and 3) advanced standoff jammer technologies.

(U) FY 1996 ($ in Thousands):

- (U) $8,070 Develop technology to demonstrate low-cost (based on commercial processors and open architecture), off-board and on-board threat sensor fusion for improving situation awareness for both new and existing aircraft.
  - (U) Completed development of software requirements and design of a sensor fusion technology demonstration model.
  - (U) Completed fabrication of hardware and development of software and began in-laboratory sensor fusion technology demonstrations.
  - (U) Prepared plans and began hardware integration for interim flight demonstration of a sensor fusion technology model.
- (U) $3,397 Develop and investigate techniques to suppress adversary defense command and control networks.
  - (U) Flight demonstrated hardware and software techniques to counter specific types of command and control warfare signals.
  - (U) Developed and flight demonstrated an approach to counter airborne navigation aids.
  - (U) Developed techniques to counter modern threat command and control processing nets/nodes.
  - (U) Developed/designed (using new commercial technologies) affordable, modular, efficient, wide-band, high-power amplifier for use in existing and new command and control warfare systems.
- (U) $11,467 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology PROJECT 2432

(U) FY 1997 ($ in Thousands):

- (U) $5,401 Develop technology to demonstrate low-cost (based on commercial processors and open architecture), off-board and on-board threat sensor fusion for situation awareness that meets needs for both new and existing aircraft.
  - (U) Conduct preliminary flight demonstrations for hardware and software optimization of off-board and on-board threat sensor fusion technology.
  - (U) Optimize hardware and algorithms/software in preparation for final demonstration of sensor fusion technology model.
- (U) $2,301 Develop and investigate techniques to suppress adversary defense command and control networks.
  - (U) Complete demonstrations of techniques to counter specific types of command and control warfare signals.
  - (U) Complete development and demonstration of an approach to counter airborne navigation aids.
  - (U) Fabricate and integrate components (based on new commercial technology) to demonstrate techniques to counter threat command and control processing nets/nodes.
  - (U) Design and analyze advanced techniques for countering airborne navigation systems.
- (U) $7,702 Total

(U) FY 1998 ($ in Thousands):

- (U) $3,119 Develop low-cost (based on commercial processors and open architecture) technologies to demonstrate fusion of data (e.g., threat, targeting, command and control, etc.) from off-board and on-board sensors to enhance situation awareness in both new and existing aircraft.
  - (U) Conduct tactical flight test demonstration of optimized sensor fusion technology within existing avionics size, weight, and power constraints.
- (U) $2,479 Develop and investigate command and control warfare electronic attack (EA) techniques to suppress and counter adversary command and control networks.
  - (U) Complete critical hardware/software designs; initiate fabrication of components for jamming modern digital command and control network links.
  - (U) Complete preliminary and critical designs of EA techniques to counter advanced navigation systems.
- (U) $624 Develop and evaluate advanced defensive techniques based on fusion of multiple information sources including defensive sensors, offensive sensors, off-board broadcast information, off-board data links, and cooperative off-board sensors.
  - (U) Complete preliminary design of a combat information system that integrates defensive avionics functions.
- (U) $6,222 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 2432

(U) FY 1999 ($ in Thousands):

- (U) $1,470 Develop low-cost (based on commercial processors and open architecture) technologies to demonstrate fusion of data (e.g., threat, targeting, command and control, etc.) from off-board and on-board sensors to enhance situation awareness in both new and existing aircraft.
  - (U) Optimize final Ada code for sensor fusion technology model for multiple platforms.
  - (U) Complete preliminary design trade offs for candidate techniques and algorithms via commercial technology architectures.
- (U) $4,742 Develop and investigate command and control warfare electronic attack (EA) techniques to suppress and counter adversary command and control networks.
  - (U) Complete hardware/software integration of brassboard demonstration model and conduct ground/field testing against modern digital command and control network links.
  - (U) Complete fabrication of EA demonstration model hardware; prepare ground/flight test parameters for demonstration against global/integrated navigation systems.
  - (U) Demonstrate laboratory EA technique to counter communications network nodes.
- (U) $1,103 Develop and evaluate advanced defensive techniques based on fusion of multiple information sources including defensive sensors, offensive sensors, off-board broadcast information, off-board data links, and cooperative off-board sensors.
  - (U) Develop integration model of a defensive combat information system.
  - (U) Evaluate defensive combat information system model for new technique development.
- (U) $7,315 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 2432

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	11,625	8,066	7,034	7,277	Cont
(U) Current Budget Submit/FY 1998 PB	11,467	7,702	6,222	7,315	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0604270F, Electronic Warfare (EW) Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603270F Electronic Combat (EC) Technology

PROJECT: 431G

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
431G Radio Frequency (RF) Warning and Countermeasures	5,153	5,773	8,873	10,099	8,968	8,007	9,169	9,306	Continuing	Continuing

Note: In FY 1998 and out, the radio frequency countermeasures efforts from former Project 691X, On-board Countermeasures, have moved into a new Project 431G, Radio Frequency Warning and Countermeasures. Also, the infrared missile warning efforts from former Project 431G, Threat Alert, have been moved to Project 691X, Electro-Optical/Infrared (EO/IR) Warning and Countermeasures. For clarity, both the FY 1996 and FY 1997 portions of this exhibit have used the new project structure. In addition, precision location and identification efforts (previously conducted in former Project 2432, Defensive System Fusion, until FY 1997) are now reported as part of this project.

(U) A. **Mission Description and Budget Item Justification:** This project develops and demonstrates advanced technologies for radio frequency (RF) electronic countermeasures suites to enhance aircraft survivability and provide crew situation awareness. One major technology area addressed covers missile/aircraft warning, radar frequency receiver technologies, electronic combat (EC) preprocessor technologies, advanced sorting/preprocessing algorithms, and expert software for applications on existing and future EC systems. Another technology area focuses on the development and demonstration of systems and components for generating the on-board/off-board RF countermeasure techniques. This includes the development of actual electronic countermeasures (ECM) techniques and as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 431G

(U) FY 1996 ($ in Thousands):

- (U) $551 Conduct risk reduction efforts for low-cost advanced radio frequency (RF) emitters and infrared (IR) warning concepts and techniques.
  - (U) Established technology requirements for further IR/RF technology development.
- (U) $1,387 Conduct continuing demonstrations to establish the benefits of integrating electronic warfare sensor suites to support situation awareness and electronic attack response strategy.
  - (U) Completed integration of multi-spectral electronic combat testbed to include processing capability for situation awareness, attack response strategy, and RF countermeasures.
  - (U) Completed implementation and integration of testbeds for expanded situation awareness insertion and precision location and identification technology developments.
- (U) $3,215 Develop technology to demonstrate capability for single aperture precision location and identification of both ground and airborne radio frequency emitters for low-cost insertion into fielded equipment.
  - (U) Conducted preliminary and critical design reviews for demonstration of single aperture precision location and identification technology.
  - (U) Fabricated/integrated hardware and developed software for a single aperture precision location and identification technology demonstration.
  - (U) Lab demonstrated single aperture precision location and identification to prove hardware and software technology approaches.
- (U) $5,153 Total

(U) FY 1997 ($ in Thousands):

- (U) $644 Conduct risk reduction efforts for low-cost advanced radar and other RF emitters, and IR warning concepts and techniques.
  - (U) Define performance requirements for an advanced radar warning receiver operating in a complex RF environment.
  - (U) Develop design concepts for a digital RF receiver (cooperative effort with Navy).
- (U) $169 Develop algorithms which provide aircraft defensive systems with threat missile time-to-intercept data using sensor information from a passive, on-board IR missile warning receiver.
- (U) $3,123 Develop aircraft RF self-protection technology to counter the advanced RF threats associated with air defense weapon systems expected to be deployed over the next ten years.
  - (U) Continue cooperative efforts with the other Services and other countries to conduct tests to evaluate various RF countermeasure algorithm and/or hardware solutions.
  - (U) Identify promising solutions and design/fabricate technology to demonstrate approaches for countering RF threats.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 431G

- (U) $1,837 Complete technology development for single aperture precision location and identification of ground and airborne radio frequency (RF) emitters.
  - (U) Develop demonstration plans and integrate precision location hardware into technology demonstration aircraft.
  - (U) Complete flight demonstration of technology for single aperture precision location and identification of ground RF emitters and transition to users.
- (U) $5,773 Total

(U) FY 1998 ($ in Thousands):

- (U) $2,224 Develop low-cost advanced radar and RF emitter warning concepts and techniques.
  - (U) Conduct continuing demonstrations to establish benefits and effectiveness of evolving jam-on-pulse RF receiver technology.
  - (U) Initiate development of a wideband digital receiver for affordable electronic support measures (ESM) and radar warning receiver (RWR) suites based on PE 0602204F brassboard test.
  - (U) Complete design for an advanced antenna which improves antenna gain factor by a factor of ten at half the cost of current designs.
- (U) $6,649 Develop aircraft self-protection technologies to counter advanced RF threats associated with current and future air defense weapon systems.
  - (U) Complete preliminary design of critical flight-worthy technology components required to jam monopulse radar systems.
  - (U) Design and develop critical components for a tunable/switchable high temperature superconductivity filter to increase probability of detecting real threats.
  - (U) Initiate design trade offs of RF hardware, software, and countermeasure techniques necessary for optimizing current inventory RF countermeasure suite performance through modification of system configurations.
- (U) $8,873 Total

(U) FY 1999 ($ in Thousands):

- (U) $3,044 Develop low-cost advanced radar and RF emitter warning concepts and techniques.
  - (U) Conduct continuing demonstrations to establish the benefits and effectiveness of evolving jam-on-pulse RF receiver technology.
  - (U) Complete critical design of a wideband digital receiver for affordable ESM and RWR suites.
- (U) $7,055 Develop aircraft self-protection technologies to counter advanced RF threats associated with current and future air defense weapon systems.
  - (U) Develop and demonstrate critical high risk technology for the monopulse angle jamming integrated electronic countermeasures (ECM) program.
  - (U) Demonstrate a tunable/switchable high temperature superconductivity filter to improve ECM receiver performance in a dense electromagnetic battlefield environment.
  - (U) Complete design trade offs necessary for optimizing current inventory RF countermeasure suite performance through modification of ECM system configurations. Evaluate demonstration models.
- (U) $10,099 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 431G

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	3,910	6,046	8,834	10,399	Cont
(U) Current Budget Submit/FY 1998 PB	5,153	5,773	8,873	10,099	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0604270F, Electronic Warfare (EW) Development.
- (U) PE 0604270N, EW Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603270F Electronic Combat (EC) Technology

PROJECT: 691X

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
691X Electro-Optical/Infrared (EO/IR) Warning and Countermeasures	4,681	12,939	10,526	9,351	11,155	13,683	11,488	11,538	Continuing	Continuing

Note: In FY 1998 and out, former Project 2222, Expendable Countermeasures, and the infrared missile warning efforts from former Project 431G, Threat Alert, have been combined within this project. In addition, in FY 1998 and out, the RF countermeasures efforts previously conducted under the former project 691X, On-Board Countermeasures, have moved into Project 431G, Radio Frequency Warning and Countermeasures. For clarity, both the FY 1996 and FY 1997 portions of this exhibit have used the new project structure.

(U) A. **Mission Description and Budget Item Justification:** This project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical (EO), infrared (IR), and laser threat systems. The off-board (decoys and expendables) and on-board countermeasure technologies developed provide robust, affordable solutions for protection against IR missiles with autonomous seekers, multi-spectral threats, laser-guided weapons and EO/IR tracking systems used to direct EO/IR/radio frequency (RF) missiles. Countermeasure capability against advanced EO, IR, and laser-guided threats are vital for operational aircraft survival in wartime, peacekeeping, and supply mission environments.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 691X

(U) FY 1996 ($ in Thousands):

- (U) $2,099 Develop threat-adaptable, laser-based infrared countermeasure (IRCM) technology for large aircraft to defeat current and future infrared (IR) missiles in multiple threat scenarios.
  - (U) Completed joint-Service technology demonstration plan for application of closed loop IRCM technology to large aircraft.
  - (U) Conducted tower tests of laser-based IRCM jamming techniques and evaluate their potential to defeat potential IR missile seeker threats.
  - (U) Developed and demonstrated closed-loop IRCM technologies under laboratory and field conditions necessary to provide risk reduction for transition.
  - (U) Conducted hardware-in-the-loop tests in-house to develop countermeasure techniques and assist in the development of digital models of potential threat seekers.
- (U) $648 Develop IR missile warning technology for product improvement of existing and new aircraft-installed equipment, lowering life cycle costs and improving performance to meet the critical needs of detecting advanced, lower signature threats.
  - (U) Developed concepts for using an advanced sensor array that eliminates the need for expensive cryogenic cooling.
  - (U) Completed development of techniques to enhance the detection of threat missiles in a variety of high-background-clutter environments.
- (U) $47 Develop IR, multi-spectral expendables to address Air Mobility Command decoy requirements.
  - (U) Conducted laboratory evaluations of expendable source materials to determine burn duration and spectrum of operation.
  - (U) Completed mechanical design and fabrication of multi-spectral expendable samples for characterization.
- (U) $35 Develop future generation expendables to counter rapidly advancing threat environment.
  - (U) Completed field demonstrations and characterized electro-optical/IR jammer for large aircraft.
- (U) $1,852 Develop integrated multi-spectral countermeasure expendables for IR and dual-mode (IR/radio frequency) seeker threats.
  - (U) Completed preliminary design of expendables designed to defeat non-imaging threat missiles.
  - (U) Conducted joint test with United Kingdom on flares against internationally operational missiles.
- (U) $4,681 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 691X

(U) FY 1997 ($ in Thousands):

- (U) $9,750 Develop threat-adaptable, laser-based infrared countermeasure (IRCM) technology for large aircraft to defeat current and future infrared (IR) missiles in multiple threat scenarios.
  - (U) Continue tower testing of threat-adaptable laser-based IRCM jamming techniques and evaluate their potential to defeat IR missiles in accordance with the joint-Service demonstration plan.
  - (U) Conduct live fire field demonstration of static, closed-loop IRCM brassboard against air-to-air missiles at White Sands Missile Range North Obscura Peak.
  - (U) Develop and demonstrate closed-loop IRCM technologies under laboratory and field conditions necessary for continued risk reduction.
  - (U) Continue to conduct hardware-in-the-loop tests in-house to analyze threat missile operations, develop countermeasure techniques, and assist in developing digital models of potential threat seekers.
- (U) $793 Develop laser-based electro-optical (EO)/IRCM technology to defeat advanced day/night vision EO/IR acquisition/tracking sensors on threat air defense weapon systems.
  - (U) Conduct threat analysis, vulnerability studies, and associated experiments to determine optimum countermeasure techniques for threat EO/IR acquisition/tracking sensors.
- (U) $622 Develop IR missile warning technology for product improvement of existing and new aircraft-installed equipment, lowering life cycle costs and improving performance to meet the critical need of detecting advanced, lower signature threats.
  - (U) Complete design for an IR missile warning subsystem which utilizes an advanced IR sensor array that eliminates the expensive cryogenic cooling requirement.
  - (U) Complete evaluation of a temporal algorithm with a commercial image processor for IR missile warning applications.
- (U) $1,774 Develop integrated multi-spectral countermeasure expendables for IR and dual mode (IR/radio frequency) seeker threats.
  - (U) Complete critical design and fabricate test samples of IR expendables which defeat non-imaging threat missiles.
  - (U) Design and analyze technologies to counter enemy dual mode missile seekers.
- (U) $12,939 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology PROJECT 691X

(U) FY 1998 ($ in Thousands):

- (U) $8,987 Develop on-board threat adaptable, laser-based infrared countermeasure (IRCM) technology and off-board (active decoy) technology to defeat current and future infrared (IR) missiles in multiple scenarios.
  - (U) Continue tower testing threat adaptable, laser-based jamming codes to defeat specific threat IR missiles in accordance with the joint-Service demonstration plan.
  - (U) Fabricate and integrate hardware components necessary to demonstrate threat-adaptable, laser-based IR countermeasure system for large aircraft.
  - (U) Continue to conduct hardware-in-the-loop experiments to analyze threat missile operations, develop countermeasure techniques, and assist in developing digital models of potential threat infrared seekers.
  - (U) Conduct field test demonstration of signature management countermeasures against advanced imaging IR missile seekers.
- (U) $1,069 Develop the laser warning and countermeasure technologies necessary to defeat advanced day/night electro-optical (EO)/IR acquisition/tracking sensors on threat air defense systems. These technologies include on-board and off-board (expendable jammers), EO/laser countermeasures, and precision guided weapon countermeasures.
  - (U) Complete development and laboratory testing of techniques for detection of beamrider missiles.
  - (U) Complete threat analysis and initiate design of laser-based countermeasure concepts to defeat EO/IR tracking systems used to direct a wide variety of weapons.
  - (U) Develop non-mechanical beam steering technologies for EO, laser, and IR countermeasures.
  - (U) Complete threat definition and initiate design of IR/RF decoy concepts to negate multi-mode threat seekers.
- (U) $470 Develop IR missile warning technologies for product improvement of existing and new aircraft-installed equipment. These technologies will lower life cycle costs and improve the performance required to detect advanced, low signature threat missiles.
  - (U) Complete evaluation of uncooled IR focal plane arrays for use in lower-cost passive threat warning devices.
  - (U) Complete evaluation of commercial image processor for use in running IR threat warning algorithms in real-time.
  - (U) Complete design of sensors and algorithms for missile warning, situational awareness, and defensive infrared search and track.
- (U) $10,526 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 691X

(U) FY 1999 ($ in Thousands):

- (U) $7,987 Develop on-board threat adaptable, laser-based infrared countermeasure (IRCM) technology and off-board (active decoy) technology to defeat current and future infrared (IR) missiles in multiple scenarios.
  - (U) Continue tower testing threat-adaptable, laser based jamming techniques to defeat IR missiles in accordance with the joint-Service demonstration plan.
  - (U) Conduct live-fire IR missile firing at White Sands Missile Range against the technology demonstration hardware developed for a threat-adaptable, laser based IR countermeasure system for large aircraft.
  - (U) Fabricate flight test hardware for a threat-adaptable, laser-based IR countermeasure system for large aircraft.
  - (U) Continue to conduct in-house experiments to analyze the latest acquired threat missile operation, develop countermeasure techniques, and assist in developing digital models of potential threat IR seekers.
  - (U) Complete development and integration of a new target simulator for imaging IR seekers.
  - (U) Continue development of a reduced-sized, threat-adaptable, laser-based IR countermeasure concept for tactical combat aircraft.
  - (U) Complete development of IR imaging countermeasure concept and laboratory demonstration.
  - (U) Continue the development of hardware for field demonstration of countermeasures against advanced imaging IR missile seekers.
- (U) $894 Develop the laser warning and countermeasure technologies necessary to defeat advanced day/night electro-optical (EO)/IR acquisition/tracking sensors on threat air defense systems. These technologies include on-board and off-board (expendable jammers), EO/laser countermeasures, and precision guided weapon countermeasures.
  - (U) Continue development of countermeasure concepts to defeat newly developed EO/IR tracking systems.
  - (U) Continue development of gimballess beam steering technologies that have applications to EO laser and IR countermeasures.
  - (U) Develop advanced countermeasure technologies to defeat anti-aircraft laser aided/guided weapon systems.
  - (U) Continue development and complete threat modeling technologies to counter enemy dual mode missile seekers.
- (U) $470 Develop IR missile warning technologies for product improvement of existing and new aircraft-installed equipment. These technologies will lower life cycle costs and improve the performance required to detect advanced, low signature threat missiles.
  - (U) Complete design of distributed aperture demonstration hardware for real-time processing demonstration of multiple passive functions (missile warning, navigation, defensive IR search-track).
- (U) $9,351 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 691X

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	5,929	11,090	11,489	11,215	Cont
(U) Current Budget Submit/FY 1998 PB	4,681	12,939	10,526	9,351	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0604270F, Electronic Warfare (EW) Development.
- (U) PE 0604270N, EW Development.
- (U) PE 0603203F, Avionics for Aerospace Vehicles.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	18,162	22,353	16,247	22,037	22,805	22,816	23,572	24,192	Continuing	Continuing
0003 Launch Vehicle Technology	571	588	663	663	672	682	703	725	Continuing	Continuing
4373 Launch and Orbit Transfer Propulsion Technology	15,686	19,526	13,707	19,488	20,233	20,216	20,927	21,496	Continuing	Continuing
6339 Tactical Propulsion Technology	286	298	336	340	349	358	366	376	Continuing	Continuing
6340 Satellite Control and Maneuvering Propulsion Technology	1,619	1,941	1,541	1,546	1,551	1,560	1,576	1,595	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 1996, launch technology efforts in Projects 6340 and 6341 were combined into Project 4373. Also, in FY 1996, Project 0003, Launch Vehicle Technology, was transferred from PE 0603401F into this PE to combine all space launch technologies into a single PE.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates advanced rocket propulsion and space launch technologies. This program provides the technological step necessary to transition the most promising rocket propulsion and space launch technologies to applications using full-scale, proof-of-principle demonstrations. The projects within this program are structured to support Air Force Space Command's and Air Combat Command's mission area requirements for space and missile technologies which include the goals established in the Integrated High Payoff Rocket Propulsion Technology Initiative, a multi-agency/industry effort to focus the development of U.S. rocket propulsion technology.

New and improved components will be integrated with the environmentally improved propellants developed in this program to create new propulsion systems for the next generation of launch vehicles and satellites. Anticipated technological advances in this program will improve the performance of expendable systems' payload capabilities by 21% and reduce the launch and operations and support (O&S) costs by 28%. In a reusable launch system, the anticipated improvements are an increase in payload capability of 170% and a reduction in launch and O&S costs of 79%. The advances in propulsion in this program result from the achievement of the 2010 goals of the Integrated High Payoff Rocket Propulsion Technology Initiative. The development of these technologies has been coordinated with NASA to eliminate duplication of efforts. The space launch and missile propulsion industry will leverage the technologies from this program to enhance the country's industrial competitiveness.

Note: Congress added $5 million for Integrated High Payoff Rocket Propulsion Technology (IHPRPT) in FY 1996 and $2 million for Pentaborane Disposal and $3 million for Scorpius in FY 1997 which explains the perceived decrease in FY 1998. In FYs 1999 and out, additional emphasis has been placed on space launch technology.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	19,246	15,740	15,114	17,069	Cont
(U) Appropriated Value	20,203	23,240			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-451	-466			
b. SBIR	-305	-399			
c. Omnibus/Other Above Threshold Reprogrammings	-460	-22			
e. Below Threshold Reprogrammings	-825				
(U) Current Budget Submit/FY 1998 PB	18,162	22,353	16,247	22,037	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

PROJECT: 0003

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
0003 Launch Vehicle Technology	571	588	663	663	672	682	703	725	Continuing	Continuing

Note: In FY 1996, launch technology efforts in Projects 6340 and 6341 were combined into Project 4373. Also, in FY 1996, Project 0003, Launch Vehicle Technology, was transferred from PE 0603401F into this PE to combine all space launch technologies into a single PE.

(U) A. **Mission Description and Budget Item Justification:** This project develops advanced and innovative launch vehicle technologies in the areas of structures (i.e., fairings, interstages, struts, thermal protection systems, etc.), tanks, and operations.

(U) FY 1996 ($ in Thousands):
- (U) $571 Develop space launch vehicle technology.
  - (U) Defined technological needs for future expendable and reusable military launch vehicles including operations technologies, light-weight airframe structures, durable composite cryogenic tanks, and all-weather thermal protection.
  - (U) Designed and fabricated advanced composite sub-scale vehicle stage connectors (interstages) using techniques that promise up to 50% weight reductions and 30-60% cost reductions.
- (U) $571 Total

(U) FY 1997 ($ in Thousands):
- (U) $588 Develop space launch vehicle technology.
  - (U) Continue to define technological needs for future expendable and reusable military launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and all-weather thermal protection.
  - (U) Fabricate full-size advanced composite interstages for future launch vehicles, using and validating techniques that promise up to 50% weight reductions and 30-60% cost reductions.
- (U) $588 Total

(U) FY 1998 ($ in Thousands):
- (U) $663 Develop space launch vehicle technology.
  - (U) Continue to define technological needs for future expendable and reusable military launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and all-weather thermal protection.
  - (U) Continue fabrication of full-size advanced composite interstages for future launch vehicles, using and validating techniques that promise up to 50% weight reductions and 30-60% cost reductions.
- (U) $663 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion PROJECT 0003

(U) FY 1999 ($ in Thousands):

- (U) $663 Develop space launch vehicle technology.
  - (U) Continue to define technological needs for future expendable and reusable military launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and all-weather thermal protection.
  - (U) Complete fabrication of full-size advanced composite interstages for future launch vehicles, using and validating techniques that promise up to 50% weight reductions and 30-60% cost reductions.
  - (U) Begin flight experiment for advanced composite payload shroud.
- (U) $663 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	571	612	617	624	Cont
(U) Current Budget Submit/FY 1998 PB	571	588	663	663	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603401F, Advanced Spacecraft Technology.
- (U) PE 0603853F, Evolved Expendable Launch Vehicle Program.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion PROJECT 4373

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4373 Launch and Orbit Transfer Propulsion Technology	15,686	19,526	13,707	19,488	20,233	20,216	20,927	21,496	Continuing	Continuing

Note: In FY 1996, launch technology efforts in Projects 6340 and 6341were combined into this project.

(U) A. **Mission Description and Budget Item Justification:** This project develops advanced and innovative, low-cost rocket turbomachinery and components, low-cost space and missile launch propulsion system manufacturing technologies, and environmentally acceptable propellants. Characteristics such as environmental acceptability, affordability, reliability, reduced weight, reduced operation and launch costs, and increased life and performance of propulsion systems are emphasized in this project. Technological advances developed in this program will improve the performance of expendable systems' payload capabilities by 21% and reduce the launch and operations and support (O&S) costs by 28%. The advances in propulsion in this program result from the achievement of the 2010 goals of the Integrated High Payoff Rocket Propulsion Technology Initiative.

(U) FY 1996 ($ in Thousands):

- (U) $6,436 Develop advanced, environmentally acceptable propellants for current and future launch systems.
  - (U) Completed large-scale testing of non-toxic, chlorine-free space launch propellant and verified the performance capabilities and cost-benefit analyses for replacement of current propellants.
  - (U) Quantified costs and benefits, and performance characteristics of solid motors developed using environmentally acceptable manufacturing techniques.
  - (U) Conducted impact analyses of environmentally improved propellants on solid rocket motor components (such as hotter burning temperatures and highly erosive environments) and determined performance needs of replacement components.
  - (U) Developed low-cost, carbon/carbon nozzles, quantifying the manufacturing cost savings of a new, rapid densification process.
  - (U) Identified and assessed technologies for solid motor components.
- (U) $9,250 Develop propulsion technologies for existing and future launch vehicles.
  - (U) Completed design and began fabrication of low-cost, highly reliable turbopump, preburner, and thrust chamber components with fluid film bearing technologies to increase liquid booster propulsion capabilities.
- (U) $15,686 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion PROJECT 4373

(U) FY 1997 ($ in Thousands):

- (U) $5,294 Develop advanced, environmentally acceptable propellants technology for current and future launch systems.
  - (U) Publish final report assessing the increased performance benefits of a new, non-toxic chlorine-free propellant for replacement of current propellants in solid launch systems.
  - (U) Continue studying current and proposed environmental regulations for their impact on the manufacturing of large-scale solid rocket booster propellants.
  - (U) Begin development of a new solid-fuel motor which maintains motor integrity and performance while drastically increasing safety by creating a method to load the fuel at the launch site. (This eliminates the risk of explosion during transport).
  - (U) Design, fabricate, and demonstrate solid motor components.
  - (U) Begin disposal of pentaborane.
- (U) $14,232 Develop propulsion technologies for existing and future launch vehicles.
  - (U) Integrate fluid film bearing technologies into the oxygen and hydrogen rocket turbopumps, increasing liquid-booster propulsion performance.
  - (U) Begin development of advanced, lightweight, thrust chamber components to be integrated with rocket turbopumps and preburners.
  - (U) Design and fabricate a complete thrust chamber with extended thermal-cycle life, decreased system costs, and increased liquid engine reliability that will be used in boost and orbit transfer missions.
- (U) $19,526 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
	PROJECT 4373

(U) FY 1998 ($ in Thousands):

- (U) $3,699 Develop advanced, environmentally acceptable propellants technology for current and future launch systems.
  - (U) Publish report detailing impacts to solid rocket motor designs by using the environmentally cleaner propellants.
  - (U) Publish report detailing environmentally acceptable manufacturing techniques for the development of future cleaner burning large solid booster.
  - (U) Begin to scale-up the technology developed in the Process Efficient Motor Technology program to apply innovations to full-scale solid boosters.
- (U) $6,806 Develop propulsion technologies for existing and future launch vehicles.
  - (U) Continue fabrication of turbopump assemblies and begin testing in relative environment.
  - (U) Continue development of advanced lightweight thrust chamber components for integration into advanced liquid booster.
- (U) $3,202 Develop propulsion technologies for existing and future upperstage and orbit transfer vehicles.
  - (U) Complete design and begin fabrication and assembly of a high pressure liquid oxygen/hydrogen upperstage engine.
  - (U) Begin design of high altitude solar thermal Orbital Transfer Vehicle (OTV) balloon experiment.
  - (U) Begin design of pulsed plasma thruster for inclusion in the MightlySat Flight demo.
- (U) $13,707 Total

(U) FY 1999 ($ in Thousands):

- (U) $6,705 Develop advanced, environmentally acceptable propellants technology for current and future launch systems.
  - (U) Continue scale-up of the technology developed in the Process Efficient Motor Technology program to apply innovations to full-scale solid boosters.
- (U) $6,547 Develop propulsion technologies for existing and future launch vehicles.
  - (U) Complete testing of turbopump assembly and preburner components for integration into an advanced liquid booster.
  - (U) Complete assembly and engine testing of a 1200 psi liquid oxygen/hydrogen upperstage engine.
- (U) $6,236 Develop propulsion technologies for existing and future upperstage and orbit transfer vehicles.
  - (U) Complete assembly and engine testing of a high pressure liquid oxygen/hydrogen upperstage engine.
  - (U) Complete design and high altitude balloon testing of solar thermal OTV propulsion.
  - (U) Continue testing of pulsed plasma thruster for insertion into MightySat flight demo.
- (U) $19,488 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
	PROJECT 4373

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	16,770	14,050	13,681	15,606	Cont
(U) Current Budget Submit/FY 1998 PB	15,686	19,526	13,707	19,488	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603853F, Evolved Expendable Launch Vehicle Program.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

PROJECT: 6339

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
6339 Tactical Propulsion Technology	286	298	336	340	349	358	366	376	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops highly energetic propellants and propulsion systems. Improved case, insulation, and propellant interfaces as well as better performing nozzles will be developed. Technology such as thrust vector control, thrust modulation, signature characterization, and signature reduction will be developed in this project. The emphasis in this project is on rocket propulsion system affordability, weight reduction. Anticipated payoffs from these developments, identified through the Integrated High Payoff Rocket Propulsion Technology Initiative (IHPRPT), include a 49% range increase, 50% size reduction, 100% payload increase, and 21% reduction in time-to-target.

(U) FY 1996 ($ in Thousands):

- (U) $136 Develop and characterized, in lab-size quantities, propellants and components that can be incorporated into the design and manufacturing of missile systems that will result in higher performance, lower environmental impacts, and reduced missile signatures.
  - (U) Completed analysis of environmentally acceptable, reduced smoke, and low-erosion propellants, insulators, and nozzle coatings, as well as solvent-less manufacturing processes, designed to improve missile thrust and reduced signature.
- (U) $150 Conduct system payoff analyses which validate program objectives and approaches in pursuit of the IHPRPT goals for tactical missiles.
  - (U) Conducted payoff analyses to identify rocket component technologies and determine their benefit to aircraft survivability and kill ratio.
- (U) $286 Total

(U) FY 1997 ($ in Thousands):

- (U) $298 Develop and characterize, in lab-size quantities, propellants and components that can be incorporated into the design and manufacturing of missile systems that will result in higher performance, lower environmental impacts, and reduced signature characteristics.
  - (U) Demonstrate environmentally acceptable, reduced smoke, low-erosion tactical missile propellants and components that improve missile thrust and reduce plume signatures.
- (U) $298 Total

(U) FY 1998 ($ in Thousands):

- (U) $336 Develop and characterize, in lab-size quantities, propellants and components that can be incorporated into the design and manufacturing of missile systems that will result in higher performance, lower environmental impacts, and reduced signature characteristics.
  - (U) Integrate component technologies and hardware for environmentally acceptable, reduced smoke, low-erosion tactical missile propellants and components that improve missile thrust and reduce plume signatures.
- (U) $336 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
	PROJECT 6339

(U) FY 1999 ($ in Thousands):

- (U) $340 Develop and characterize, in lab-size quantities, propellants and components that can be incorporated into the design and manufacturing of missile systems that will result in higher performance, lower environmental impacts, and reduced signature characteristics.
  - (U) Scale-up development for environmentally acceptable, reduced smoke, low-erosion tactical missile propellants and components that improve missile thrust and reduce plume signatures.
- (U) $340 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	286	309	313	321	Cont
(U) Current Budget Submit/FY 1998 PB	286	298	336	340	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602303A, Missile Technology.
- (U) PE 0603313A, Missile and Rocket Advanced Technology.
- (U) PE 0603792N, Advanced Technology Transition.
- (U) This project has been coordinated through the Project Reliance Process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

PROJECT: 6340

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
6340 Satellite Control and Maneuvering Propulsion Technology	1,619	1,941	1,541	1,546	1,551	1,560	1,576	1,595	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Chemical, electric, and solar rocket propulsion system technologies for station keeping and on-orbit maneuvering applications are developed in this project. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy chemical propellants. The payoffs for the Integrated High Payoff Rocket Propulsion Technology Initiative (IHPRPT) include a seven-year increase in satellite on-orbit time, a 50% increase in satellite maneuvering capability, a 25% reduction in orbit transfer operational costs, and a 15% increase in satellite payload.

(U) FY 1996 ($ in Thousands):
- (U) $1,619 Demonstrate orbit transfer and maneuvering propulsion technology.
  - (U) Integrated and demonstrated the 30 kilowatts (kW) ammonia arcjet thruster on the space test and transportation satellite. The satellite was measured for its performance and successful integration with an electric propulsion system. Electromagnetic impulse, contamination, solar array degradation, etc. were scrutinized.
- (U) $1,619 Total

(U) FY 1997 ($ in Thousands):
- (U) $1,941 Demonstrate solar electric propulsion technologies for orbit transfer and maneuvering propulsion technology.
  - (U) Support launch and space demonstration of the 30kW ammonia arcjet thruster, analyze data, and draft final report.
  - (U) Design the ground demonstration hardware for a high-powered Hall Thruster.
- (U) $1,941 Total

(U) FY 1998 ($ in Thousands):
- (U) $541 Demonstrate solar electric propulsion technologies for orbit transfer and maneuvering propulsion technology.
  - (U) Continue support launch and space demonstration of the 30kW ammonia arcjet thruster, data analysis, and final report creation.
  - (U) Develop and fabricate the ground demonstration hardware for a high-powered Hall Thruster (power processing unit, thruster materials).
- (U) $1,000 Demonstrate post boost vehicle strategic sustainment technologies.
  - (U) Begin development of post boost vehicle component technologies.
  - (U) Begin development of post boost vehicle propellant technologies.
- (U) $1,541 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
	PROJECT 6340

(U) FY 1999 ($ in Thousands):

- (U) $546 Demonstrate solar electric propulsion technologies for orbit transfer and maneuvering propulsion technology
  - (U) Begin testing and analyze performance, life, and integration improvements for a high-powered Hall Thruster.
- (U) $1,000 Demonstrate post boost vehicle strategic sustainment technologies.
  - (U) Continue development of post boost vehicle component technologies.
  - (U) Continue development of post boost vehicle propellant technologies.
- (U) $1,546 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	1,619	769	503	518	Cont
(U) Current Budget Submit/FY 1998 PB	1,619	1,941	1,541	1,546	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603311F Ballistic Missile Technology

PROJECT: 4091

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4091 Missile Electronics	8,041	2,699	0	0	0	0	0	0	10,740	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program funds the development, and particularly the integrated demonstration, of advanced guidance, navigation, and control packages for ballistic missiles. Also funded are upgrades for range and safety instrumentation for ballistic missiles. Emphasis is on technologies which increase safety, reduce maintenance, and improve reliability of the currently deployed intercontinental ballistic missile force at a lower life cycle cost. Note: Congress added $5.7 million in FY 1996 for sub-orbital flight testing for ballistic missile Global Positioning System (GPS) guidance, range tracking, and range safety which explains the perceived decrease in FY 1997. This project will be terminated at the end of FY 1997.

(U) FY 1996 ($ in Thousands):

- (U) $1,000 Develop advanced boost guidance technology to reduce current operations costs and improve reliability and maintainability of existing systems.
  - (U) Developed, integrated, and tested advanced solid state navigation technology for intercontinental ballistic missile applications.
- (U) $2,696 Develop advanced navigation technology to support range instrumentation and improve safety requirements.
  - (U) Developed, integrated, and tested Global Positioning System (GPS)-based navigation packages which improve the accuracy, range, and safety of ballistic missiles.
- (U) $3,845 Conduct flight test preparations to demonstrate solid state and GPS-based navigation as well as penetration and fuze performance.
  - (U) Developed improved high velocity fuzes/instrumentation packages.
  - (U) Characterized, designed, and constructed a high-velocity penetrator.
  - (U) Integrated solid state and GPS-based navigation flight experiments with the rest of the flight experiments.
- (U) $500 Conducted an analysis to explore concepts and ideas to defeat hard and deeply buried targets.
- (U) $8,041 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603311F Ballistic Missile Technology PROJECT 4091

(U) FY 1997 ($ in Thousands):

- (U) $927 Develop advanced boost guidance technology to reduce current operations costs and improve reliability and maintainability of existing systems.
  - (U) Develop, integrate, and test advanced solid state navigation technology for intercontinental ballistic missile applications.
- (U) $1,772 Develop advanced navigation technology to support range instrumentation and improve safety requirements.
  - (U) Develop, integrate, and test Global Positioning System (GPS)-based navigation packages which improve the accuracy, range, and safety of ballistic missiles.
- (U) $2,699 Total

(U) FY 1998: Not Applicable.

(U) FY 1999: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603311F Ballistic Missile Technology PROJECT 4091

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	3,694	2,828	2,741	2,828	Cont
(U) Appropriated Value	8,785	2,828			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-174	-58			
b. SBIR	-183	-68			
c. Omnibus/Other Above Threshold Reprogrammings	-78	-3			
d. Below Threshold Reprogrammings	-309				
(U) Current Budget Submit/FY 1998 PB	8,041	2,699	0	0	TBD

(U) Change Summary Explanation:

Funding: Due to budget constraints and priorities within the Science and Technology (S&T) Program, this project is scheduled to be terminated at the end of FY 1997.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	72,456	73,215	40,846	44,679	50,031	53,902	55,418	57,412	TBD	TBD
1026 Space Structures and Controls Technology	1,139	1,058	987	2,544	3,259	4,050	3,633	3,706	Continuing	Continuing
2181 Space Electronics and Software Technology	10,241	11,975	13,632	13,036	13,016	12,652	13,441	13,880	Continuing	Continuing
3784 Space Sensors and Satellite Communication Technology	2,551	2,423	2,848	3,295	3,643	4,395	3,994	4,079	Continuing	Continuing
3834 Integrated Space Technology Demonstrations	26,768	37,847	18,788	20,358	23,402	24,279	26,170	27,392	Continuing	Continuing
4400 Satellite Survivability Technology	3,037	5,778	592	582	604	606	570	547	Continuing	Continuing
4599 Reusable Launch Vehicle Technology	23,500	9,579	0	0	0	0	0	0	TBD	TBD
682J Space Power and Thermal Management Technology	5,220	4,555	3,999	4,864	6,107	7,920	7,610	7,808	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Starting in FY 1996, PE 0603438F, Satellite Systems Survivability, was transferred to this PE as Project 4400. Also, Project 4599 was previously called Project 0003, Reusable Launch Vehicle Technology. However, in FY 1996, this project was moved to PE 0603302F, Space and Missile Launch Technology, and renamed Launch Vehicle Technology to allow for Air Force investigation of all reusable and expendable launch technologies. The only funds remaining in Project 0003 in PE 0603401F were the funds added by Congress specifically for Reusable Launch Vehicle technology. To avoid confusion with Project 0003, Launch Vehicle Technology, in PE 0603302F, Project 0003 in PE 0603401F was renumbered Project 4599, keeping its Reusable Launch Vehicle title.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates advanced spacecraft technologies through integrated ground, flight, and space demonstrations. The broad goals of the program are to decrease the time for innovative space technology to be transitioned to the warfighter and to reduce the associated development costs and risks of future Air Force space-based systems. Developmental efforts are focused on six high-payoff, satellite technology areas: (1) reusable launch vehicle technologies; (2) advanced space structures and structural controls; (3) hardened space electronics and satellite control software; (4) advanced passive/active space-based sensors and satellite communications; (5) compact, low-cost space power and thermal management; and (6) satellite survivability. Note: Congress added $46 million in FY 1996 ($25 million for Reusable Launch Vehicle (RLV) technology, $20 million for Microsat

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology

development, and $1 million for Miniature Threat Reporting System) plus $37 million in FY 1997 ($10 million for RLV technology, $25 million for Microsat development, and $2 million for Miniature Threat Reporting System) which explains the perceived decrease in FYs 1998 and out. In FYs 1999 and out, additional emphasis has been placed on evolutionary growth in space technologies.

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	71,629	39,637	44,942	48,044	Cont
(U) Appropriated Value	78,627	76,637			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-1,593	-1,656			
b. SBIR	-1,640	-1,694			
c. Omnibus/Other Above Threshold Reprogrammings	-1,573	-72			
d. Below Threshold Reprogrammings	-1,365				
(U) Current Budget Submit/FY 1998 PB	72,456	73,215	40,846	44,679	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

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DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 1026

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1026 Space Structures and Controls Technology	1,139	1,058	987	2,544	3,259	4,050	3,633	3,706	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project demonstrates advanced composite structures and structural control technologies for future Air Force space and missile systems. Prior to FY 1995, the Air Force relied on Ballistic Missile Defense Organization (BMDO) funding to address its needs in this technology area. As BMDO budgets have declined, so has their funding in this area, necessitating an increased Air Force investment to maintain critical spacecraft structures and controls technologies. Advanced space structure component efforts focus on the demonstration of new composite structure technologies. The goal is to significantly improve the payload mass fraction and reduce overall spacecraft fabrication time and cost. This project also pays for the development of advanced passive and active spacecraft structural control technologies. Structural vibration and shock suppression technologies are intended to significantly enhance space platform stability, improving the focusing/imaging ability of space-based optical components such as focal plane arrays developed in Project 3784 or solar cells developed in Project 682J.

(U) FY 1996 ($ in Thousands):

- (U) $570 Develop advanced composite spacecraft structures.
  - (U) Completed fabrication of the all-composite satellite structure to be flown on MightySat-1 demonstrator, showing 30-50 percent weight savings.
- (U) $569 Develop advanced spacecraft structural controls technology.
  - (U) Prepared the non-pyrotechnic release device technology demonstration experiment for flight on MightySat-1 demonstrator.
- (U) $1,139 Total

(U) FY 1997 ($ in Thousands):

- (U) $484 Develop advanced composite spacecraft structures technology.
  - (U) Develop preliminary design of next generation composite satellite structure for future space applications like the MilSatCom program.
- (U) $574 Develop advanced spacecraft structural controls technology.
  - (U) Complete first phase of technology demonstration program to isolate sensitive payloads from vibrations during launch.
- (U) $1,058 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 1026

(U) FY 1998 ($ in Thousands):
- (U) $100 Develop advanced composite spacecraft structures technology.
  - (U) Support lightweight, rollup solar array flight demonstration.
- (U) $887 Develop advanced spacecraft structural controls technology.
  - (U) Initiate second phase of technology demonstration program to isolate sensitive payloads from vibrations during launch.
  - (U) Support flight experiment of a stable, precision optical platform.
- (U) $987 Total

(U) FY 1999 ($ in Thousands):
- (U) $1,212 Develop advanced composite spacecraft structures technology.
  - (U) Initiate the cryogenic propellant tank experiment.
  - (U) Initiate space-based lightweight antenna structure flight experiment.
- (U) $1,332 Develop advanced spacecraft structural controls technology.
  - (U) Continue technology demonstration program to isolate sensitive payloads from vibrations during launch.
  - (U) Continue precision optical platform experiment.
- (U) $2,544 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 1026

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	1,139	1,105	1,841	2,599	Cont
(U) Current Budget Submit/FY 1998 PB	1,139	1,058	987	2,544	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603218C, Research and Support.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 2181

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2181 Space Electronics and Software Technology	10,241	11,975	13,632	13,036	13,016	12,652	13,441	13,880	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project funds the demonstration and evaluation of electronic hardware and software. Improved space-qualifiable electronics and software for data and signal processing are to be more interchangeable, interoperable, and standardized. This project sponsors the demonstration of space-qualified circuits such as Very High Speed Integrated Circuit (VHSIC)-based components, wafer scale integration (WSI) packages, electronic processors, and reusable standardized satellite control software. In the near-term, this project's work concentrates on converting (i.e., hardening) commercial data and signal processor technologies for use in Air Force space systems. Advanced electronic packaging technologies that reduce weight and volume are being developed for military space applications. Space data processor technologies like the Advanced Technology Insertion Module (ATIM 32-bit) technology are developed and demonstrated. The Advanced Spaceborne Computer Module (ASCM), ATIM's 16-bit predecessor, is currently baselined into 65 DoD, NASA, and commercial programs. Also developed and demonstrated are space signal processor technologies like the Hardened Ada Signal Processor (HASP) program. Low-cost, easily modifiable software and hardware architectures for ground control, satellite components, and autonomous satellite operations are developed. The Multi-mission Advanced Ground Intelligent Control (MAGIC) program in this project has developed a low-cost, flexible architecture for satellite control and mission operations. In the long-term, this project area focuses on developing an integrated avionics-like architecture for satellites where high-speed data busses centralize many of the functions now distributed on the spacecraft. Additionally, this project demonstrates very low-power electronics allowing dramatic size, weight, and power reductions for future Air Force Space applications.

(U) FY 1996 ($ in Thousands):

- (U) $6,291 Develop space-qualifiable, advanced low-power, hardened data processors and memory technologies.
  - (U) Fabricated engineering model of standard satellite computer to improve functionality and performance of data processors.
  - (U) Developed fully capable operating system and applications software environment using desktop computer and hardware-in-the-loop.
- (U) $1,000 Develop space-qualifiable, hardened signal processor electronics and standard electronics devices.
  - (U) Fabricated digital signal processor in bulk silicon.
  - (U) Demonstrated functionality and performance of space-qualifiable digital signal processor using commercial hardware/software tools.
- (U) $1,150 Develop space-qualifiable, advanced mixed-signal electronics packaging technology using commercial technology.
  - (U) Demonstrated two-fold increase in density and two-fold decrease in cost to space-qualified, high-density electronic interconnections.
  - (U) Integrated plastic/non-hermetic and three-dimensional (3-D) packaging technologies into a space demonstration.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 2181

- (U) $900 Develop astrodynamic routines and reusable, space-standardized satellite operations software.
  - (U) Enhanced Multi-mission Advanced Ground Intelligent Control (MAGIC) software to provide operator assistance in known-anomaly resolution.
  - (U) Installed the MAGIC software system in the Falcon AFB, CO, Demonstration Laboratory.
  - (U) Continued software support of the command and control system upgrade.
- (U) $900 Develop space-qualifiable, standard microelectronic components.
  - (U) Fabricated and ground-tested space-qualifiable 2,000 gate, field-programmable gate array.
  - (U) Demonstrated programmability of 8,000 gate, field-programmable gate array using commercial hardware/software tools.
- (U) $10,241 Total

(U) FY 1997 ($ in Thousands):

- (U) $6,722 Develop space-qualifiable, advanced low-power, hardened data processors and memory technologies.
  - (U) Fabricate space-qualifiable 32-bit processor-based computers and demonstrate the full range of performance capabilities.
  - (U) Design an advanced high throughput, low-power data processor-based on commercial technology.
- (U) $1,242 Develop space-qualifiable, hardened signal processor electronics technologies.
  - (U) Fabricate silicon on insulator (SOI) version of space-qualifiable digital signal processor.
  - (U) Evaluate the ability of both bulk silicon and SOI version of the digital signal processor to perform in the space environment.
- (U) $1,337 Develop space-qualifiable, advanced, mixed-signal electronics packaging technology such as three-dimensional (3-D) wafer scale integration.
  - (U) Demonstrate integrated sensor processing 3-D electronics assembly in robust space-qualifiable configuration.
  - (U) Demonstrate improved multi-chip module technology by constructing a complex multi-processor system.
- (U) $2,483 Develop astrodynamic routines and reusable, space-standardized satellite operations software.
  - (U) Continue enhancing multi-mission advanced ground intelligent control software to provide operator assistance with unknown anomaly resolution and expand to include independent decision making capability.
  - (U) Continue developing technology for an artificial intelligence satellite operator system.
  - (U) Integrate and test autonomous satellite operations software system technologies.
  - (U) Continue software support of the satellite command and control system upgrade.
- (U) $191 Design and develop space-qualifiable silicon components using advanced micro-electromechanical systems (MEMS) techniques.
  - Evaluate the compatibility of fabrication and packaging processes for highly integrated MEMS/electronics components able to operate in the space environment.
  - Design advanced experimental MEMS devices and demonstrate their performance in a space environment.
- (U) $11,975 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 2181

(U) FY 1998 ($ in Thousands):

- (U) $6,899 Develop space-qualifiable, advanced low-power, hardened data processors and memory technologies.
  - (U) Complete space-qualifiable 32-bit processor-based computers and demonstrate the full range of performance capabilities.
  - (U) Continue design of an advanced high throughput, low-power data processor-based on commercial technology.
- (U) $1,213 Develop space-qualifiable, hardened signal processor electronics technologies.
  - (U) Complete current design of silicon on insulator (SOI) version of space-qualifiable digital signal processor.
  - (U) Complete evaluation of the ability of both bulk silicon and SOI version of the digital signal processor to perform in the space environment.
- (U) $1,787 Develop space-qualifiable, advanced, mixed-signal electronics packaging technology such as three-dimensional (3-D) wafer scale integration.
  - (U) Continue integrated sensor processing 3-D electronics assembly in robust space-qualifiable configuration.
  - (U) Continue improved multi-chip module technology by constructing a complex multi-processor system.
- (U) $2,835 Develop astrodynamic routines and reusable, space-standardized satellite operations software.
  - (U) Continue enhancing multi-mission advanced ground intelligent control software to provide operator assistance with unknown anomaly resolution and expand to include independent decision making capability.
  - (U) Complete technology for an intelligent satellite operator system and initiate automated intelligent machine learning system.
  - (U) Integrate and test autonomous satellite operations software system technologies; initiate integrated applications of modeling and simulation technologies.
  - (U) Continue software support of the satellite command and control system upgrade; initiate software engineering effort for space system specific applications.
- (U) $898 Design and develop space-qualifiable silicon components using advanced micro-electromechanical systems (MEMS) techniques.
  - Continue to evaluate the compatibility of fabrication and packaging processes for highly integrated MEMS/electronics components able to operate in the space environment.
  - Complete design advanced experimental MEMS devices and demonstrate their performance in a space environment.
- (U) $13,632 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 2181

(U) FY 1999 ($ in Thousands):

- (U) $5,253 Develop space-qualifiable, advanced low-power, hardened data processors and memory technologies.
  - (U) Expand commercial electronics to space electronics production.
  - (U) Continue to design an advanced high throughput, low-power data processor-based on commercial technology.
- (U) $920 Develop space-qualifiable, hardened signal processor electronics technologies.
  - (U) Continue developing integrated space computer version of advanced digital signal processor to perform in the space environment.
  - (U) Initiate development of advanced next-generation digital signal processing technology and scaleable multi-processor arrays.
- (U) $1,677 Develop space-qualifiable, advanced, mixed-signal electronics packaging technology such as three-dimensional (3-D) wafer scale integration.
  - (U) Continue integrated sensor processing 3-D electronics assembly in robust space-qualifiable configuration; test in space environment.
  - (U) Continue improved multi-chip module technology by constructing a complex multi-processor system; test in space environment.
- (U) $2,945 Develop astrodynamic routines and reusable, space-standardized satellite operations software.
  - (U) Continue enhancing multi-mission advanced ground intelligent control software to provide operator assistance with unknown anomaly resolution and expand to include independent decision making capability.
  - (U) Continue developing technology for an automated intelligent satellite operations system.
  - (U) Continue to integrate and test autonomous satellite operations software system technologies using space system software engineering techniques.
  - (U) Continue software support of the satellite command and control system upgrade.
- (U) $1,307 Design and develop space-qualifiable silicon components using advanced micro-electromechanical systems (MEMS) techniques.
  - (U) Continue to evaluate the compatibility of fabrication and packaging processes for highly integrated MEMS/electronics components able to operate in the space environment.
  - (U) Test advanced experimental MEMS devices and demonstrate their performance in space flight tests.
- (U) $934 Develop real-time space simulation for training and CONOPs.
  - (U) Enhance simulation architecture for real time and variable fidelity operations.
  - (U) Advance bus health and status models for autonomous operations.
  - (U) Upgrade fidelity of surveillance payload models.
- (U) $13,036 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology
	PROJECT 2181

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	10,241	12,538	13,325	12,786	Cont
(U) Current Budget Submit/FY 1998 PB	10,241	11,975	13,632	13,036	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0303601F, MILSTAR Satellite Communications System.
- (U) PE 0305160F, Defense Meteorological Satellite Program (DMSP).
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603311F, Ballistic Missile Technology.
- (U) PE 0603215C, Limited Defense System.
- (U) PE 0603218C, Research and Support.
- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.
- (U) PE 0604609F, Reliability and Maintainability Technology Insertion Program (RAMTIP).
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 3784

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3784 Space Sensors and Satellite Communication Technology	2,551	2,423	2,848	3,295	3,643	4,395	3,994	4,079	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project funds the development of military space-based ground surveillance and satellite communication technologies. The project's work focuses on advancing space-based applications of commercial sensors and communication technologies while improving the performance, schedule, maturity, cost, and/or risk reduction. The focus of the space sensor effort is to meet spaceborne sensor needs for national missile defense and intelligence, surveillance, and reconnaissance missions. The focus of the satellite communications effort is to develop radio frequency (RF) technologies for future military, intra-space, and space-ground communication systems. This project seeks to improve affordability, reliability, and performance while significantly reducing space sensor and satellite communication size, weight, cost, and cooling and power requirements.

(U) FY 1996 ($ in Thousands):

- (U) $2,251 Develop space-based reconnaissance/surveillance sensor technology to meet high priority Air Force needs.
  - (U) Evaluated and delivered large format focal plane arrays for mid-wave infrared applications.
  - (U) Evaluated performance of advanced signal processing algorithms for surveillance sensors.
  - (U) Assessed operational utility of candidate space-based surveillance technologies.
- (U) $300 Develop satellite communication technology which supports space communications needs.
  - (U) Assessed commercial communication technology for transition to military systems.
- (U) $2,551 Total

(U) FY 1997 ($ in Thousands):

- (U) $2,138 Develop space-based reconnaissance/surveillance sensor technology to meet Air Force high priority needs.
  - (U) Conduct design study for dual-band space-based reconnaissance sensors for missile defense applications.
  - (U) Investigate efforts to increase yield and reliability of large format infrared focal plane arrays.
  - (U) Evaluate performance of advanced signal processing algorithms for surveillance sensors.
  - (U) Assess operational utility of candidate space-based surveillance technologies.
- (U) $285 Develop satellite communication technology which supports space communications needs.
  - (U) Continue assessing commercial communication technology for transition to military systems.
- (U) $2,423 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology / PROJECT: 3784

(U) FY 1998 ($ in Thousands):

- (U) $2,522 Develop space-based reconnaissance/surveillance sensor technology to meet Air Force high priority needs.
  - (U) Continue design studies for dual-band space-based reconnaissance sensors for missile defense applications.
  - (U) Continue to investigate efforts to increase yield and reliability of large format infrared focal plane arrays.
  - (U) Continue to evaluate the performance of advanced signal processing algorithms for surveillance sensors.
  - (U) Continue to assess the operational utility of candidate space-based surveillance technologies.
- (U) $326 Develop satellite communication technology which supports space communications needs.
  - (U) Complete assessment of commercial communication technology for transition to military systems.
- (U) $2,848 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,916 Develop space-based reconnaissance/surveillance sensor technology to meet Air Force high priority needs.
  - (U) Continue design studies for dual-band space-based reconnaissance sensors for missile defense applications.
  - (U) Continue to investigate efforts to increase yield and reliability of large format infrared focal plane arrays.
  - (U) Conduct evaluation and design of large format quantum well focal plane arrays.
  - (U) Continue to evaluate the performance of advanced signal processing algorithms for surveillance sensors.
  - (U) Continue to assess the operational utility of candidate space-based surveillance technologies.
- (U) $379 Develop satellite communication technology which supports space communications needs.
  - (U) Initiate development of high-speed, low-power communication ship sets and digital high-speed rapid acquisition modems for satellite communication applications
- (U) $3,295 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 3784

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	2,551	2,547	2,784	3,249	Cont
(U) Current Budget Submit/FY 1998 PB	2,551	2,423	2,848	3,295	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0303601F, MILSTAR Satellite Communications System.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602702F, Command/Control/Communication Technology.
- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.
- (U) PE 0604711F, Extremely High Frequency Satellite Communications Research and Development.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 3834

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3834 Integrated Space Technology Demonstrations	26,768	37,847	18,788	20,358	23,402	24,279	26,170	27,392	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** The Integrated Space Technology Demonstration (ISTD) program provides for the integration of government and commercially developed technologies onto satellites. The ISTD seeks to demonstrate the value of these new technologies to address new space tactics, techniques, procedures, doctrine, and possibly revolutionize future acquisitions of DoD space systems. The ISTD program will enhance commercial and civil space assets in a cost-effective manner, allowing the warfighter to assess the utility of new space technologies through leveraging opportunities and, when required, through space flight demonstration of this new program.

The highly successful Technology for Autonomous Operational Survivability (TAOS) satellite was the first of the ISTD series. TAOS was launched in March 1994 and is currently demonstrating advanced warfighter concepts and the viability of advanced computers, autonomous navigation hardware/software, laser sensors, radar sensors, and data busses in space. TAOS has allowed operators and users, for the first time, to directly conduct space exercises in conjunction with the Phillips Laboratory (PL).

In FY 1995, the ISTD program office initiated a cooperative agreement with NASA's small satellite technology program to leverage existing NASA research and development efforts with Air Force funding and technologies. PL agreed to integrate an S-band transmitter on a NASA satellite which would allow command, control, and reception of imaging payload data from mobile ground stations controlled by the warfighter. A second major FY 1995 effort was an evaluation to determine what were the right technologies to fly on the first mission. From this study, it was determined that the mission focus for the advanced space technology demonstration would be a commercially leveraged program focusing on a hyperspectral imaging sensor with automatic target recognition. In general, the ISTD series of space technology demonstrations will allow users to assess new space technologies, which, when integrated, will become technology options for space systems.

(U) FY 1996 ($ in Thousands):

- (U) $2,981 Perform the TAOS flight demonstration.
  - (U) Performed TAOS mission data analysis and continued the navigator, laser, and radar sensor experimentation with user operators.
- (U) $4,264 Conduct ISTD program: Clark and Warfighter-1.
  - (U) Integrated and tested an S-band transmitter on NASA's Clark demonstrator spacecraft.
  - (U) Fabricated, assembled, integrated, and tested the Clark spacecraft mobile ground station equipment.
  - (U) Released final Request for Proposal (RFP) for Warfighter-1 (Integrated Space Technology Flight-1).
- (U) $ 993 Develop algorithim for integrated satellite payloads and mission utility.
  - (U) Completed satellite and environmental effects simulation software interfaces and demonstrated real-time throughput.
- (U) $18,530 Develop and demonstrate miniaturized space technologies
  - (U) Identified appropriate technologies and conducted mission evaluations to determine best mission for this technology.
- (U) $26,768 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 3834

(U) FY 1997 ($ in Thousands):

- (U) $1,433 Complete the Technology for Autonomous Operational Survivability (TAOS) flight demonstration.
  - (U) Complete TAOS mission data analysis and deliver final report.
  - (U) De-orbit TAOS spacecraft, dispense mission unique equipment/software, and close out contract.
- (U) $11,567 Conduct Integrated Space Technology Demonstration (ISTD) demonstration series program.
  - (U) Continue joint Air Force-NASA on-orbit technology assessments and data collection.
  - (U) Complete demonstrator spacecraft long lead-time hardware fabrication.
  - (U) Begin design, fabrication, integration, and test of payload.
- (U) $ 956 Develop algorithm for integrated satellite payloads, mission utility, and system engineering.
  - (U) Establish real-time connectivity to operational test and evaluation environments.
- (U) $23,891 Develop and demonstrate miniaturized space technologies
  - (U) Select a mission and develop component technologies for the Clementine 2 microsatellite technology development
- (U) $37,847 Total

(U) FY 1998 ($ in Thousands):

- (U) $ 400 Continue joint Air Force-NASA on-orbit technology assessments, data collection, and algorithm development (Clark spacecraft mission).
- (U) $17,390 Conduct ISTD demonstration series program, Warfighter 1.
  - (U) Continue development of target detection payload.
  - (U) Continue design, fabrication, integration, and test of payload and spacecraft.
  - (U) Procure long lead items for launch vehicle integration requirements.
- (U) $ 998 Develop algorithm for integrated satellite payloads, mission utility, and system engineering.
  - (U) Complete satellite and environmental effects simulation software interfaces and demonstrate real-time throughput.
- (U) $18,788 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology
	PROJECT 3834

(U) FY 1999 ($ in Thousands):

- (U) $100 Complete joint Air Force-NASA on-orbit technology assessments, data collection, and algorithm development.
  - Close out mission operations and prepare final report.
- (U) $20,258 Conduct Integrated Space Technology Demonstration series program.
  - (U) Conduct system level test of payload with spacecraft.
  - (U) Ship spacecraft to launch site and begin spacecraft to launch vehicle integration.
  - (U) Begin mission operations.
- (U) $20,358 Total

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	24,441	14,604	18,509	20,187	Cont
(U) Current Budget Submit/FY 1998 PB	26,768	37,847	18,788	20,358	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 4400

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4400 Satellite Survivability Technology	3,037	5,778	592	582	604	606	570	547	Continuing	Continuing

Note: Starting in FY 1996, PE 0603438F, Satellite Systems Survivability, was transferred to this PE as Project 4400.

(U) A. **Mission Description and Budget Item Justification:** This project funds the development and demonstration of technologies required to assure operation of U.S. space assets in potentially hostile warfighting environments. Work performed includes assessment of critical components, subsystems, and systems' threat susceptibility and vulnerability. This project also develops technologies to mitigate identified vulnerabilities. Further, technology options are developed and demonstrated to support balanced satellite protection strategies for detecting, avoiding, and operating in a hostile space environment. Efforts under this project will be closely integrated with exploratory space technologies such as those developed under PE 0602601F, Project 8809, and advanced space technologies developed under this PE in Projects 1026, 2181, 3784, and 682J. Where appropriate, end products include integrated demonstrations with technologies developed in Project 3834. Through this project, the Air Force assumes responsibility for critical spacecraft survivability technology from the Ballistic Missile Defense Organization (BMDO).

(U) FY 1996 ($ in Thousands):

- (U) $925 Assess selected directed energy weapon threat environment susceptibility/vulnerability of critical space-based sensor and communications subsystems.
  - (U) Performed sensor laser jamming model refinements and vulnerability assessments.
  - (U) Performed sensor radio frequency susceptibility evaluations.
  - (U) Performed communication subsystems disruption/degradation modeling and susceptibility evaluations.
  - (U) Initiated ground-based observations of vulnerability to spacecraft-environment interaction threat.
- (U) $2,037 Select candidate radio frequency/high-powered microwave detector technologies for threat warning sensor development.
  - (U) Developed miniaturized radar warning detector.
  - (U) Evaluated communication intrusion/interference detection technologies.
  - (U) Evaluated high-power microwave detection concepts.
  - (U) Developed/integrated sensor signal processor design.
- (U) $75 Evaluate candidate directed energy weapon sensor jamming protection techniques for critical sensor optical components.
  - (U) Assessed candidate radio frequency mitigation techniques for optical sensors.
- (U) $3,037 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 4400

(U) FY 1997 ($ in Thousands):

- (U) $1,146 Assess selected directed energy weapon threat environment susceptibility/vulnerability of critical space-based sensor and communications subsystems.
  - (U) Perform analytical and experimental verification of selected laser and radio frequency jamming sensor protection techniques.
  - (U) Perform analytical and experimental verification of radio frequency interference mitigation techniques for advanced space communication technologies.
  - (U) Complete ground-based observations of vulnerability to spacecraft-environment interaction threat.
- (U) $3,766 Perform radio frequency/high-powered microwave (HPM) threat warning space-based sensors testing.
  - (U) Integrate radar warning, intrusion/interference, and high powered microwave detector concepts.
  - (U) Optimize/integrate spacecraft signal processor designs.
  - (U) Test integrated radio frequency/high-powered microwave threat warning sensor.
- (U) $440 Select, for evaluation, laser weapon detector technologies for satellites in hostile environments.
  - (U) Develop and evaluate selected pulsed laser detection concepts.
- (U) $426 Evaluate and demonstrate directed energy weapon space sensor and communications jamming protection techniques.
  - (U) Demonstrate satellite communication subsystem front-end radio frequency protection devices.
- (U) $5,778 Total

(U) FY 1998 ($ in Thousands):

- (U) $592 Perform susceptibility/vulnerability assessments of critical space-based subsystems to ambient/enhanced space environments and directed energy weapon threats.
  - (U) Assess hostile/stressing environment impact on subsystem performance parameters.
  - (U) Develop criteria and technical requirements for effects mitigation and subsystem protection.
  - (U) Evaluate protection implications of selected advanced spacecraft technologies.
- (U) $592 Total

(U) FY 1999 ($ in Thousands):

- (U) $ 582 Continue susceptibility/vulnerability assessments of critical space-based subsystems to ambient/enhanced space environments and directed energy weapon threats.
  - (U) Assess hostile/stressing environment impact on subsystem performance parameters.
  - (U) Develop criteria and technical requirements for effects mitigation and subsystem protection.
  - (U) Evaluate protection implications of selected advanced spacecraft technologies.
- (U) $582 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 4400

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	3,037	4,049	3,599	3,445	Cont
(U) Current Budget Submit/FY 1998 PB	3,037	5,778	592	582	Cont

(U) Change Summary Explanation:

Funding: Changes in this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603410F, Space Systems Environmental Interactions Technology.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 4599

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4599 Reusable Launch Vehicle Technology	23,500	9,579	0	0	0	0	0	0	TBD	TBD

Note: This project was previously called Project 0003, Reusable Launch Vehicle Technology. However, in FY 1996, this project was moved to PE 0603302F, Space and Missile Launch Technology, and renamed Launch Vehicle Technology to allow for Air Force investigation of all reusable and expendable launch technologies. The only funds remaining in Project 0003 in PE 0603401F were the funds added by Congress specifically for Reusable Launch Vehicle technology. To avoid confusion with Project 0003, Launch Vehicle Technology, in PE 0603302F, Project 0003 in PE 0603401F was renumbered Project 4599, keeping its Reusable Launch Vehicle title.

(U) A. **Mission Description and Budget Item Justification:** This project accounts for the FY 1996 and 1997 Congressional adds for Reusable (space) Launch Vehicle (RLV) technology development. This Air Force RLV technology project directly complements and leverages off of the NASA-led RLV program. The spending plan has also been coordinated and approved by NASA Headquarters. The tasks identified in this project summary represent the DoD stake in RLV technology development as recommended by the Space Launch Modernization Plan (SLMP) study.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 4599

(U) FY 1996 ($ in Thousands):
- (U) $4,500 Apply advanced rocket propulsion technology to Reusable Launch Vehicles (RLVs).
  - (U) Continued modifications to the design of the Integrated Power-Head pre-burner components.
  - (U) Continued demonstration of the advanced long life turbopump fluid film bearing technologies to RLVs.
  - (U) Continued investigation of high performance thrust cell unconventional nozzles and fundamental technologies.
- (U) $4,500 Perform RLV structures/tankage technology development.
  - (U) Continued demonstrations of lightweight, RLV structures.
  - (U) Continued demonstrations of RLV composite, cryogenic propellant tanks.
- (U) $2,000 Perform advanced RLV thermal protection system technology development.
  - (U) Continued demonstration of lightweight, reusable, maintainable, and affordable RLV thermal protection critical technologies.
- (U) $4,500 Perform advanced RLV operations technology development.
  - (U) Continued development and demonstration of reliable, cost-effective RLV ground and flight operations.
  - (U) Developed technologies for integrated avionics and guidance, navigation, and control, vehicle health monitoring, and automated mission planning.
- (U) $2,000 Perform technology development for upperstages as they apply to RLVs.
  - (U) Developed concepts and technologies for use in an upperstage.
- (U) $3,000 Perform application and feasibility analyses to assess capability of RLVs to meet military unique needs.
  - (U) Developed concepts and technologies which are necessary to meet the unique needs of the military in its application of an RLV.
- (U) $3,000 Execute and coordinate the Department of Defense RLV program including operations at White Sands.
- (U) $23,500 Total

(U) FY 1997 ($ in Thousands):
- (U) $6,705 Apply advanced military unique technologies to military spaceplanes.
  - (U) Develop an integrated technology testbed to coordinate technology development.
- (U) $958 Perform technology development for upperstages as they apply to military spaceplanes.
  - (U) Continue development of concepts and military unique technologies for use in an upperstage.
- (U) $1,916 Execute and coordinate the Department of Defense Military Spaceplane program including coordination with NASA's X-33 program.
- (U) $9,579 Total

(U) FY 1998: Not Applicable.

(U) FY 1999: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology
	PROJECT 4599

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	25,000	0	0	0	TBD
(U) Current Budget Submit/FY 1998 PB	23,500	9,579	0	0	TBD

(U) Change Summary Explanation:

Funding: Congress added $25 million in FY 1996 and $10 million in FY 1997 for Reusable Launch Vehicle technology.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602269F, Hypersonic Technology Program.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) PE 0603853F, Evolved Expendable Launch Vehicle Program.
- (U) UPN 242, NASA Reusable Launch Vehicle Program.
- (U) This project has been coordinated through the Project Reliance process and with NASA to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 682J

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
682J Space Power and Thermal Management Technology	5,220	4,555	3,999	4,864	6,107	7,920	7,610	7,808	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops and demonstrates compact, low-cost, spacecraft and ballistic missile power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. Power generation work focuses on lightweight, low-cost, low volume, and survivable solar cell arrays. Energy storage work focuses on lightweight nickel hydrogen (NiH_2) and sodium sulfur (NaS) spacecraft batteries for extended (five-ten year) satellite missions. Power distribution efforts focus on producing lightweight, high efficiency, standardized power busses for use on future Air Force space programs. This project also funds the development and demonstration of the non-nuclear technologies associated with space nuclear power systems such as power conversion, conditioning, and power system thermal management. In addition, investigations into alternative technologies to increase space vehicle power subsystem performance, lifetime, survivability, and safety while reducing costs/risks. In FY 1995, the Air Force assumed responsibility for the Ballistic Missile Defense Organization's (BMDO's) goal to develop spacecraft thermal management technologies. Examples of this are cryogenic coolers necessary to maintain passive (e.g., infrared focal plane array) sensors in low-light backgrounds through this project.

(U) FY 1996 ($ in Thousands):

- (U) $2,520 Develop space conventional power technologies such as advanced solar cells and arrays.
  - (U) Completed and transitioned multi-junction higher efficiency solar cell technology to the Manufacturing Technology office.
  - (U) Completed development of Thin-Film Roll-out Array for improved stowage and deployment.
  - (U) Flight-tested 'Channel Astro' edge concentrating solar array (150 watts/kilogram) on a small satellite.
- (U) $1,400 Develop space vehicle conventional power technologies such as compact volume/weight batteries.
  - (U) Performed life testing of nickel hydrogen (NiH_2) batteries.
  - (U) Flight-tested sodium sulfur (NaS) batteries.
- (U) $300 Develop non-nuclear technologies associated with space nuclear power systems such as thermionics technology.
  - (U) Initiated more efficient alkali-metal thermal to electric converter cells (25%) development.
- (U) $1,000 Develop space vehicle thermal management technology such as cryogenic coolers for infrared focal plane arrays.
  - (U) Conducted first phases of single-stage, reverse Brayton-cycle cryocooler development.
- (U) $5,220 Total

(U) FY 1997 ($ in Thousands):

- (U) $2,660 Develop space conventional power technologies such as advanced solar cells and arrays.
  - (U) Flight test Thin Film Roll-Out Array and develop 30% efficient energy conversion devices.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology
	PROJECT 682J

- (U) $1,330 Develop space vehicle conventional power technologies such as compact volume/weight batteries.
  - (U) Continue NiH_2 low earth orbit life testing.
  - (U) Develop 200 watt hour/kilogram (WHr/kg) solid state lithium battery for satellite applications.
- (U) $190 Develop non-nuclear technologies associated with space nuclear power systems such as thermionics technology.
  - (U) Develop 25% alkali metal thermal to electric conversion cells.
  - (U) Design and fabricate thermionic bed power system components for evaluation.
- (U) $375 Develop space vehicle thermal management technology such as cryogenic coolers for infrared focal plane arrays.
  - (U) Qualify single-stage reverse Brayton-cycle cryocooler for space applications.
- (U) $4,555 Total

(U) FY 1998 ($ in Thousands):

- (U) $1,977 Develop space conventional power technologies such as advanced solar cells and arrays.
  - (U) Initiate advanced concentrator array follow-on development.
  - (U) Initiate multi-bandgap flight test program.
  - (U) Continue to develop 30% efficient energy conversion devices.
- (U) $1,622 Develop space vehicle conventional power technologies such as compact volume/weight batteries.
  - (U) Expand cooperative development of high power, high efficiency Power Management and Distribution (PMAD) components exploring dc/dc converters and solid state switches.
- (U) $400 Develop space vehicle thermal management technology such as cryogenic coolers for infrared focal plane arrays.
  - (U) Fabricate and begin testing of prototype flight unit of single-stage reverse Brayton-cycle cryocooler for space applications.
- (U) $3,999 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,486 Develop space conventional power technologies such as advanced solar cells and arrays.
  - (U) Continue advanced concentrator follow-on.
  - (U) Continue multi-bandgap flight test program.
  - (U) Continue to develop 30% efficient energy conversion devices, fabricate, and test for space environment.
- (U) $1,910 Develop space vehicle conventional power technologies such as compact volume/weight batteries.
  - (U) Continue development of high-power, high efficiency PMAD components focusing on integration into flight test program.
- (U) $468 Develop space vehicle thermal management technology such as cryogenic coolers for infrared focal plane arrays.
  - (U) Qualify and test flight test unit of single-stage reverse Brayton-cycle cryocooler for space applications.
- (U) $4,864 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology PROJECT 682J

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	5,220	4,794	4,884	5,778	Cont
(U) Current Budget Submit/FY 1998 PB	5,220	4,555	3,999	4,864	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) PE 0603218C, Research and Support.
- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603410F Space Systems Environmental Interactions Technology

PROJECT: 2822

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2822 Space Environmental Impact Test	3,187	2,793	3,151	3,527	3,809	3,863	3,979	4,101	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, Projects 2822, Space Environmental Impact Test, and 2823, Space Hazards Mitigation, were combined under Project 2822. For clarity, the funding for FY 1996 and FY 1997 reflects this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program's objectives are to improve the survivability and reliability of Air Force space systems, and expedite the transfer of new technologies into military hardware. Cost-effective solutions to mitigate hazardous, space-environmental interactions that degrade spacecraft operations are developed and demonstrated in this program. Advanced technology goals include: (1) an autonomous active charge control system to prevent charge buildup on high-altitude spacecraft; (2) a compact environmental anomaly sensor to provide warning to satellites of space-environmental conditions likely to cause anomalous operations; and (3) improved specifications for advanced solar array technologies from the Photovoltaic Array Space Power Plus Diagnostics experiment. These goals will be achieved through space experiments such as the Charging Hazards and Wake Studies experiment (that will determine space environmental hazards to exposed high voltages), the Shuttle Potential and Return Electrons Experiment (which will investigate the effect of high current electron beams on the ambient space environment), and the Space Waves in Plasmas Experiment (which will look at space effects on high-frequency radio transmissions).

(U) FY 1996 ($ in Thousands):

- (U) $583 Develop and test miniaturized space plasma sensors. Characterize plasma in and around spacecraft wakes to improve low-earth environmental specifications and provide critical validation of charge analysis modeling codes necessary for spacecraft designers.
  - (U) Continued analysis of plasma data collected from space hazard sensors during shuttle flight STS 69 to verify performance of space plasma sensors and to validate analysis modeling codes.
  - (U) Developed the Digital Ion Driftmeter (space plasma sensor designed for use on the National Polar Orbiting Experimental Satellite) for space test to obtain the space qualification data needed to assess operational use.
- (U) $200 Demonstrate next-generation solar array technologies that provide the required performance standards in space before being integrated into future power systems. Characterize array interactions with natural space environment.
  - (U) Analyzed data from the Photo Voltaic Array Space Power (PASP) Plus diagnostics experiment launched on the "Advanced Power Experiment" (APEX) satellite in Aug 94 and produced detailed reports on high-voltage plasma interactions and on advanced solar array radiation degradation for use in updating space power design guidelines and test standards.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology PROJECT 2822

- (U) $660 Determine vehicle charging and environmental interactions which will result in new preventive measures to protect spacecraft from charging hazards. Enhanced analytical models of vehicle charging and spacecraft environmental interactions directly applicable to future high-powered space systems will be studied.
  - (U) Analyzed Shuttle Potential and Return Electronics Experiment (SPREE) data which will lead to improvements in modeling codes for vehicle charging effects and environmental interactions.
- (U) $272 Determine the interactions between spacecraft and their environment that limit performance of long-range, high frequency communications and radar systems.
  - (U) Supported the sounding rocket launch and data collection.
  - (U) Conducted preliminary analysis data for eventual incorporation into design and performance standards to counter scintillation effects and decrease susceptibility to plasma interactions.
- (U) $1,153 Develop and test a suite of miniaturized, low-power instruments to measure the populations of natural space particles responsible for radiation dose effects and hazardous charge buildups.
  - (U) Completed design and began fabrication of a miniaturized, low-power electron telescope to provide charge buildup information, a dosimeter to provide high energy dose and single event upset information, and a proton telescope to provide low energy dose information during space tests.
- (U) $63 Develop and demonstrate an autonomous, active charge control system to prevent hazardous charge buildup on high-altitude and geosynchronous orbit satellites, decreasing circuitry upsets and component damage, improving on-orbit reliability, and enhancing system performance.
  - (U) Continued evaluation of the data obtained from the advanced charge control system on Defense Satellite Communications System satellite. Supported initial on-orbit operations and began evaluating performance of the advanced charge control system.
- (U) $256 Develop and test an autonomous, compact, lightweight, low-power instrument to monitor the space environment near a satellite that warns of hazardous conditions.
  - (U) Supported integration and testing of the charge-warning instruments on the Space Test Program TSX-5 satellite.
- (U) $3,187 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology PROJECT 2822

(U) FY 1997 ($ in Thousands):

- (U) $401 Develop and test miniaturized space plasma sensors. Characterize plasma in and around spacecraft wakes to improve low-earth environmental specifications to provide critical validation of charge analysis modeling codes necessary for spacecraft designers.
  - (U) Complete data analysis from STS 69 experiment and publish results from space plasma sensors to validate charge analysis modeling codes.
  - (U) Deliver the Digital Ion Driftmeter to the Space Test Program Office for integration and support to launch operations to obtain the space qualification needed for operational use.
- (U) $432 Demonstrate next-generation solar array technologies that provide the required performance standards in space before being integrated into future power systems. Characterize array interactions with natural space environment.
  - (U) Complete analysis of Photovoltaic Array Space Power (PASP) Plus data and publish final technical reports on high-voltage plasma interactions and on advanced solar array radiation degradation for use in updating space power design guidelines and test standards.
  - (U) Begin conceptual design of future solar array technologies to prove their space performance before being integrated into future space power systems.
- (U) $407 Determine vehicle charging and environmental interactions which will result in new preventive measures to protect spacecraft from charging hazards. Enhanced analytical models of vehicle charging and spacecraft environmental interactions directly applicable to future high-powered space systems will be developed.
  - (U) Complete data analysis and publish report to improve modeling codes for vehicle charging effects and environmental interactions.
- (U) $57 Determine the interactions between spacecraft and their environment that limit performance of long-range, high frequency communications and radar systems.
  - (U) Continue analysis of sounding rocket data for eventual incorporation into design and performance standards used to counter scintillation effects and decrease susceptibility to plasma interactions.
- (U) $1,217 Develop and test a suite of miniaturized, low-power instruments to measure the populations of natural space particles responsible for radiation dose effects and hazardous charge buildups.
  - (U) Complete design and begin fabrication of a miniaturized, low-power electron telescope to provide charge buildup information, a dosimeter to provide high energy dose and single event upset information, and a proton telescope to provide low energy dose information during space tests.
- (U) $22 Develop and demonstrate an autonomous active control system to prevent hazardous-charge buildup on high-altitude and geosynchronous orbit satellites, decreasing circuitry upsets and component damage, improving on-orbit reliability, and enhancing system performance.
  - (U) Finish evaluating the data from the Defense Satellite Communications System flight and produce a final report.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology PROJECT 2822

- (U) $257 Develop and test an autonomous, compact, lightweight, low-power instrument to monitor the space environment near a satellite that warns of hazardous conditions.
  - (U) Support the launch of and provide on-orbit support for the charge-warning instruments on the Space Test Program TSX-5 satellite.
- (U) $2,793 Total

(U) FY 1998 ($ in Thousands):

- (U) $2,575 Develop and test miniaturized, low-power sensors to measure the populations of hazardous natural space particles responsible for radiation dose effects, hazardous charge buildups, and single event upsets to satellite operations.
  - (U) Support on-orbit Digital Ion Drift Meter (space plasma sensor designed for use on the National Polar Orbiting Experimental Satellite) operations and collect data on Space Test Program's Space Test Experiments Platform (STEP)-4 satellite to validate the concept and to obtain the space qualification needed for operational use. Begin data analysis.
  - (U) Deliver, integrate, and support launch operations of a Digital Ion Drift Meter on a German satellite to evaluate performance in an operationally representative orbit.
  - (U) Continue fabrication of a miniaturized, low-power, proton telescope that provides low energy dose information during space tests.
  - (U) Complete fabrication of a miniaturized, lower-power, electron telescope to provide charge buildup information during space tests.
  - (U) Continue fabrication of a miniaturized dosimeter to provide high energy dose and single event upset information during space tests.
  - (U) Begin design and fabrication of a central controller to obtain charge buildup information from the electron telescope, low energy dose information from the proton telescope, and high energy dose and single event upset information from the dosimeter during space operations.
- (U) $132 Demonstrate next-generation solar array technologies that provide the required performance standards in space before being integrated into future power systems. Characterize array interactions with natural space environment. Determine environmental interactions hazardous to space power generation.
  - (U) Continue conceptual design of future solar array technologies to prove the space performance of future solar array technologies to before being integrated into future space power systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology PROJECT 2822

– (U) $444 Develop and test technologies to mitigate hazardous environmental interactions. Demonstrate an autonomous, active charge control system to prevent hazardous charge buildup on high-altitude and geosynchronous orbit satellites, decreasing circuitry upsets and component damage, and improving on-orbit reliability and performance. Demonstrate an autonomous, compact, lightweight, low-power instrument to monitor the space environment near a satellite and warn of hazardous conditions.

- (U) Finish evaluating the long-term performance on the Defense Satellite Communications System satellite and produce a final report.
- (U) Support launch and on-orbit operations of the hazard-warning instrument on the Space Test Program TSX-5 satellite. Collect data and begin analysis of performance.
- (U) Support launch and on-orbit operations of the hazard-warning instrument on the United States/British Space Test Research Vehicle (STRV)-1C satellite to evaluate performance in a high radiation space environment. Collect data and begin analysis of performance.

– (U) $3,151 Total

(U) FY 1999 ($ in Thousands):

– (U) $2,183 Develop and test miniaturized, low-power sensors to measure the populations of hazardous natural space particles responsible for radiation dose effects, hazardous charge buildups, and single event upsets to satellite operations.

- (U) Analyze data from on-orbit Digital Ion Drift Meter (space plasma sensor designed for use on the National Polar Orbiting Experimental Satellite) operations and collect data on Space Test Program's Space Test Experiments Platform (STEP)-4 satellite to validate the concept and to obtain the space qualification needed for operational use.
- (U) Support on-orbit operations of a Digital Ion Drift Meter on a German satellite to evaluate performance in an operationally representative orbit.
- (U) Complete fabrication of a miniaturized, low-power, proton telescope that provides low energy dose information during space tests.
- (U) Complete fabrication of a miniaturized, lower-power, electron telescope to provide charge buildup information during space tests.
- (U) Complete fabrication of a miniaturized dosimeter to provide high energy dose and single event upset information during space tests.
- (U) Continue design and fabrication of a central controller to obtain charge buildup information from the electron telescope, low energy dose information from the proton telescope, and high energy dose and single event upset information from the dosimeter during space operations.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology
	PROJECT 2822

- (U) $667 Demonstrate next-generation solar array technologies that provide the required performance standards in space before being integrated into future power systems. Characterize array interactions with natural space environment. Determine environmental interactions hazardous to space power generation.
  - (U) Continue conceptual design and begin fabricating hardware to prove the space performance of future solar array technologies before their integration into future space power systems.
- (U) $192 Determine environmental interactions hazardous and disruptive to satellite operations. Demonstrate that next-generation and commercial off-the-shelf satellite electronics technologies provide the required performance standards in a natural space charging environment before being integrated into future space systems. Characterize natural space charging and radiation environment.
  - (U) Begin conceptual design of an integrated modular system to prove the space performance of future electronics technologies in a natural space charging environment.
- (U) $485 Develop and test technologies to mitigate hazardous environmental interactions. Demonstrate an autonomous, compact, lightweight, low-power instrument to monitor the space environment near a satellite and warn of hazardous conditions.
  - (U) Continue on-orbit support operations of the hazard-warning instrument on the Space Test Program TSX-5 satellite. Continue data collection and analysis of performance.
  - (U) Continue on-orbit operations of the hazard-warning instrument on the United States/British Space Test Research Vehicle (STRV)-1C satellite to evaluate performance in a high radiation space environment. Continue data collection and analysis of performance.
- (U) $3,527 Total

(U) B. Program Change Summary ($ in Thousands):

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology
	PROJECT 2822

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	3,349	2,914	3,488	3,577	Cont
(U) Appropriated Value	3,479	2,914			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-68	-59			
b. SBIR	-63	-59			
c. Omnibus/Other Above Threshold Reprogrammings	-29	-3			
d. Below Threshold Reprogrammings	-132				
(U) Current Budget Submit/FY 1998 PB	3,187	2,793	3,151	3,527	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	31,719	23,754	26,227	23,712	24,570	24,529	24,993	25,534	Continuing	Continuing
670A Ordnance Technology	19,549	15,638	11,403	10,182	8,146	11,805	13,091	16,572	Continuing	Continuing
670B Guidance Technology	12,170	8,116	14,824	13,530	16,424	12,724	11,902	8,962	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, technologies related to Global Positioning System (GPS) guidance (i.e., differential GPS and anti-jam technologies) and highly agile missile flight control will be developed in Project 670B, Guidance Technology, rather than in Project 670A.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates air-to-surface and air-to-air conventional weapons technologies including guidance, ordnance, and aeromechanics. This program develops the following technologies: autonomous, adverse-weather advanced guidance seekers; fuzes; energetic, insensitive, and less sensitive explosives; hard target warheads; explosives, bombs, submunitions, and their dispensing mechanisms; air-to-surface and air-to-air weapon airframes and carriage; smart submunitions; and weapon ordnance subsystem integration. Hardware/software for advanced technologies are developed and evaluated to determine effectiveness and potential operational value. Note: FY 1998 increase is due to additional emphasis which has been placed on the development of terminal guidance technology for small smart bombs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	32,455	24,885	26,490	24,919	Cont
(U) Appropriated Value	34,137	24,885			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-675	-565			
b. SBIR	-676	-543			
c. Omnibus/Other Above Threshold Reprogrammings	-542	-23			
d. Below Threshold Reprogrammings	-526				
(U) Current Budget Submit/FY 1998 PB	31,719	23,754	26,227	23,712	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary :** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology

PROJECT: 670A

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
670A Ordnance Technology	19,549	15,638	11,403	10,182	8,146	11,805	13,091	16,572	Continuing	Continuing

Note: Beginning in FY 1998, technologies related to Global Positioning System (GPS) guidance (i.e., differential GPS and anti-jam technologies) and highly agile missile flight control will be developed in Project 670B, Guidance Technology, rather than in Project 670A.

(U) A. **Mission Description and Budget Item Justification**: This project develops and demonstrates the effectiveness and operational utility of conventional (non-nuclear) ordnance technologies for current and future air-delivered weapons. The project develops the following technologies: fuzes; energetic, insensitive and less sensitive explosives; hard target warheads; explosives, bombs, submunitions, and their dispensing mechanisms; air-to-surface and air-to-air weapon airframes and carriage; smart submunitions; and weapon ordnance subsystem integration.

(U) FY 1996 ($ in Thousands):

- (U) $12,537 Develop advanced air-delivered munition and submunition technologies for components, subsystems, and systems to increase performance, lethality, safety, affordability, and supportability.
  - (U) Completed final integrated design of an antimateriel submunition (e.g., warhead, seeker, submunition airframe, etc.) to demonstrate advanced antimateriel submunition technology which is highly effective against all mobile ground targets.
  - (U) Performed large-scale testing of agent defeat kill mechanism to develop weapon payloads for defeating chemical and biological weapons.
  - (U) Completed integration and test of antimateriel warhead capable of operating in shaped charge, aerostable slug, and multiple fragment modes.
- (U) $7,012 Demonstrated advanced ordnance, weapon airframe and carriage technologies for air-to-air and air-to-surface munitions and submunitions to demonstrate operational effectiveness.
  - (U) Completed subsystem testing of an affordable anti-jam Global Positioning System/Inertial Navigation System (GPS/INS) receiver and integrated it into a weapons airframe for flight test to enable GPS accuracy in a jammed environment.
  - (U) Completed design and begin fabrication of advanced suspension and release equipment for future fighter aircraft which will reduce size, weight, and supportability issues associated with conventional pyrotechnic racks, maximize weapon loadout, and reduce drag and radar cross section.
- (U) $19,549 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology PROJECT 670A

(U) FY 1997 ($ in Thousands):

- (U) $8,752 Develop advanced air-delivered munition and submunition technologies for components, subsystems, and systems to increase performance, lethality, safety, affordability, and supportability.
  - (U) Complete flight test demonstration of a 250-pound class miniature munition.
  - (U) Complete delivery of antimateriel warheads for flight testing.
  - (U) Complete trade studies on dense metal case penetrating warhead.
  - (U) Complete in-house testing of an antimateriel submunition and fabrication of instrumented and live-fire units for flight testing to demonstrate advanced antimateriel submunition technology which is highly effective against all mobile ground targets.
  - (U) Complete testing of weapon concept for defeating biological weapons in storage facilities.
- (U) $6,886 Demonstrate advanced ordnance, weapon airframe and carriage technologies for air-to-air and air-to-surface munitions and submunitions to demonstrate operational effectiveness.
  - (U) Integrate and ground test a Global Positioning System/Inertial Navigation System (GPS/INS) jam resistant receiver demonstration unit in a weapon flight test vehicle.
  - (U) Develop overall air-to-air missile concept and conduct technology trade studies for a highly agile dual-range missile capable of within visual range and beyond visual range engagements.
- (U) $15,638 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology PROJECT 670A

(U) FY 1998 ($ in Thousands):

- (U) $5,290 Develop advanced air-delivered munition and submunition technologies for components, subsystems, and systems to increase performance, lethality, safety, affordability, and supportability.
  - (U) Complete preliminary design and subscale testing for dense metal case penetrating weapon for defeating very hard targets.
  - (U) Perform testing of warhead payloads for neutralizing chemical and biological weapons in production and storage facilities.
  - (U) Complete requirements study and conceptual design of a multi-event fuze for initiating simultaneous or sequential warhead events.
- (U) $6,113 Demonstrate advanced ordnance, weapon airframe and carriage technologies for air-to-air and air-to-surface munitions and submunitions to demonstrate operational effectiveness.
  - (U) Complete ground testing of suspension and release equipment for future fighter aircraft which will reduce size, weight, and supportability issues associated with conventional pyrotechnic racks, maximize weapon loadout, and reduce drag and radar cross section.
  - (U) Conduct integrated submunition ground testing and initiate captive flight testing to demonstrate advanced anti-materiel submunition technology which is highly effective against all mobile ground targets.
  - (U) Complete design of a low-cost captive dispensing system that will permit large loadouts of smart submunitions or small smart bombs to be carried and dispensed from internal bays of existing and advanced aircraft.
- (U) $11,403 Total

(U) FY 1999 ($ in Thousands):

- (U) $3,608 Develop advanced air-delivered munition and submunition technologies for components, subsystems, and systems to increase performance, lethality, safety, affordability, and supportability.
  - (U) Complete detail design and conduct full-scale sled and flight testing for dense metal case penetrating weapon for defeating very hard targets.
  - (U) Complete detailed design and component testing of a multi-event fuze for initiating simultaneous or sequential warhead events.
- (U) $6,574 Demonstrate advanced ordnance, weapon airframe and carriage technologies for air-to-air and air-to-surface munitions and submunitions to demonstrate operational effectiveness.
  - (U) Complete live-fire flight testing to demonstrate advanced anti-materiel submunition technology which is highly effective against all mobile ground targets.
  - (U) Complete ground testing of captive dispensing system to ensure flight test readiness of the low-cost captive dispensing system.
- (U) $10,182 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology
	PROJECT 670A

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	20,278	16,385	18,878	17,417	Cont
(U) Current Budget Submit/FY 1998 PB	19,549	15,638	11,403	10,182	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602602F, Conventional Munitions.
- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0603792N, Advanced Technology Demonstrations.
- (U) PE 0604407D, Joint Standoff Weapon.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology

PROJECT: 670B

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
670B Guidance Technology	12,170	8,116	14,824	13,530	16,424	12,724	11,902	8,962	Continuing	Continuing

Note: Beginning in FY 1998, technologies related to Global Positioning System (GPS) guidance (i.e., differential GPS and anti-jam technologies) and highly agile missile flight control will be developed in Project 670B rather than Project 670A, Ordnance Technology.

(U) A. **Mission Description and Budget Item Justification:** This project develops and demonstrates affordable, autonomous, and adverse-weather advanced guidance technologies for conventional air-to-air and air-to-surface armament. Objectives include: increased accuracy, adverse-weather operation; real-time targeting and battle damage assessment (BDA); enhanced target classification/identification; standoff delivery munitions; detection and "lock-on" of reduced signature targets; improved survivability; more reliable system operation; improved countermeasure performance; and enhanced affordability.

(U) FY 1996 ($ in Thousands):

- (U) $11,486 Develop and demonstrate affordable, autonomous, and adverse-weather advanced air-to-surface guidance technologies.
  - (U) Completed detailed design of a five-cubic-inch optical correlator coupled with a laser radar (LADAR) to enable autonomous target identification in a cluttered environment.
  - (U) Conducted detailed integration analysis and design for an affordable, adverse-weather capable, autonomous, precision synthetic aperture radar (SAR) guidance seeker.
  - (U) Completed design and fabricate an advanced digital electronic processor for weapons seeker applications suitable for air-to-surface and counterair guided munition applications.
- (U) $684 Developed and demonstrated advanced guidance technologies and affordable, reliable components to counter the next generation air-to-air threats.
  - (U) Demonstrated capability for the primary high-fidelity, wideband, two-color, infrared scene projector for use in imaging infrared sensor development and test.
- (U) $12,170 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology PROJECT 670B

(U) FY 1997 ($ in Thousands):

- (U) $7,161 Develop and demonstrate affordable, autonomous, and adverse-weather advanced air-to-surface guidance technologies.
  - (U) Fabricate and ground test an optical correlator and laser radar (LADAR) for autonomous target identification in a clutter.
  - (U) Fabricate and bench test an affordable, autonomous, adverse-weather capable, precision synthetic aperture radar (SAR) seeker; integrate with GBU-15 guidance and control subsystems.
  - (U) Assess degree of commonality of components across LADAR seekers designed for direct attack, submunition, and cruise missile operations; identify critical technical issues for each design; and focus development of critical component technologies for the direct attack munition seeker design to support testbed fabrication.
- (U) $955 Develop and demonstrate guidance technologies and affordable, reliable components to counter the next generation air-to-air threats.
  - (U) Conduct analyses on an advanced digital electronic processor for weapons seeker applications suitable for air-to-surface and counter-air guided munition applications.
- (U) $8,116 Total

(U) FY 1998 ($ in Thousands):

- (U) $11,784 Develop and demonstrate affordable, autonomous, and adverse-weather advanced air-to-surface guidance technologies.
  - (U) Complete ground testing and captive flight test of an optical correlator and LADAR for autonomous target identification in a cluttered environment.
  - (U) Integrate SAR-guided GBU-15 with F-16 and captive flight test an affordable, autonomous, adverse-weather capable, precision, synthetic aperture radar seeker.
  - (U) Complete development of required hardware and software, and produce detailed advanced solid state LADAR sensor design.
  - (U) Define system requirements for an extended range, precision guided 250-pound miniaturized munition that provides the target penetration performance and effectiveness of a 2000-pound munition.
  - (U) Develop overall program to demonstrate capabilities of conformal electronically scanned array seeker to be used in conjunction with advanced control technology to support dual-range missile technology.
  - (U) Develop an advanced digital electronic processor for weapons seeker applications, suitable for air-to-surface and counter-air guided munition applications; complete high-speed chip development; fabricate and package phase II parallel algebraic logic technology.
  - (U) Conduct free-flight tests of a high anti-jam Global Positioning System/Inertial Navigation System (GPS/INS) guided weapon to demonstrate performance in harsh jamming environments.
- (U) $3,040 Develop and demonstrate guidance technologies and affordable, reliable components to counter the next generation air-to-air threats.
  - (U) Fabricate and integrate host test vehicles, develop flight software, and conduct hardware-in-the-loop simulations in preparation for ground tests of a highly agile dual-range missile capable of close-in combat, within visual range, and beyond visual range engagements.
- (U) $14,824 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology
	PROJECT 670B

(U) FY 1999 ($ in Thousands):

- (U) $10,882 Develop and demonstrate affordable, autonomous, and adverse-weather advanced air-to-surface guidance technologies.
  - (U) Conduct free-flight demonstrations of an affordable, autonomous, adverse-weather capable, precision synthetic aperture radar seeker.
  - (U) Fabricate an advanced solid state laser radar sensor.
  - (U) Complete design of an extended range, precision guided 250-pound miniaturized munition that provides the target penetration performance and lethality of a 2000-pound munition.
  - (U) Develop conformal electronically scanned array (CESA) seeker design and evaluate the capabilities of the CESA seeker, when coupled with advanced control technology, to support dual-range missile technology.
  - (U) Complete an advanced digital electronic processor for weapons seeker applications, suitable for air-to-surface and counter-air guided munition applications; test phase II parallel algebraic logic technology and conduct demonstrations.
- (U) $2,648 Develop and demonstrate advanced guidance technologies and affordable, reliable components to counter the next generation air-to-air threats.
  - (U) Complete fabrication and perform pre-flight testing to ensure readiness for flight tests of a highly agile dual-range missile capable of close-in combat, within visual range, and beyond visual range engagements.
- (U) $13,530 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology
	PROJECT 670B

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	12,177	8,500	7,612	7,502	Cont
(U) Current Budget Submit/FY 1998 PB	12,170	8,116	14,824	13,530	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0603792N, Advanced Technology Demonstrations.
- (U) PE 0604618F, Joint Direct Attack Munitions.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	73,277	54,027	41,238	41,660	41,120	41,117	42,102	43,434	Continuing	Continuing
3150 Advanced Optics Technology	20,051	11,442	1,707	1,589	1,715	2,622	2,713	2,815	Continuing	Continuing
3151 High Power Semiconductor Laser Technology	7,640	4,440	6,410	10,043	11,448	9,779	10,118	10,499	Continuing	Continuing
3152 High Power Microwave Technology	19,810	14,347	7,363	7,521	7,601	8,570	8,841	9,112	Continuing	Continuing
3647 High Energy Laser Technology	25,776	23,798	25,758	22,507	20,356	20,146	20,430	21,008	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification**: This Advanced Technology Development program demonstrates advanced directed energy and optical imaging concepts. Speed-of-light weapons and long-range, high resolution optical imaging through the turbulent atmosphere offer significant payoffs for many Air Force missions, such as theater missile defense, suppression of enemy air defenses, and control of space. This program has already demonstrated many major technological breakthroughs such as removing significant atmospheric distortions from optical transmissions (e.g., laser beams) and producing small, relatively high power laser diode phased arrays. Major emphasis areas include: high power microwave and high energy laser technologies; long-range optical imaging; and high power laser diodes and diode arrays. Because of the unique effects associated with high power microwaves there are many potential applications ranging from low power disruptions to high power destruction of electronic devices. Thus, a wide range of high power microwave technologies are being developed. Within high energy lasers the emphasis is on developing methods to increase the power on target. This is done by continuing to remove more of the atmospheric degradations and to develop more efficient laser devices. Long-range optical imaging offers high resolution images of space objects from the ground for applications such as satellite status assessments. High power diodes offer great potential for very small optical sources at many wavelengths for applications such as infrared illuminators and infrared countermeasure sources as well as high data rate secure communications. This PE will continue to develop a wide range of directed energy technologies for many DOD applications. Note: Congress added $27 million for laser radar and excimer technologies in FY 1996 and $10 million for space laser imaging and $5 million for laser-induced microwave imaging (these were the efforts under the FY 1996 excimer program) in FY 1997 which explains the perceived decease in FYs 1998 and out.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	71,603	41,895	40,148	39,798	Cont
(U) Appropriated Value	74,919	56,895			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-2,016	-1,671			
b. SBIR	-1,300	-1,145			
c. Omnibus/Other Above Threshold Reprogrammings	-613	-52			
d. Below Threshold Reprogrammings	+2,287				
(U) Current Budget Submit/FY 1998 PB	73,277	54,027	41,238	41,660	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3150

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3150 Advanced Optics Technology	20,051	11,442	1,707	1,589	1,715	2,622	2,713	2,815	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops advanced optical technologies for locating, identifying, and analyzing distant and/or dim objects. This work supports high energy laser technologies because an imaging subsystem is required for target verification, accurate and sustainable laser beam placement on target, and near-real time damage assessment. Several advanced technologies including nonlinear optics, adaptive optics, and specialized signal processing are being developed. The goal is high quality optical image reconstruction, concentrating on removing turbulent atmosphere-induced distortions. Many of these technologies developed/being developed have significant application to astronomy research.

(U) FY 1996 ($ in Thousands):

- (U) $3,113 Develop and demonstrate advanced optical imaging technologies that support applications such as space object imaging.
  - (U) Demonstrated daylight satellite imaging concepts using adaptive optics for atmospheric compensation. This capability dramatically increases the number of satellites imaged each day.
  - (U) Demonstrated a more user friendly, advanced electro-optical exploitation software tool for analyzing images. This software significantly reduces user time required for image analysis.
- (U) $491 Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.
  - (U) Designed and modeled a laboratory breadboard of an ultra-high resolution, lightweight imaging satellite subsystem using nonlinear optics to compensate for deformations in a large diameter, deployable primary mirror.
- (U) $88 Perform upgrades/demonstrations to the Maui Space Surveillance System located in Maui, HI.
  - (U) Evaluated the potential of laser imaging, detection, and ranging (LIDAR) technology as a permanent addition to the Maui capabilities for 24-hour space object surveillance and identification.
- (U) $9,623 Develop active imaging technology with application for excimer lasers.
  - (U) Completed delivery and installation of laser illuminator.
  - (U) Completed active imaging receiver and tracker integration with the 3.5 meter telescope at Starfire Optical Range.
  - (U) Conducted initial active imaging field tests and demonstrations.
  - (U) Evaluated feasibility of active imaging techniques for long-range imaging applications.
- (U) $6,736 Develop the LIDAR field demonstration.
  - (U) Completed installation of the LIDAR system in the Maui Space Surveillance System. This system provides a high-precision ranging and velocity measurement capability for identifying satellite position location to accuracies of two meters or less.
- (U) $20,051 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3150

(U) FY 1997 ($ in Thousands):

- (U) $680 Develop and demonstrate advanced optical imaging technologies that support applications such as space object imaging.
  - (U) Transition technology for daytime imaging of low-earth orbit satellites to the Maui Space Surveillance System 3.67 meter telescope. This capability dramatically increases the number of satellites imaged each day.
- (U) $309 Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.
  - (U) Construct, characterize, and demonstrate a laboratory breadboard of the telescope subsystem for an ultra-high resolution, lightweight imaging satellite telescope concept which uses nonlinear optics to compensate for deformations in a large diameter deployable primary mirror.
- (U) $863 Develop and demonstrate advanced, very long-range optical imaging technologies which increase resolution and data fusion to support missions such as space object identification and ground target identification from space.
  - (U) Begin development of field hardware to demonstrate feasibility of long-range optical imaging for space object identification/mission payload assessment, extending our reach, for the first time, to geosynchronous altitudes.
- (U) $9,590 Develop technologies for active imaging of space objects such as excimer lasers.
  - (U) Conduct active imaging field tests and demonstrations.
- (U) $11,442 Total

(U) FY 1998 ($ in Thousands):

- (U) $1,156 Develop and demonstrate advanced, very long-range optical imaging technologies which increase resolution and data fusion to support missions such as space object identification and ground target identification from space.
  - (U) Continue development of field hardware to demonstrate feasibility of long-range optical imaging for space object identification/mission payload assessment, extending our reach, for the first time, to geosynchronous altitudes.
  - (U) Demonstrate target identification using multispectral images from space to improve battle damage assessment and allow imagery of targets under all types of camouflage while reducing satellite size, weight, and cost.
- (U) $551 Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.
  - (U) Design and model a brassboard based on the FY 1997 telescope subsystem breadboard for characterization in a space environmental chamber to evaluate operational properties.
- (U) $1,707 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3150

(U) FY 1999 ($ in Thousands):

- (U) $1,030 Develop and demonstrate advanced technologies which increase resolution and data fusion for very long-range optical imaging to support missions such as space object identification and ground target identification from space.
  - (U) Continue development of field hardware to demonstrate feasibility of long-range optical imaging for space object identification/mission payload assessment, extending our reach, for the first time, to geosynchronous altitudes.
  - (U) Demonstrate fusion of multispectral images gathered in FY 1998 with data from other space assets to improve battle damage assessment, defeat all types of camouflage, and reduce satellite size, weight and cost.
- (U) $559 Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.
  - (U) Construct the ultra-high resolution, lightweight imaging satellite telescope brassboard designed in FY 1998; and test in a space environmental chamber to determine operational properties.
- (U) $1,589 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
	PROJECT 3150

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	18,360	2,038	2,679	2,751	Cont
(U) Current Budget Submit/FY 1998 PB	20,051	11,442	1,707	1,589	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0305910F Spacetrack
- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3151

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3151 High Power Semiconductor Laser Technology	7,640	4,440	6,410	10,043	11,448	9,779	10,118	10,499	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project continues to yield revolutionary breakthroughs in compact, robust, and affordable laser system technology for a wide range of military applications requiring small compact laser sources with low to moderate optical power. This is a long-term technology development project with both near-term and long-term goals. Near-term goals include developing compact, reliable infrared sources for a range of applications including night vision systems, landing zone markers, remote sensing and covert communication systems. Longer term goals focus on producing compact, significantly higher power sources for military applications including aircraft protection. This project leads the development of and builds upon a wide range of commercial advancements. Commercially available semiconductor lasers are widely used due to their low cost, small size and weight, high reliability, and high efficiency in converting electricity to laser energy. The project preserves these attractive features while continually scaling output to higher powers/efficiencies and/or to military application-specific wavelengths. The project is divided into three technology areas. The first area investigates methods to increase output power from individual laser diodes while increasing power density onto a small spot. Secondly, semiconductor laser array integration methods, which produce a single, high quality laser beam at significantly higher power levels are developed. Thirdly, wavelength-specific laser diodes for military applications are developed. Project scientists/managers also work directly with field users to develop proof-of-capability demonstrations and field tests for these revolutionary laser sources. This technology has many commercial applications, especially for eye-safe lasers.

(U) FY 1996 ($ in Thousands):

- (U) $2,563 Develop laser diodes for improved performance/higher power in near-term applications such as illumination, designation, and communication and for incorporation into laser diode array architectures.
  - (U) Demonstrated three watts of continuous output power from a single–mode fiber, improving current semiconductor laser state–of–the art by a factor of two. This demonstration identified technical issues which must be solved to reach higher power levels for increased space laser communication data rates and increased system security.
  - (U) Demonstrated semiconductor laser devices that will have the potential to be modulated and scaled to higher powers, with payoff to optical communications applications.
- (U) $2,463 Develop coherent laser diode arrays for improved performance/higher power in applications requiring high power levels.
  - (U) Demonstrated 200 watts continuous power from an array of diode lasers. This laser array, while not phased, is the first step in achieving a 200 watt, continuous power, phased array for high performance aircraft and space asset self–protection system designs.
  - (U) Demonstrated the ruggedness and reliability of a high power system with a one cubic foot laser head. This laser design will demonstrate the feasibility of a compact, high–power laser system.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology — PROJECT: 3151

- (U) $1,985 Develop high power laser diodes and diode arrays at alternate wavelengths that will be transitioned to many military applications such as eye-safe optical systems and infrared countermeasures (IRCM).
  - (U) Demonstrated 60 milliwatts electrically pumped diode laser output power at 4 micron wavelength and 80 degrees Kelvin.
  - (U) Demonstrated lasing of a one watt electrically-pumped laser diode at a wavelength of 3.3 microns.
  - (U) Demonstrated 425 milliwatts continuous direct diode laser output power at a 3.4 micron wavelength and 80 degrees Kelvin. This laser device may reduce the size, weight, and complexity of sources used in Band 2 IRCM systems.
  - (U) Demonstrated 3 watts continuous output power from a 2.0 micron wavelength diode laser array operating at room temperature. This device may reduce the size, weight, and complexity of sources used for Band 1 IRCM systems.
- (U) $629 Investigate applications for these advanced semiconductor laser diodes and diode arrays.
  - (U) Transitioned Pocket Laser Communicator to an industry partner for commercialization.
  - (U) Continued transition of semiconductor laser technology to multiple users for illumination/designation field applications.
- (U) $7,640 Total

(U) FY 1997 ($ in Thousands):

- (U) $2,420 Develop laser diodes for improved performance/higher power in near-term applications such as illumination, designation, and communication and for incorporation into laser diode array architectures.
  - (U) Demonstrate five watts of continuous wave output power from a single–mode fiber, improving current semiconductor laser state–of–the–art by a factor of two. This demonstration will identify technical issues which must be solved to reach higher power levels for increased space laser communication data rates and increased system security.
  - (U) Demonstrate devices that will have the potential to be modulated and scaled to high powers.
- (U) $2,020 Develop coherent laser diode arrays for improved performance/higher power in applications requiring high power levels.
  - (U) Develop phasing methods for the 200 watt continuous output power diode laser array developed in FY 1996.
  - (U) Demonstrate 100 watts continuous wave output power from a one cubic foot laser head. This laser design will demonstrate the feasibility of a compact, high–power laser system.
- (U) $4,440 Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3151

(U) FY 1998 ($ in Thousands):

- (U) $1,519 Develop laser diodes for improved performance/higher power as sources in near-term applications infrared countermeasures, illumination, designation, and communication and for incorporation into laser diode array architectures.
  - (U) Demonstrate ten watts of continuous wave output power from a single–mode fiber, improving current semiconductor laser state–of–the–art by a factor of two. This demonstration will form the baseline for advanced space laser communications by reducing optics size, enabling higher data rates, and increasing system security.
  - (U) Demonstrate devices that will have the potential to be modulated and scaled to higher powers. These devices will provide the enabling technology to extend current and future communication systems for geosynchronous and deep–space operation.
- (U) $1,072 Develop coherent laser diode arrays for improved performance/higher power as sources in applications requiring high power levels.
  - (U) Evaluate design and trade off decisions related to high power semiconductor diode array ruggedness, compactness, and portability for integration into system application designs.
- (U) $3,819 Develop semiconductor laser diode and optically-pumped semiconductor lasers for sources to support future advanced infrared countermeasures (IRCM) system upgrades to tactical fixed and rotary-wing aircraft. Development will focus on concepts with the potential for high efficient, compact IR laser sources covering Bands 2 and 4.
  - (U) Demonstrate two watt coherent peak output power at quasi-continuous wave operation from a single, Band 2 semiconductor diode at an operating temperature of 200 degrees Kelvin. This device will demonstrate the necessary powers needed to jam Band 2 infrared surface-to-air missiles.
  - (U) Demonstrate two watt coherent peak output at quasi-continuous wave operation from a single, Band 4 optically-pumped semiconductor laser at an operating temperature of 85 degrees Kelvin. The collected data will demonstrate the necessary powers needed to jam Band 4 infrared surface-to-air missiles.
- (U) $6,410 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,981 Develop laser diodes for improved performance/higher power as sources in near-term applications infrared countermeasures, illumination, designation, and communication and for incorporation into laser diode array architectures.
  - (U) Demonstrate a rugged, fully packaged ten watt continuous wave power breadboard laser device for applications such as laser communications and laser radar.
  - (U) Identify reliability and failure mode issues to validate advanced high–power, reliable, long–life diode laser systems for military and applications.

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- (U) $1,149 Develop coherent laser diode arrays for improved performance/higher power as sources in applications requiring high power levels.
  - (U) Apply optimization criteria to 100-200 watt class semiconductor diode arrays to minimize size and weight and maximize operating temperature range and vibration, shock, dust, and water/humidity resistance. The application of these parameters to high power arrays will provide system designers a fully fieldable weapon system design which can be incorporated into protection/offensive systems to meet next generation threats.
- (U) $6,913 Develop semiconductor laser diode and optically-pumped semiconductor lasers for sources to support future advanced infrared countermeasures (IRCM) system upgrades to tactical fixed and rotary-wing aircraft. Development will focus on concepts with the potential for high efficient, compact IR laser sources covering Bands 2 and 4.
  - (U) Demonstrate a less than three times diffraction limited beam at one watt peak output power from a single, Band 2 semiconductor diode laser at an operating temperature of 200 degrees Kelvin. This demonstration will provide the necessary beam quality needed to directionally focus the power downrange and jam Band 2 infrared surface-to-air missiles.
  - (U) Demonstrate a less than three times diffraction limited beam at one watt peak output power from a single, Band 4 optically-pumped semiconductor laser at an operating temperature of 85 degrees Kelvin. This device will demonstrate the necessary beam quality needed to directionally focus the power downrange and jam Band 4 infrared surface-to-air missiles.
- (U) $10,043 Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
	PROJECT 3151

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	7,640	4,697	4,229	6,852	Cont
(U) Current Budget Submit/FY 1998 PB	7,640	4,440	6,410	10,043	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602234N, Systems Support Technology.
- (U) Representatives from Army, Navy, Ballistic Missile Defense Organization, National Laboratories, and Air Force using commands are members of the government review team for this technology.
- (U) Joint field demonstrations of this technology are ongoing with: the Air Force Pararescue School; the Air Force Special Operations Command; the U.S. Coast Guard; and the U.S. Customs Service.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3152

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3152 High Power Microwave Technology	19,810	14,347	7,363	7,521	7,601	8,570	8,841	9,112	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops high power microwave generation technologies. It also develops a susceptibility/vulnerability/lethality data base to identify potential vulnerabilities of U.S. systems to high power microwave threats and to provide a basis for future offensive and defensive weapons system decisions. Representative U.S. and foreign assets will be tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) technologies are being developed. The technologies developed in this project will demonstrate the applicability of high power microwaves that can damage/degrade/deny/destroy electronic systems and subsystems for missions such as suppression of enemy air defense, command and control warfare, and aircraft self-protection.

(U) FY 1996 ($ in Thousands):

- (U) $1,951 Develop generic high power microwave technology.
  - (U) Continued development of narrowband and wideband high power microwave sources and antennas.
- (U) $500 Evaluate the susceptibility of representative military hardware and software to high power microwave effects.
  - (U) Conducted effects studies of electromagnetic propagation into facilities.
  - (U) Completed database on various ground and flightline maintenance equipment.
  - (U) Completed susceptibility report for large U.S. aircraft and began hardening criteria development.
  - (U) Completed experiments to determine coupling of high power microwave energy into hangers.
- (U) $1,615 Develop suppression of enemy air defense technologies.
  - (U) Conducted low power coupling and high power damage experiments on selected integrated air defense assets.
  - (U) Refined system parameter requirements to guide technology development.
- (U) $2,000 Develop aircraft self-protection technologies.
  - (U) Downselected high power microwave wideband source and began source/antenna brassboard design.
  - (U) Initiated field test planning for technology demonstration with downselected source.
  - (U) Conducted vulnerability/susceptibility testing and dynamic simulations of three guided missiles.
- (U) $11,070 Develop the laser-induced microwave emissions related technologies including excimer laser technology.
  - (U) Developed an integrated response model of the laser-induced microwave emissions phenomenon.
  - (U) Conducted laboratory and field experiments on operational systems to quantify effects and compare with models and predictions.
  - (U) Developed conceptual designs that will satisfy military mission requirements. Construct critical hardware and conduct feasibility experiments of laser-induced microwave emissions applications.
  - (U) Quantified the physical mechanisms associated with this technology such as coupling mechanisms.

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3152

- (U) $1,722 Develop command and control warfare technologies.
  - (U) Continued development of compact wideband sources and antennas for both damage and disruption missions.
  - (U) Performed limited in situ experiments on command/control/communications equipment in building/facilities.
  - (U) Extended materials studies to in situ effects applications.
- (U) $952 Develop high power microwave space control technologies.
  - (U) Completed broad-level application concept studies.
  - (U) Completed and reported on vulnerability assessment of two satellite receivers and two satellite imaging subsystems.
- (U) $19,810 Total

(U) FY 1997 ($ in Thousands):

- (U) $3,125 Develop suppression of enemy air defense technologies.
  - (U) Conduct experiments on selected integrated air defense assets.
  - (U) Complete detailed systems engineering specifications for high power microwave suppression of enemy air defenses weapon concept.
  - (U) Complete explosive pulse power development for suppression of enemy air defenses weapon concept.
  - (U) Complete source development for suppression of enemy air defenses weapon concept.
- (U) $3,004 Develop aircraft self-protection technologies.
  - (U) Complete high power microwave hardening criteria evaluation for large U.S. aircraft.
  - (U) Complete required electromagnetic hardening on range assets used for technology demonstration field test.
  - (U) Continue development of wideband high power microwave brassboard for field demonstrations.
  - (U) Conduct laboratory experiments on missiles to identify alternative/enhanced kill mechanisms.
  - (U) Complete technology demonstration field test planning.
  - (U) Initiate plan to transition technology to large aircraft system program offices.
- (U) $1,168 Develop command and control warfare technologies.
  - (U) Continue equipment characterization of command and control assets.
  - (U) Expand propagation studies and models for various construction materials/techniques.
  - (U) Continue development of wideband sources and antennas for command and control warfare applications
  - (U) Initiate studies of potential delivery and implementation techniques.
- (U) $4,795 Develop laser-induced microwave emissions technology.
  - (U) Validate the integrated response model of the laser-induced microwave emissions phenomenon.
  - (U) Complete experiments, begun in FY 1996, on operational systems and develop draft hardening specifications.
  - (U) Complete feasibility experiments and analyze results for various applications.
- (U) $500 Develop active denial technology.

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3152

- (U) Begin application concept studies for next-generation technology.

- (U $ 1,755 Develop high power microwave space control technologies.
  - (U) Complete concept study threat basing mode analysis.
  - (U) Perform subsystem and component level susceptibility experiments on satellite communication, imaging and control technologies.
  - (U) Evaluate source technologies for threat demonstration.
- (U) $14,347 Total

(U) FY 1998 ($ in Thousands):

- (U) $3,191 Develop suppression of enemy air defense technologies.
  - (U) Conduct critical experiments of integrated pulsed power generator and high power microwave source.
  - (U) Conduct subsystem level effects test of an integrated air defense asset.
  - (U) Start engineering design of high power microwave suppression of enemy air defenses weapon brassboard.
- (U) $2,404 Develop aircraft self-protection technologies.
  - (U) Complete wideband high power microwave brassboard for technology demonstration field test.
  - (U) Conduct field experiments for demonstrate self-protect technology.
  - (U) Complete plan to transition technology to large aircraft systems program office.
  - (U) Final assessment of wideband high power microwave technology's ability to effectively counter missile threats prior to transition to large aircraft system program offices.
- (U) $1,268 Develop command and control warfare technologies.
  - (U) Expand equipment characterization experiments and effects database.
  - (U) Begin selection of wideband source and pulse power designs.
  - (U) Develop delivery and implementation options.
- (U) $500 Develop active denial technology.
  - (U) Continue application concept studies for next-generation technology.
- (U) $7,363 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3152

(U) FY 1999 ($ in Thousands):

- (U) $3,421 Develop suppression of enemy air defense technologies.
  - (U) Complete high power microwave suppression of enemy air defenses weapon brassboard for technology demonstration in FY 2000.
  - (U) Continue to conduct experiments on selected integrated air defense asset.
- (U) $2,404 Develop aircraft self-protection technologies.
  - (U) Continue development of wideband high power microwave sources and antennas for aircraft self-protect applications to counter next generation infrared missiles and to expand application to electro-optical, radio frequency, and laser threats.
  - (U) Demonstrate and integrate self-protection technologies for aircraft applications.
  - (U) Transition technology to large aircraft system program offices.
- (U) $1,196 Develop command and control warfare technologies.
  - (U) Finalize first wideband source and pulse power design for ground control network application.
  - (U) Complete equipment characterization of command and control assets.
  - (U) Continue effects experiments of electromagnetic propagation into command and control facilities.
- (U) $500 Develop active denial technology.
  - (U) Complete application concept studies for next-generation technology.
- (U) $7,521 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
	PROJECT 3152

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	19,810	9,961	9,960	10,227	Cont
(U) Current Budget Submit/FY 1998 PB	19,810	14,347	7,363	7,521	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602120A, Electronic Survivability and Fuzing Technology.
- (U) PE 0602111N, Anti-Air Warfare, Anti-Surface Warfare Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3647

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3647 High Energy Laser Technology	25,776	23,798	25,758	22,507	20,356	20,146	20,430	21,008	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**: This project provides for the development, demonstration, and detailed assessment of technology needed for high energy laser weapons. Near-term focus is on ground-based and airborne high energy laser missions, although the technology developed for this project is directly applicable to most high energy laser applications. Critical technologies demonstrated include: scaleable laser devices, with near-term emphasis on the Chemical Oxygen-Iodine Laser (COIL); optical components; and laser beam control to efficiently compensate and propagate laser radiation through the atmosphere to a target. Detailed computational models to establish high energy laser weapon effectiveness and satellite and missile vulnerability will be developed. Correcting the laser beam for distortions induced by propagation through the turbulent atmosphere is the key technology in most high energy laser applications. The beam control technology developed in this project has a significant benefit to the astronomy community.

(U) FY 1996 ($ in Thousands):

- (U) $4,060 Develop and demonstrate high energy laser device components for potential weapon applications.
  - (U) Completed advanced diagnostics development and conduct diagnostic Chemical Oxygen-Iodine Laser (COIL) testing to quantitatively determine the excited oxygen generator yield, water vapor pressure, and laser cavity gas temperature.
  - (U) Evaluated COIL diagnostic data to improve understanding of current COIL device performance and identify areas for further development to improve performance.
  - (U) Began development of hardware to demonstrate efficient wavelength-shifting with a COIL device, to establish the technology base for COIL-based illuminator laser for active tracking.
- (U) $1,713 Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems that are protected against laser threats.
  - (U) Conducted laser vulnerability experiments on satellite subsystems.
  - (U) Began detailed vulnerability analysis on satellite optical payload systems.
  - (U) Began detailed satellite vulnerability assessments using newly incorporated uncertainty method.
  - (U) Assessed the potential of near-term laser countermeasures on satellites.
- (U) $1,434 Perform atmospheric measurements and characterization of the high energy laser beam propagation environment from ground and airborne platforms.
  - (U) Completed analysis and evaluation of optical measurements collected in high altitude airborne flights during FY 1995. The data was used to validate computer models which predict atmospheric effects on Airborne Laser military effectiveness.

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3647

- (U) $2,124 Develop and demonstrate active imaging technology to support ground-based laser beam control for target verification, aimpoint designation, and damage assessment.
  - (U) Demonstrated feasibility and performance of promising active imaging concepts, using the active imaging receiver developed during FY 1995, coupled to the 3.5 meter telescope at the Starfire Optical Range (SOR). Provides critical design information for advanced optical systems with imaging applications.
- (U) $16,445 Perform atmospheric compensation/beam control experiments from ground-based and airborne platforms to support applications ranging from weaponization to space object identification.
  - (U) Completed development and integration of 600 watt laser for active (laser illuminated) 24-hour satellite tracking at SOR.
  - (U) Demonstrated real-time correction of turbulence-induced track jitter on stars at the SOR's 1.5 meter telescope, establishing basis for laser weapon aimpoint maintenance.
  - (U) Completed construction of adaptive optics and installation of relay optics system for SOR 3.5 meter telescope. First generation adaptive optics provides initial compensated images and identifies hardware and software issues which need to be addressed to improve atmospheric compensation performance.
  - (U) Initiated active satellite tracking experiments with 1.0 meter laser beam director and 1.5 meter telescope using 400 watt laser. Experimental results provided data necessary to implement 24-hour tracking capability.
  - (U) Initiated design of a two laser beacon system for full-scale atmospheric compensation of the 3.5 meter telescope.
  - (U) Began integrated active tracking/atmospheric compensation experiments in static ground testing simulating the high-altitude, horizontal propagation path for theater missile defense scenarios.
  - (U) Conducted initial active tracking experiments against boosting missiles at White Sands Missile Range, reproducing realistic target phenomenology for the theater missile defense scenario.
- (U) $25,776 Total

(U) FY 1997 ($ in Thousands):

- (U) $2,970 Develop and demonstrate high energy laser components for potential weapon applications.
  - (U) Demonstrate a 10-20% additional improvement in Chemical Oxygen-Iodine Laser (COIL) performance, based on advanced concepts developed from diagnostic testing and evaluation during FY 1996.
  - (U) Demonstrate a pulsed, multi-kilowatt COIL device with good beam quality, suitable for high efficiency wavelength-shifting for illuminator applications.

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3647

– (U) $1,468 Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems that are protected against laser threats.
- (U) Continue to conduct laser vulnerability experiments on satellite subsystems.
- (U) Continue to perform detailed vulnerability analysis on satellite optical payload systems.
- (U) Continue detailed satellite vulnerability assessments on satellites using newly incorporated uncertainty methodology.
- (U) Continue assessing the potential of near-term laser countermeasures on satellites.

– (U) $10,070 Perform atmospheric compensation/beam control experiments from ground-based and airborne platforms to support applications ranging from weaponization to space object identification.
- (U) Initiate development of a two laser beacon system for full-scale atmospheric compensation on the 3.5 meter telescope.
- (U) Demonstrate real-time compensation of atmospheric turbulence-induced distortions on satellite images.
- (U) Continue satellite active tracking experiments to evaluate synergistic effects with atmospheric compensation and demonstrate 24-hour satellite tracking.
- (U) Complete testing of first-generation adaptive optics on Starfire Optical Range (SOR) 3.5 meter telescope using stars and satellites. Testing results will identify hardware and software issues which need to be addressed to improve atmospheric compensation performance.
- (U) Complete construction of second-generation adaptive optics system to maximize resolution and compensation of the SOR 3.5 meter telescope.
- Demonstrate real-time compensated imaging of satellites without laser beacon on SOR 3.5 meter telescope.

– (U) $9,290 Characterize atmospheric attenuation and distortion on laser beam propagation, conduct atmospheric compensation and beam control experiments, and develop an airborne ultra-precision inertial pointing system to enhance boot phase theater ballistic missile tracking.
- (U) Analyze and evaluate FY 1995 atmospheric optical data that simulates airborne high energy laser operating conditions.
- (U) Collect atmospheric aerothermal data for strategic locations worldwide to develop parametric database for high energy laser (operational assessments) analysis.
- (U) Correlate atmospheric aerothermal and optical parameters in an analytical model to provide a cost-effective method of determining laser weapon effectiveness against specific threats.
- (U) Design near full-scale acquisition, tracking, and pointing experiments to demonstrate and validate atmospheric compensation, tracking, and laser beam control techniques against fixed targets and boost phase theater ballistic missiles. The experiments will be conducted at White Sands Missile Range, NM.
- (U) Design small-scale laboratory and field experiments to explore innovative atmospheric compensation, tracking, and laser beam control options reducing the technical risk of developing airborne high energy laser weapons.

– (U) $23,798 Total

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BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology — PROJECT: 3647

(U) FY 1998 ($ in Thousands):

- (U) $3,054 Develop and demonstrate high energy laser components for potential weapon applications.
  - (U) Increase fieldability of the Chemical Oxygen Iodine Laser (COIL) for airborne and ground-based weapon systems by examining new nozzle designs, transport gases, and cavity design to increase efficiency, and reduce size and weight.
  - (U) Demonstrate efficient wavelength shifting of a pulsed, multi-kilowatt, COIL device which would double the range of the targeting system of the airborne and ground based laser weapon systems.
- (U) $2,182 Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems that are protected against laser threats.
  - (U) Continue to conduct laser vulnerability experiments on satellite subsystems.
  - (U) Continue to perform detailed vulnerability analysis on satellite optical payload systems.
  - (U) Continue detailed satellite vulnerability assessments using newly incorporated uncertainty methodology.
  - (U) Continue assessing the potential of near-term laser countermeasures on satellites.
- (U) $1,095 Investigate and develop advanced, high energy laser optical components.
  - (U) Continue to develop and evaluate techniques to monitor optical components installed in an operational high-energy laser system.
  - (U) Continue to optimize deposition techniques and characterization of low absorption, low-scatter optical thin film coatings for uncooled optics and other specialized applications. Transfer technology to industry for scaling. Low absorption, low scatter, durable coatings are critical to the performance of uncooled optics planned for use in future high energy laser systems.
  - (U) Evaluate the performance of a cooled, transmissive optical element in the Thermal Distortion Test Facility. Determine the distortion due to simulated high-energy laser heating.
- (U) $11,570 Perform atmospheric compensation and laser beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification.
  - (U) Complete development of two-laser beacon system to enable full-scale atmospheric compensation on the 3.5 meter telescope.
  - (U) Integrate second-generation adaptive optics system on 3.5 meter telescope to improve image quality of observed space objects.
  - (U) Continue satellite active tracking experiments to evaluate synergistic effects with atmospheric compensation and demonstrate 24-hour satellite acquisition and tracking capability.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3647

- (U) $7,857 Characterize atmospheric attenuation and distortion on laser beam propagation, conduct atmospheric compensation and beam control experiments, and develop an airborne ultra-precision inertial pointing brassboard to enhance boot phase theater ballistic missile tracking.
  - (U) Conduct near full-scale acquisition, tracking, and pointing experiments that demonstrate and validate atmospheric compensation, tracking, and laser beam control techniques against fixed targets and boost phase theater ballistic missiles. The experiments will be conducted at White Sands Missile Range, NM.
  - (U) Conduct small-scale laboratory and field experiments to explore innovative atmospheric compensation, tracking, and laser beam control options reducing the technical risk of developing airborne high energy laser weapons.
  - (U) Implement a sequence of experiments to develop an airborne ultra-precision inertial pointing system which improves pointing accuracy by rejecting vibrations from the aircraft.
- (U) $25,758 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,729 Develop and demonstrate high energy laser components for potential weapon applications.
  - (U) Continue to improve performance and fieldability of the Chemical Oxygen Iodine Laser to support the transition of the airborne laser weapon system to the operational community.
  - (U) Conduct high-power laser research for ground and space-based laser systems to insure operation control of space and the tactical and strategic theaters.
- (U) $1,727 Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems that are protected against laser threats.
  - (U) Continue to conduct laser vulnerability experiments on satellite subsystems.
  - (U) Continue to perform detailed vulnerability analysis on satellite optical payload systems.
  - (U) Continue detailed satellite vulnerability assessments using newly incorporated uncertainty methodology.
  - (U) Continue assessing the potential of near-term laser countermeasures on satellites.
- (U) $761 Investigate and develop advanced, high energy laser optical components.
  - (U) Continue to evaluate techniques to monitor optical components installed in an operational high-energy laser system. Transfer monitoring equipment to users. Such techniques are useful for predicting performance degradation and/or catastrophic failure of an optical component in an operational high energy laser system.
  - (U) Continue to optimize very low absorption, low-scatter optical thin film coatings. Transfer technology to industry for scaling. Low absorption, low scatter, durable coatings are critical to the performance of uncooled optics planned for future high-energy laser systems.
  - (U) Use the cooled, transmissive optical element in imaging experiments to demonstrate its thermal loading capability in an operational system.

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BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology — PROJECT: 3647

- (U) $11,425 Perform atmospheric compensation and laser beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification.
  - (U) Demonstrate atmospheric compensation of images using dual laser beacon system on 3.5 meter telescope.
  - (U) Demonstrate compensated laser propagation to satellites on 3.5 meter telescope.
  - (U) Continue active satellite tracking to investigate phenomena resulting from satellite illumination for various targets and engagements.
  - (U) Use track jitter compensation with atmospheric compensation and active tracking to point a laser with sufficient accuracy to maintain a selected aimpoint on a satellite target.
- (U) $5,865 Characterize atmospheric attenuation and distortion on laser beam propagation, conduct atmospheric compensation and beam control experiments, and develop an airborne ultra-precision inertial pointing brassboard to enhance boot phase theater ballistic missile tracking.
  - (U) Collect atmospheric aerothermal data for strategic locations worldwide to develop parametric database for high energy laser (operational assessments) analysis.
  - (U) Conduct near full-scale acquisition, tracking, and pointing experiments that demonstrate and validate atmospheric compensation, target tracking, and laser beam control techniques against fixed targets and boost phase theater ballistic missiles. The experiments will be conducted at White Sands Missile Range, NM.
  - (U) Conduct small-scale laboratory and field experiments to explore innovative atmospheric compensation, tracking, and laser beam control options reducing the technical risk of developing airborne high energy laser weapons.
  - (U) Perform a sequence of experiments to develop an airborne ultra-precision inertial pointing system to enhance tracking of boost phase missiles.
- (U) $22,507 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
	PROJECT 3647

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	25,793	25,199	23,280	19,968	Cont
(U) Current Budget Submit/FY 1998 PB	25,776	23,798	25,758	22,507	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603319F, Airborne Laser Demonstration.
- (U) PE 0305910F, Spacetrack.
- (U) PE 0603217C, Ballistic Missile Defense, Advanced Development (High Altitude Balloon Experiment).
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603707F Weather Systems Technology

PROJECT: 2688

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2688 Weather Support Technology	4,194	3,273	2,036	2,056	1,906	1,783	1,810	2,015	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, Projects 2688, Weather Support Technology, 2781, Weather Radar Technology, and 4026, Centralized Support Technology, were combined within Project 2688. For clarity, FY 1996 and FY 1997 funding reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** New technologies for weather support forces and their operational customers are demonstrated and transitioned to the user in this Advanced Technology Development program. Technologies developed include new weather impact decision aids that will be incorporated into mission planning systems and used by battlefield commanders for optimum selection of electro-optical systems and tactics to accomplish mission objectives. The program also provides new technologies to improve centralized space/weather support capabilities at the Air Force's Global Weather Central and Space Forecast Center. Improves the Air Force's ability to gather and integrate information for weather forecasts in battle areas where data is denied. Develops models for forecasting conditions in the earth's neutral atmosphere, ionosphere, and magnetosphere which are needed to provide critical support to Air Force surveillance, communications, and other satellite assets. New global and theater weather forecast techniques that improve the Air Force's capability to provide centralized weather data are also developed. Develops new technologies to fully exploit the capabilities of new operational DOD Doppler weather radars. These technologies will be used by the Air Force to better observe and forecast severe weather such as windshear, tornadoes, and hail.

(U) FY 1996 ($ in Thousands):

- (U) $540 Develop Tactical Forecast System observation, analysis, and forecast technology.
  - (U) Completed evaluation of tactical weather observation sensors for Air Weather Service.
- (U) $1,648 Develop weather impact decision aids.
  - (U) Completed requirements analysis for electro-optical weather impact modules for automated mission planning.
  - (U) Incorporated new mission scenarios into Night Vision Goggle Operations Weather Software and delivered to Air Force Special Operations Command.
  - (U) Completed infrared scene visualization system and installed at Eglin Air Force Base, FL, for evaluation.
- (U) $649 Develop centralized weather support technology.
  - (U) Delivered initial cloud layer and surface visibility diagnostic algorithm to Air Force Global Weather Central.
  - (U) Continued development of aviation hazard diagnostic algorithms (thunderstorms, aircraft icing, turbulence).
- (U) $964 Develop space environmental algorithms.
  - (U) Continued development of advanced space environmental algorithms.
  - (U) Continued development of executive algorithm to integrate space environmental algorithms.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603707F Weather Systems Technology PROJECT 2688

- (U) $393 Develop severe weather prediction software.
  - (U) Completed a storm structure algorithm to predict severe weather.
  - (U) Completed an algorithm to determine location/intensity of weather fronts.
  - (U) Continued development of lightning algorithm.
- (U) $4,194 Total

(U) FY 1997 ($ in Thousands):

- (U) $305 Develop Tactical Forecast System observation, analysis, and forecast technology.
  - (U) Complete integration of automated, theater weather observations into the tactical forecast system and deliver to Electronic Systems Center.
  - (U) Continue development of artificial intelligence forecast model, emphasizing graceful degradation of system in data-denied situation.
- (U) $1,647 Develop weather impact decision aids.
  - (U) Deliver advanced physics Night Vision Goggle Operations Weather Software to Air Force Special Operations Command/Air Combat Command.
  - (U) Continue evaluation of infrared scene visualization system.
  - (U) Develop new target acquisition software and mission impact modules for weather decision aid models.
- (U) $735 Develop centralized weather support technology.
  - (U) Deliver validated cloud layer and surface visibility diagnostic algorithms to Air Force Global Weather Central.
  - (U) Continue development of thunderstorm, aircraft icing, and turbulence diagnostic algorithms.
- (U) $202 Develop space environmental algorithms.
  - (U) Continue development of the integrated space environmental model.
- (U) $384 Develop severe weather prediction software.
  (U) Complete development of lightning algorithm.
- (U) $3,273 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603707F Weather Systems Technology PROJECT 2688

(U) FY 1998 ($ in Thousands):

- (U) $1,432 Develop weather impact decision aids.
  - (U) Develop Night Vision Goggle operations scene visualization capability.
  - (U) Transition infrared scene visualization system to Air Force Mission Support System Program Office at Electronic Systems Center.
  - (U) Continue development of new target acquisition software and mission impact modules for weather decision aids.
- (U) $498 Develop centralized weather support technology.
  - (U) Continue development of validated thunderstorm, aircraft icing, and turbulence diagnostic algorithms.
- (U) $106 Develop space environmental algorithms.
  - (U) Continue development of the integrated space environmental model.
- (U) $2,036 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,442 Develop weather impact decision aids.
  - (U) Complete/deliver Night Vision Goggle Operations Weather Software to Air Force Special Operations Command/Air Combat Command.
  - (U) Develop weather automated stoplight mission planning software.
  - (U) Develop new target acquisition software and mission impact modules to support electro-optical weapons.
- (U) $498 Develop centralized weather support technology.
  - (U) Deliver thunderstorm, aircraft icing, and turbulence diagnostic algorithms to Air Force Global Weather Central.
  - (U) Develop advanced global/theater cloud-layer algorithms to support air targeting and reconnaissance planning operations.
- (U) $116 Develop space environmental algorithms.
  - (U) Continue development of the integrated space environmental model.
- (U) $2,056 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603707F Weather Systems Technology PROJECT 2688

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	4,414	3,406	3,262	3,347	Cont
(U) Appropriated Value	4,577	3,406			
(U) Adjustments to Appropriated Value					
a. Congressional General Reductions	-90	-68			
b. SBIR	-75	-62			
c. Omnibus/Other Above Threshold Reprogrammings	-44	-3			
d. Below Threshold Reprogrammings	-174				
(U) Current Budget Submit/FY 1998 PB	4,194	3,273	2,036	2,056	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program..

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) Related Activities:

- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0305111F, Weather Service.
- (U) PE 0602601F, Phillips Laboratory.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603723F Environmental Engineering Technology

PROJECT: 2103

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2103 Environmental Quality Technology	8,421	7,520	4,084	4,857	5,347	4,475	7,935	9,293	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, Project 2103, Environmental Quality Technology, and Project 3037, Noise and Sonic Boom Impact Technology, are combined within Project 2103, Environmental Quality Technology. The total PE costs shown for FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates advanced technologies to address Air Force-unique environmental problems and determines the effect of aircraft noise and sonic boom stimuli on humans, animals, and structures. Specific projects advance and integrate environmental issues and operating concerns into air base design, support, and maintenance. Develops and demonstrates advanced technologies to solve environmental restoration problems, reduce hazardous emissions from weapon systems, minimize Air Force industrial waste, and eliminate toxic pollutant releases from Air Force operations. Develops and demonstrates technologies to predict and evaluate the environmental impacts of noise from aircraft operations, as directed by the National Environmental Policy Act. Improving this capability is essential for timely response to public concerns, preparation of accurate environmental impact statements, and minimizing unfavorable legal challenges to Air Force operations. Note: Significant reductions in FY 1998 through FY 2001 are due to termination of site remediation S&T. In FYs 2002 and out, additional emphasis has been placed on compliance and prevention techologies (i.e., increasing efforts in reducing air toxic emmissions).

(U) FY 1996 ($ in Thousands):

- (U) $2,804 Demonstrated technologies and design criteria for improved monitoring, disposal, characterization, and assessment of risks to the environment posed by Air Force activities.
  - (U) Completed characterization of atmospheric diffusion to validate space launch toxic risk assessment models for Cape Canaveral Air Station.
  - (U) Completed development and commercialization of a real-time in-place laser spectrometer for fuel contaminated site characterization and developed and demonstrated in-place fiber optic sensors to monitor contaminant sources and plumes.
  - (U) Demonstrated dense solvent detection and monitoring technology; validated the fate and transport characteristics of contaminants in soils and groundwater to enhance and validate models for development of treatment plans.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603723F Environmental Engineering Technology PROJECT 2103

- (U) $4,304 Demonstrated technologies to reduce/destroy wastes and contamination of the environment by Air Force materials and operations.
  - (U) Completed demonstration of bioventing for non-petroleum compounds; demonstrated in-place biotechnology to clean up Air Force sites contaminated with fuels and solvents in soil and groundwater.
  - (U) Concluded agreement with Hill AFB to build and test an air recirculating paint hangar to control Volatile Organic Compounds (VOC) emissions from painting of C-130 aircraft.
  - (U) Demonstrated a non-thermal plasma technology to remove nitrogen oxides from engine exhaust streams.
  - (U) Developed technology to treat waste hydraulic fluids, reducing hazardous waste generation and disposal costs; developed cost-competitive hydrothermal oxidation process for treatment of Hazard Class (Mass Detonatable) 1.1 solid rocket propellant waste.
- (U) $1,313 Developed and demonstrated noise effects assessment technologies.
  - (U) Developed technology to expand ability to assess environmental impacts of aircraft noise to flights within subsonic military operations areas.
  - (U) Determined the extent of military aircraft overflights of national parks and wilderness areas using Geographic Information System (GIS) technology and existing national digital databases to support airspace environmental planning efforts.
  - (U) Measured and analyzed the potential for damage from sonic booms to unconventional and historic structures.
- (U) $8,421 Total

(U) FY 1997 ($ in Thousands):

- (U) $2,133 Demonstrate technologies and design criteria for improved monitoring, disposal, characterization, and assessment of risks to the environment posed by Air Force activities.
  - (U) Completed development of advanced air monitoring technology and characterization of atmospheric diffusion following catastrophic space launch aborts to validate space launch toxic risk assessment models for Vandenberg AFB.
  - (U) Demonstrated additional in-place sensors and monitoring technologies to locate, identify, and monitor solvent contaminant sources and plumes; demonstrate direct push data point mapping and monitoring assessment using Global Positioning System (GPS) technology.
  - (U) Provided full-scale field evaluation of techniques to determine remediation rates of fuel/solvent contaminants (including natural or enhanced biodegradation).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603723F Environmental Engineering Technology
	PROJECT 2103

- (U) $4,327 Demonstrated technologies to reduce/destroy wastes and contamination of the environment by Air Force materials and operations.
  - (U) Completed design and begin construction of an air recirculating paint booth with biofilter and Volatile Organic Compounds (VOCs) emissions control technology; continue to develop and demonstrate affordable technologies to control air polluting emissions from Air Force industrial processes (to comply with Clean Air Act amendments).
  - (U) Continued to develop cost-effective alternate processes and materials that reduce or eliminate the production of hazardous wastes and the use of hazardous materials; demonstrate non-chromate conversion coating by ion vapor deposition of aluminum; demonstrate spray casting as a replacement for cadmium/nickel plating.
  - (U) Developed chemical/physical processes to treat oil/water wastes, emulsions, and aqueous film forming foam (AFFF) in waste water (including membrane separation, hydrogen peroxide treatment, direct nucleate flotation, and hydrothermal oxidation).
- (U) $1,060 Developed and demonstrated noise effects assessment technology.
  - (U) Initiated study on the extent of military overflight noise impacts on national parks.
  - (U) Demonstrated the use of the animal noise monitor with GPS technology for assessment of the effects of military aircraft noise on free-ranging herd animals in military operating areas and on Air Force ranges.
  - (U) Developed model to determine the penetration of sonic booms into water for assessment of impacts on marine mammals.
- (U) $7,520 Total

(U) FY 1998 ($ in Thousands):

- (U) $1,107 Demonstrate technologies and design criteria for improved monitoring, disposal, characterization, and assessment of risks to the environment posed by Air Force activities.
  - (U) Evaluate chemical fate and environmental transport of compounds of potential use to the Air Force or new to the Air Force inventory.
  - (U) Begin development of immunochemical detection systems to provide inexpensive, accurate, and robust measurements of Air Force toxic wastes.
  - (U) Begin adaptation of environmental sensor networks to air toxic monitoring.
- (U) $1,747 Demonstrate technologies to reduce/destroy wastes and contamination of the environment by Air Force materials and operations.
  - (U) Continue development of a recirculating paint booth with biofilter and Volatile Organic Compounds (VOCs) emissions control technology; continue to develop and demonstrate affordable technologies to control air pollutant emissions from Air Force industrial processes (to comply with Clean Air Act amendments).
  - (U) Continue to develop chemical/physical processes to treat oil/water wastes, emulsions, and aqueous film forming foam (AFFF) in waste water (including membrane separation, hydrogen peroxide treatment, direct nucleate flotation, and hydrothermal oxidation).
  - (U) Continue to develop cost-effective alternate processes and materials that reduce or eliminate the production of hazardous wastes and the use of hazardous materials.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603723F Environmental Engineering Technology
	PROJECT 2103

- (U) $1,230 Develop and demonstrate noise effects assessment technology.
  - (U) Upgrade the Assessment System for Aircraft Noise (ASAN) with the ability to predict noise from military aircraft operating in subsonic military operating areas.
  - (U) Conduct study to determine the effect of sleep disturbance habituation from aircraft noise.
  - (U) Characterize the habitat of marine mammals exposed to military aircraft noise and develop baseline noise levels for Air Force use.
- (U) $4,084 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,450 Demonstrate technologies and design criteria for improved monitoring, disposal, characterization, and assessment of risks to the environment posed by Air Force activities.
  - (U) Continue to evaluate chemical fate and environmental transport of compounds of potential use to the Air Force or new to the Air Force inventory.
  - (U) Continue development of immunochemical detection systems to provide inexpensive, accurate, and robust measurements of Air Force toxic wastes.
  - (U) Demonstrate adaptation of environmental sensor networks to air toxic monitoring.
- (U) $2,180 Demonstrate technologies to reduce/destroy wastes and contamination of the environment by Air Force materials and operations.
  - (U) Demonstrate a recirculating paint booth with biofilter and Volatile Organic Compounds (VOCs) emissions control technology; continue to develop and demonstrate affordable technologies to control air polluting emissions from Air Force industrial processes to comply with Clean Air Act amendments.
  - (U) Continue to develop several chemical/physical processes to treat oil/water wastes, emulsions, and aqueous film forming foam (AFFF) contaminated waste water (including membrane separation, hydrogen peroxide treatment, direct nucleate flotation, and hydrothermal oxidation).
  - (U) Continue to develop cost-effective alternate processes and materials that reduce or eliminate the production of hazardous wastes and the use of hazardous materials.
- (U) $1,227 Develop and demonstrate noise effects assessment technology.
  - (U) Conduct field test of active noise control system for airfield noise barriers.
  - (U) Demonstrate Remote Area Monitoring System for wide area noise monitoring.
  - (U) Develop noise mitigation tools for Air Force use.
- (U) $4,857 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603723F Environmental Engineering Technology
	PROJECT 2103

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget	8,478	7,885	8,859	9,129	Cont
(U) Appropriated Value	8,835	7,885			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-171	-174			
b. SBIR	-187	-184			
c. Omnibus/Other Above Threshold Reprogrammings	-54	-7			
d. Below Threshold Reprogrammings	-2				
(U) Current Budget Submit/FY1998 PB	8,421	7,520	4,084	4,857	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602202F, Armstrong Lab Exploratory Development
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0603716D, Strategic Environmental Research and Development Program.
- (U) PE 0604706F, Life Support Systems.
- (U) PE 0604708F, Other Operational Equipment.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603726F C3 Subsystem Integration

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	11,157	8,390	9,922	10,566	11,801	12,119	12,381	12,768	Continuing	Continuing
2810 Advanced Image/Information/Optical Memory Technology Applications	7,054	6,262	4,867	5,286	5,965	6,136	6,220	6,404	Continuing	Continuing
2863 Integrated Photonics	4,103	2,128	5,055	5,280	5,836	5,983	6,161	6,364	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, Project 2810, Advanced Image/Information Applications, and Project 3192, Advanced Optical Memory Technology, have been combined into Project 2810, Advanced Image/Information/Optical Memory Technology Applications, within this PE. The total PE costs shown for FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates Command, Control, and Communications (C3) technologies in the areas of processing and fusion of digital databases, photonics technology, optical disk storage/processing of digital information, and distributed processing technology for interoperability between dispersed command centers. These technologies provide increased storage, processing, and transmission of digital data that contains unlimited data content. Note: In FYs 1998 and out, additional emphasis has been placed on advanced subsystems integration and information warfare technologies to meet future user requirements.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	11,404	8,777	10,334	12,048	Cont
(U) Appropriated Value	12,008	8,777			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-233	-176			
b. SBIR	-251	-203			
c. Omnibus/Other Above Threshold Reprogrammings	-194	-8			
d. Below Threshold Reprogrammings	-173				
(U) Current Budget Submit/FY 1998 PB	11,157	8,390	9,922	10,566	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration PROJECT 2810

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2810 Advanced Image/Information/Optical Memory Technology Applications	7,054	6,262	4,867	5,286	5,965	6,136	6,220	6,404	Continuing	Continuing

Note: Beginning in FY 1998, Project 2810, Advanced Image/Information Applications, and Project 3192, Advanced Optical Memory Technology, have been combined into Project 2810, Advanced Image/Information/Optical Memory Technology Applications, within this PE. The total PE costs shown for FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This project develops and demonstrates techniques and algorithms to meet weapon systems requirements for processed and fused multi-source information required for mission planning, navigation, targeting, and terrain analysis. It provides generic language translation processing techniques, and standard applications algorithms for Air Force exploitation of digitally processed image and spatial database products, as well as develop automated capabilities to reference and display hypermedia information, and offensive and defensive information warfare technologies. This project also develops the erasable optical data storage systems with high capacity and fast input/output speed for fighter aircraft operation (to provide fast airborne access to mission-oriented data and the digital terrain system), and electronic surveillance aircraft (for on-board sensor data recording, operational mission planning requirements, large data storage requirements (i.e., high-volume, soft-copy, digital imagery exploitation)). Algorithms will be provided to automate the selection, and retrieval, and downloading of information stored on mass storage devices which are distributed across the data network. An array of optical disk drives will be developed for high throughput speed and fault-tolerant requirements. Three-dimensional (3-D) optical memory systems will be developed for volumetric digital data storage. This new mass storage technology will demonstrate ultra-high data density and fast, parallel data access within a low-cost, compact system.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603726F C3 Subsystem Integration / PROJECT: 2810

(U) FY 1996 ($ in Thousands):

- (U) $3,049 Developed and demonstrated advanced imagery information sensor fusion and spatial database technologies to enhance warfighter mission planning, navigation, targeting, and terrain analysis.
  - (U) Developed a transportable electronic information correlator and automated message update, filter, and retrieval processes; demonstrated Phase 1 multiple database integration and update capability using information and electronic messages; developed initial query robot for update analysis enhancement demonstration to support battlefield analysis.
  - (U) Developed an all-source fusion capability to locate, identify, and track mobile red, green, and blue military components; completed system design and sensor cueing/cross cueing and information acquisition modules module.
- (U) $539 Developed and demonstrated automated capabilities to access, process, and display hypermedia (integrated text, imagery, audio, and video) information which fully exploit relationships between data available to the field commander in a timely manner.
  - (U) Completed integrated hypermedia demonstration of video, audio, and automated linking; assessed at operational exercises.
  - (U) Developed Phase 2 hypermedia analysis and implementation effort for an operational planning and rehearsal system.
- (U) $100 Developed and demonstrated advanced interrogative techniques which fully exploit the information available to the warfighter.
  - (U) Completed delivery of expanded language modules for the automated voice translation system; demonstrated to the user automated, multi-language, voice translation for field interrogation.
- (U) $1,177 Developed and demonstrated optical information data handling, storage, and access technologies for strategic and tactical applications.
  - (U) Demonstrate a high-fault-tolerant array of optical disk drives providing ten gigabytes of on-line storage, data access time less than 50 milliseconds, and three megabytes per second data transfer speeds to interface with data bases.
  - (U) Designed a three-dimensional (3-D) optical computer memory system, addressing architectural issues and storage media performance; provides needed storage capacity and input/output bandwidth for next-generation aircrew training and data handling.
- (U) $2,189 Designed, developed, and demonstrated optical disk and interface technologies which can be implemented in joint theater operations.
  - (U) Developed an automated, high-capacity Optical Jukebox that can store and retrieve several 14-inch diameter, rewritable optical disks; examined large diameter rewritable media capable of storing ten gigabytes/disk and an optical drive capable of high-speed data recording, playback, and erasure as a means of providing critical data storage to meet user's growing requirements.
  - (U) Demonstrated a deployable Optical Jukebox with an operational mission planning capability.
  - (U) Designed and developed a mass storage retrieval algorithm-based approach used to query and retrieve information from a large mass storage system; algorithms control all mass data storage operations and provide user access to multiple terabytes of data.
- (U) $7,054 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration
	PROJECT 2810

(U) FY 1997 ($ in Thousands):

- (U) $3,052 Develop and demonstrate advanced imagery information sensor fusion and spatial database technologies to enhance warfighter mission planning, navigation, targeting, and terrain analysis.
  - (U) Conduct Phase 2 demonstration of multiple database integration and update capability to maintain a single uniform and current vector database for real-time access; demonstrate automated update of multiple heterogeneous data bases simultaneously to support interdisciplinary correlation and new information sources.
  - (U) Develop a portable electronic information correlator for deployment with tactical communications systems to automatically correlate signal intelligence multisensor inputs on the battlefield; conduct final demonstration at user's site of the enhanced, all-source, sensor fusion capability to locate, identify, and track mobile friend and foe (i.e., threats and targets) battlefield components.
- (U) $250 Develop and demonstrate automated capabilities to access, process, and display hypermedia (integrated text, imagery, audio, and video) information which fully exploit relationships between data available to the field commander in a timely manner.
  - (U) Develop hypermedia algorithms for use with operational databases and navigational aids capabilities.
  - (U) Develop advanced hypermedia techniques for video indexing overlaps and links to connect secure information data bases.
- (U) $1,750 Develop and demonstrate optical information data handling, storage, and access technologies for strategic and tactical applications.
  - (U) Fabricate pre-brassboard model of a three-dimensional (3-D) optical memory capable of storing 100 gigabytes of information and reconstructing it using a parallel optical readout technique; exploit virtual reality technology using digital data stored and accessed via 3-D optical memories.
- (U) $1,210 Design, develop, and demonstrate optical disk and interface technologies which can be implemented in joint theater operations.
  - (U) Complete the fabrication and demonstration of high-capacity Optical Jukebox interfaced with an information network.
  - (U) Enhance algorithm development and demonstrate capability to select, retrieve, and store digital data from different sources and transfer such data to field units.
- (U) $6,262 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration PROJECT 2810

(U) FY 1998 ($ in Thousands):

- (U) $2,680 Develop and demonstrate advanced imagery information and spatial data base technologies to enhance warfighter mission planning, navigation, targeting, and terrain analysis.
  - (U) Complete Phase 2 demonstration of multiple database integration and update capability to maintain a single uniform and current vector database for real-time access; demonstrate automated update of multiple heterogeneous data bases simultaneously to support interdisciplinary correlation and new information sources.
  - (U) Test the design of the portable electronic information correlator for deployment with tactical communications systems to automatically correlate signal intelligence multisensor inputs on the battlefield.
- (U) $270 Develop and demonstrate automated capabilities to access, process, and display hypermedia (integrated text, imagery, audio, and video) information which fully exploit relationships between data available to the field commander in a timely manner.
  - (U) Complete development of hypermedia algorithms for use with operational intelligence databases.
  - (U) Develop advanced hypermedia techniques for collection, integration and dissemination of hypermedia for widespread use.
  - (U) Develop information extraction technologies and capabilities to exploit data from unformatted text by automating the extraction and visualization process.
- (U) $1,066 Develop and demonstrate optical information data handling, storage, and access technologies for strategic and tactical applications.
  - (U) Deliver and demonstrate within an operational facility, a three-dimensional (3-D) optical memory using a write-once, read-many optical material.
  - (U) Design a pre-brassboard model using a fully erasable 3-D optical material.
  - (U) Design mass storage modules that integrate the benefits of 3-D optical memory with optical communication for instant access to multi-terabyte digital libraries.
- (U) $851 Design, develop, and demonstrate optical disk and interface technologies which can be implemented in joint theater operations.
  - (U) Deliver and evaluate search and retrieval algorithms for application to networked intelligence production facilities.
  - (U) Develop a multi-layered optical disk technique for a ten-fold (10X) storage improvement.
  - (U) Develop optical tape recording providing terabyte storage on a 12-inch reel for long-term, high-dense data retention applications.
- (U) $4,867 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration PROJECT 2810

(U) FY 1999 ($ in Thousands):

- (U) $3,008 Develop and demonstrate advanced imagery information sensor fusion and spatial database technologies to enhance warfighter mission planning, navigation, targeting, and terrain analysis.
  - (U) Conduct Phase 3 demonstration of multiple database integration and update capability to maintain a single uniform and current vector database for real-time access.
  - (U) Demonstrate the portable electronic information correlator for deployment with tactical communications systems to automatically correlate signal intelligence multisensor inputs on the battlefield.
- (U) $279 Develop and demonstrate automated capabilities to access, process, and display hypermedia (integrated text, imagery, audio, and video) information which fully exploit relationships between data available to the field commander in a timely manner.
  - (U) Demonstrate hypermedia algorithms for use with operational intelligence databases.
  - (U) Test the design of advanced hypermedia techniques for collection, integration and dissemination of hypermedia for widespread use.
  - (U) Test the design of information extraction technologies and the capability to exploit data from unformatted text by automating the extraction and visualization process.
- (U) $1,139 Develop and demonstrate optical information data handling, storage, and access technologies for strategic and tactical applications.
  - (U) Complete system design for a fully erasable three-dimensional (3-D) optical memory.
  - (U) Complete a design for an initial mass storage module providing a two-dimensional (2-D) optical filtering/correlation function. Provides a high-speed associative search capability.
- (U) $860 Design, develop, and demonstrate optical disk and interface technologies which can be implemented in joint theater operations.
  - (U) Demonstrate a multi-layered optical disk system using a erasable phase change material for higher storage capacity and lower manufacturing costs.
  - (U) Demonstrate an optical tape recorder/reader using a multi-laser beam design for a ten-fold (10X) improvement in data transfer speeds.
- (U) $5,286 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration
	PROJECT 2810

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	7,301	6,550	7,944	9,066	Cont
(U) Current Budget Submit/FY 1998 PB	7,054	6,262	4,867	5,286	Cont

(U) Change Summary Explanation:

Funding: Changes in this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0603789F, C3 Advanced Development.
- (U) PE 0603728F, Advanced Computer Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1997
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603726F C3 Subsystem Integration		PROJECT: 2863

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2863 Integrated Photonics	4,103	2,128	5,055	5,280	5,836	5,983	6,161	6,364	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**: Current electronic systems are susceptible to electromagnetic interference, electromagnetic pulse, and radio frequency (RF) interference. Size constraints, speed, and reliability also limit traditional electronic systems. Photonics-based systems, which process information in the form of light (photonic) signals, will provide major improvements in tactical and strategic Command, Control, and Communications (C3) systems by providing small-size, high-performance, high-capacity, survivable alternatives to electronic-based systems. This project develops and demonstrates advanced hardware technology in optical processing, adaptive transmission, and nonlinear optical processing.

(U) FY 1996 ($ in Thousands):

- (U) $1,008 Developed and demonstrated analog and digital optical processing technologies to provide the warfighter with real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems.
  - (U) Developed and designed photonic C3 processor providing reliable, agile, all-optical, general purpose processors for current and future airborne radars.
- (U) $3,095 Developed and demonstrated microwave/millimeter-wave photonics processing and subsystems essential for advanced optically-controlled RF systems at increased frequencies.
  - (U) Developed and designed super high frequency (SHF) optically-controlled phased array antenna demonstrating the agility necessary to steer communications antennas.
  - (U) Conducted initial design phase of an extremely high frequency (EHF) optically-controlled phased array antenna to demonstrate the agility necessary to steer operational-based communications antennas.
- (U) $4,103 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration PROJECT 2863

(U) FY 1997 ($ in Thousands):

- (U) $690 Develop and demonstrate analog and digital optical processing technologies to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems.
  - (U) Fabricate a photonic Command, Control, and Communications (C3) processor for a technology demonstrator; task will demonstrate the advantages of all-optical, high-speed agile processors in a variety of radar and communications functions.
- (U) $1,438 Develop and demonstrate microwave/millimeter-wave photonics processing and subsystems for advanced optically-controlled radio frequency (RF) systems at increased frequencies.
  - (U) Fabricate a super high frequency (SHF) optically controlled phased array antenna.
  - (U) Conduct first stage development of 100 Gigahertz (GHz) RF photonic interconnect system extending the frequency and bandwidth of previous microwave link programs to support communications.
  - (U) Design an extra high frequency (EHF) optically-controlled phased array antenna demonstrating the agility necessary to steer operational-based communications antennas.
- (U) $2,128 Total

(U) FY 1998 ($ in Thousands):

- (U) $1,463 Develop and demonstrate analog and digital optical processing technologies to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems.
  - (U) Complete fabrication and transition the photonic C3 processor into a technology demonstrator; task will demonstrate the advantages of all-optical, high-speed agile processors in a variety of radar and communications functions.
- (U) $3,592 Develop and demonstrate microwave/millimeter-wave photonics processing and subsystems for advanced optically-controlled RF systems at increased frequencies.
  - (U) Conduct initial testing of SHF optically-controlled phased array antenna components.
  - (U) Fabricate a 100 GHz RF photonic interconnect system; conduct preliminary testing of EHF optically-controlled, phased array system, extending the frequency and bandwidth of previous microwave link programs.
  - (U) Develop and fabricate an EHF optically-controlled phased array antenna demonstrating the agility necessary to steer operational-based communications antennas.
- (U) $5,055 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration
	PROJECT 2863

(U) FY 1999 ($ in Thousands):

- (U) $1,501 Develop and demonstrate analog and digital optical processing technologies to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems.
  - (U) Conduct initial integration and technology demonstration of a photonic Command, Control, and Communications processor to determine the advantages of employing an all-optical, high-speed (300-500 Giga-flops) agile processors in high performance computing systems.
- (U) $3,779 Develop and demonstrate microwave/millimeter-wave photonics processing and subsystems for advanced optically-controlled radio frequency (RF) systems at increased frequencies.
  - (U) Conduct integration testing of super high frequency airborne transmit/receive hardware with the optically-controlled phased array antenna components.
  - (U) Conduct initial testing of a 100 Gigahertz photonic interconnect system; conduct developmental testing of extra high frequency optically-controlled, phased array antenna system, extending the frequency and bandwidth of previous microwave link programs.
  - (U) Complete fabrication and begin testing an extra high frequency optically-controlled phased array antenna demonstrating the agility necessary to steer operational-based communications antennas.
- (U) $5,280 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration
	PROJECT 2863

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	4,103	2,227	2,390	2,982	Cont
(U) Current Budget Submit/FY 1998 PB	4,103	2,128	5,055	5,280	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to added emphasis on photonics technologies to meet future user needs.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0603789F, C3 Advanced Development.
- (U) PE 0603728F, Advanced Computer Technology.
- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603728F Advanced Computing Technology

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	10,327	8,089	5,613	6,684	6,647	6,215	6,698	6,860	Continuing	Continuing
2527 Software Life Cycle Tools	3,692	2,438	1,167	1,687	1,552	1,389	1,569	1,597	Continuing	Continuing
2530 Distributed Systems Reliability and Survivability	3,264	2,492	1,674	2,028	2,034	1,861	2,017	2,063	Continuing	Continuing
2532 Knowledge-Based Systems	3,371	3,159	2,772	2,969	3,061	2,965	3,112	3,200	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates technologies needed to control cost, reduce risk, and increase efficiency and effectiveness of software and computers required for Air Force mission critical combat systems. The Air Force has experienced a dramatic escalation in the cost of acquiring and maintaining embedded computer software for increasingly complex military systems which must be reliable and survivable in the battlefield environment. The requirement for survivable tactical and strategic computing systems has driven the need for automatic integration and interoperability of multiple processing elements, automatic redistribution of data and functions, and location-independent access of data. Distributed processing techniques, which can dynamically reconfigure assets to accommodate lost components or nodes, are required to ensure survivable mission critical command and control functions. Note: In FYs 1999 and out, additional emphasis has been placed on advanced computer technologies to meet future user requirements. Also, in FY 1996, Congress added/transferred $25.8M for Information Technology to this PE, however, these funds were subsequently reprogrammed into two new PEs to realign funds into the proper programs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	9,879	8,509	7,866	7,983	Cont
(U) Appropriated Value	36,605	8,509			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-765	-212			
b. SBIR	-794	-201			
c. Omnibus/Other Above Threshold Reprogrammings	-26,030	-7			
d. Below Threshold Reprogrammings	+1,311				
(U) Current Budget Submit/FY 1998 PB	10,327	8,089	5,613	6,684	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:** Not Applicable.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology PROJECT 2527

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2527 Software Life Cycle Tools	3,692	2,438	1,167	1,687	1,552	1,389	1,569	1,597	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Advanced computer systems in Air Force weapon systems require software life cycle tools and technology to reduce costs, improve quality, and enhance productivity. This project develops, evaluates, and transitions new software technology that reduces cost, while improving software, systems, and productivity factors. It develops software life cycle support environments which incorporate both laboratory and commercial off-the-shelf (COTS) products. This project provides a vehicle for software technology integration, transition, and evaluation under operational and field conditions. Technologies for system requirements analysis, reuse of software components, software quality specification, measurement, assessment, and high performance (parallel) computer software engineering are also produced.

(U) FY 1996 ($ in Thousands):

- (U) $1,082 Developed and demonstrated network software support environments which address the network life cycle for parallel and concurrent networks while emphasizing affordability and software reuse certification technologies.
  - (U) Developed Phase 3 advanced software components, based on industry standards, and integrated them into the software architectural environment.
  - (U) Completed the certification framework for reusable software; demonstrated the capability to expand the framework for domain-specific reuse environments.
- (U) $998 Developed and demonstrated advanced software technologies to provide the user the means to analyze operational software requirements.
  - (U) Developed a performance modeling demonstration of advanced requirements analysis workstation (Block 1).
  - (U) Conducted demonstration tests of requirements analysis tools for the user and industry.
- (U) $512 Developed and demonstrated software quality enhancements through automated tools and methods.
  - (U) Developed additional case studies for the software quality technology demonstration; provided second increment of repository software information installation.
- (U) $1,100 Developed high performance advanced parallel computer software and architecture for weapon and information system applications.
  - (U) Designed methods to upgrade and optimize the Parallel Assessment Window System to provide a "user friendly" interface for adding new architectures and execution criteria.
  - (U) Developed an architecture-independent parallel design tool to provide a capability to conduct trade studies and analyses during early life cycle phases of heterogeneous systems that include parallel computers.
- (U) $3,692 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology PROJECT 2527

(U) FY 1997 ($ in Thousands):

- (U) $765 Design, develop, test, and demonstrate technology for the capture and exploitation of information for building evolutionary systems, capabilities to model and analyze complex systems, dynamic programming languages, and formal methods for defining, analyzing, and assessing evolutionary systems.
  - (U) Complete final demonstrations of network-oriented software support environments which emphasize affordability and software reuse certification technologies and provide this capability to the user.
  - (U) Design technologies for packaging diverse software capabilities such as visualization, hyper-programming, dynamic testing, and object oriented languages. Combine with an integrated approach for dealing with system requirements and documentation.
  - (U) Design open-systems technology for evolving software systems which are compatible with the commercial international network.
- (U) $727 Develop and demonstrate advanced software technologies to provide the user the means to analyze operational software requirements.
  - (U) Complete the development performance modeling aspect of the Block 1 advanced requirements analysis workstation.
  - (U) Based on industry comments, user feedback, and the need for addressing operational software requirements analysis, complete an assessment of the operational requirements analysis/workstation.
- (U) $340 Develop and demonstrate software quality enhancements through automated tools and methods.
  - (U) Complete case studies for software quality technology demonstration; provide third increment of repository software information.
- (U) $606 Develop high performance advanced parallel computer software and architecture for weapon and information system applications.
  - (U) Developed and tested software upgrades to the Parallel Assessment Window System to provide a "user friendly" interface for adding new architectures and execution criteria. Efforts were focus on capabilities to define emerging parallel architectures and methods for comparing execution profiles.
  - (U) Complete development efforts on the architecture-independent parallel design tool and demonstrate it on advanced parallel computer systems.
  - (U) Design and develop methods for integrating and demonstrating component level software technology for parallel computing systems for "typical" Air Force Command, Control, Communications and Intelligence (C3I) problem domains.
- (U) $2,438 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology PROJECT 2527

(U) FY 1998 ($ in Thousands):

- (U) $875 Design, develop, test, and demonstrate technology for the capture and exploitation of information for building evolutionary systems, capabilities to model and analyze complex systems, dynamic programming languages, and formal methods for defining, analyzing, and assessing evolutionary systems.
  - (U) Develop and test technology for packaging diverse software capabilities such as visualization, hyper-programming, dynamic testing, and object-oriented languages. Combine with an integrated approach for dealing with system requirements and documentation and implement using the existing systems engineering framework.
  - (U) Develop and test open-systems technology for evolving software systems which are compatible with the commercial international network technology and which enhance life cycle costs of Air Force software intensive systems. Efforts will focus on component level capabilities for design rationale, capture, and architecture based framework implementation.
- (U) $292 Develop high performance advanced parallel computer software and architecture for weapon and information system applications.
  - (U) Complete the effort to optimize parallel software upgrades to the Parallel Assessment Window System. Demonstrate these capabilities on heterogeneous systems made up of commercial-off-the-shelf (COTS) technology and specialized weapon system hardware/software.
  - (U) Develop methods for integrating and demonstrating parallel computing systems software technology for "typical" Air Force Command, Control, Communications and Intelligence (C3I) problem domains.
- (U) $1,167 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,263 Design, develop, test, and demonstrate technology for the capture and exploitation of information for building evolutionary systems, capabilities to model and analyze complex systems, dynamic programming languages, and formal methods for defining, analyzing, and assessing evolutionary systems.
  - (U) Fully demonstrate technology for packaging diverse software capabilities such as visualization, hyper-programming, dynamic testing, and object-oriented languages in Air Force operational problem domains and systems.
  - (U) Fully demonstrate open-systems technology for evolving software systems which are compatible with the commercial international network technology and which enhance life cycle costs of Air Force software intensive systems.
- (U) $424 Develop high performance advanced parallel computer software and architecture for weapon and information system applications.
  - (U) Demonstrate scaleable advanced parallel computing technology on candidate Air Force systems where commercial and government off-the-shelf hardware and software are combined in a heterogeneous system environment. The emphasis will be on assessing the performance of parallel computer in systems of varying heterogeneity.
- (U) $1,687 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology PROJECT 2527

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	2,445	2,564	2,300	2,335	Cont
(U) Current Budget Submit/FY 1998 PB	3,692	2,438	1,167	1,687	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0604740F, Computer Resource Management.
- (U) PE 0701112F, Inventory Control Point Operation.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology PROJECT 2530

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2530 Distributed Systems Reliability and Survivability	3,264	2,492	1,674	2,028	2,034	1,861	2,017	2,063	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops software technology to provide the distributed computer information handling for future Command, Control, Communications, and Computer (C4) systems which integrate numerous heterogeneous processing networks and provides secure, seamless access to information. The system must be reconfigurable, operate in real-time, and be survivable, as well as capable of integrating the full spectrum of multimedia data. The system will operate in an "information pull" mode where the users' requests for information are filled without explicit action on the part of the user to locate, retrieve, or merge data. An object-oriented architecture will be used to provide a common perspective which will serve as the basis for the merger between the communications control system and the distributed computing environment.

(U) FY 1996 ($ in Thousands):

- (U) $1,575 Developed and demonstrated heterogeneous, secure, multi-networked distributed computing environments for interoperability and survivability.
  - (U) Demonstrated multi-networked distributed computing environment for a distributed air operations center.
  - (U) Demonstrated an asynchronous-based distributed computing environment.
  - (U) Developed distributed virtual computing architecture and computation model.
- (U) $759 Developed and demonstrated distributed database management techniques for managing multimedia data in distributed information systems.
  - (U) Developed distributed query capability for multimedia database management system.
  - (U) Demonstrated concurrence mechanisms for multimedia database management in a distributed information system.
  - (U) Established tri-Service testbed for the development of multimedia distributed database management.
- (U) $930 Developed real-time adaptive distributed computing environments to support crisis management and survivability.
  - (U) Demonstrated use of artificial intelligent agents for adaptive distributed resource management.
  - (U) Demonstrated real-time distributed computing across multiple local computers.
  - (U) Developed standard specification for real-time computing in an object-based distributed computing environment.
- (U) $3,264 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology
	PROJECT 2530

(U) FY 1997 ($ in Thousands):

- (U) $893 Develop and demonstrate heterogeneous, secure, multi-networked distributed computing environments for interoperability and survivability.
  - (U) Develop the integration of security mechanisms into multi-networked distributed computing environments.
  - (U) Develop the ability to establish a distributed computing environment across a limited bandwidth interconnection.
  - (U) Integrate mobile computing nodes into a heterogeneous distributed computing environment.
- (U) $790 Develop and demonstrate distributed database management techniques for managing multimedia data in distributed information systems.
  - (U) Develop artificial intelligent agents for retrieval of multimedia data across a wide area network.
  - (U) Integrate speech as a managed object in an object-based, distributed, multimedia database management system.
  - (U) Develop multimedia database management across multiple locally netted computers.
- (U) $809 Develop real-time adaptive distributed computing environments to support crisis management and survivability.
  - (U) Develop an adaptive reconfigurable distributed computing environment based upon an application-derived parameter.
  - (U) Develop real-time distributed computing architecture across heterogeneous networks for tracking.
  - (U) Develop dynamic process and data migration across a multi-networked distributed information system.
- (U) $2,492 Total

(U) FY 1998 ($ in Thousands):

- (U) $620 Develop and demonstrate heterogeneous, secure, multi-networked distributed computing environments for interoperability and survivability.
  - (U) Demonstrate utility of security mechanisms integrated into multi-networked distributed computing environments.
  - (U) Test the design of a distributed computing environment across a limited bandwidth connection.
  - (U) Test the design of mobile computing nodes in a heterogeneous distributed computing environment.
- (U) $478 Develop and demonstrate distributed database management techniques for managing multimedia data in distributed information systems.
  - (U) Test the artificial intelligent design for retrieval of multimedia data across a wide area network.
  - (U) Integrate video as a managed object in an object-based, distributed, multimedia database management system.
  - (U) Test the design of multimedia database management across multiple locally netted computers.
- (U) $576 Develop real-time adaptive distributed computing environments to support crisis management and survivability.
  - (U) Test the adaptive reconfigurable distributed computing environment design based upon an application-derived parameter.
  - (U) Test the design of a real-time distributed computing architecture across heterogeneous networks for tracking.
  - (U) Demonstrate dynamic process and data migration across a multi-networked distributed information system.
- (U) $1,674 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology
	PROJECT 2530

(U) FY 1999 ($ in Thousands):

- (U) $735 Develop and demonstrate heterogeneous, secure, multi-networked distributed computing environments for interoperability and survivability.
  - (U) Integrate information warfare technologies into multi-networked distributed computing environments.
  - (U) Demonstrate the ability of a distributed computing environment to adapt to a limited bandwidth interconnection.
  - (U) Demonstrate the ability to dynamically and autonomously reconfigure the distributed network for mobile computing nodes in a heterogeneous distributed computing environment.
- (U) $597 Develop and demonstrate distributed database management techniques for managing multimedia data in distributed information systems.
  - (U) Demonstrate the utility of artificial intelligent agents for the retrieval of multimedia data across a wide area network.
  - (U) Demonstrate the integration of audio/video/data as a managed object in an object-based, distributed, multimedia database management system.
  - (U) Demonstrate multimedia database management across multiple wide-area networked computers.
- (U) $696 Develop real-time adaptive distributed computing environments to support crisis management and survivability.
  - (U) Demonstrate an adaptive reconfigurable distributed computing environment based upon external parameters as well as multiple application-derived parameters.
  - (U) Demonstrate real-time distributed computing architecture across heterogeneous networks for tracking.
  - (U) Develop combined process, data, and function migration across a multi-networked distributed information system.
- (U) $2,028 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology
	PROJECT 2530

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	3,264	2,633	2,420	2,455	Cont
(U) Current Budget Submit/FY 1998 PB	3,264	2,492	1,674	2,028	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0604740F, Computer Resource Management.
- (U) PE 0701112F, Inventory Control Point Operation.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology PROJECT 2532

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2532 Knowledge-Based Systems	3,371	3,159	2,772	2,969	3,061	2,965	3,112	3,200	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Knowledge-based computer systems provide the capability to automatically solve reasoning problems. This effort develops computer technologies which automate the problem solving process associated with human thought. It has three major thrusts. The first, knowledge-based analysis, provides software tools and techniques to develop and evaluate knowledge-based software systems to support robust, real-time, large-scale information systems. The second, knowledge-based planning, applies artificial intelligence (AI) technology to provide increased cost-effectiveness in diverse planning applications involving decision support to air operations planning and execution management, employment and deployment planning, logistics planning, resource allocation, and scheduling processes. The third, Knowledge-Based Software Assistant (KBSA), exploits knowledge-based methods to effect orders of magnitude improvements in software development and support activities.

(U) FY 1996 ($ in Thousands):

- (U) $150 Developed and demonstrated knowledge-based software analysis technologies to support robust, real-time, large-scale information systems.
  - (U) Developed high level tools for rapid composition and integration of large bodies of existing code, data/knowledge bases, and subsystems.
- (U) $1,694 Developed and demonstrated knowledge-based technologies to automate labor-intensive tasks to allow rapid, accurate, and efficient planning.
  - (U) Completed model for mixed initiative planning incorporating computer learning techniques and "intelligent" computer-based agents to support the air campaign planning process.
  - (U) Integrated constraint-based scheduling and modeling capabilities to support in-theater and strategic airlift.
  - (U) Integrated knowledge-based planning technologies into the Joint Forces Air Component Commander planning system; demonstrated the integrated system.
  - (U) Developed generative planning and intelligent automated assistance for both planning and monitoring of joint air campaign.
  - (U) Developed strategies for efficient planning scenario generation in various military domains.
- (U) $1,527 Developed and demonstrated knowledge-based technologies that support the evolution and adaptation of software systems.
  - (U) Conducted initial demonstration of KBSA advanced development model, supporting process representation, configuration management, text generation, instrumentation, and project management.
- (U) $3,371 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology
	PROJECT 2532

(U) FY 1997 ($ in Thousands):

- (U) $212 Develop and demonstrate knowledge-based software analysis technologies to support robust, real-time, large-scale information systems.
  - (U) Develop high level tools and methodology facilitating the evolution, evaluation, and integration of information sources for collaborative intelligent information systems capable of coordination, cooperation, and negotiation.
- (U) $1,547 Develop and demonstrate knowledge-based technologies to automate labor-intensive tasks to allow rapid, accurate, and efficient planning.
  - (U) Complete development schedule planning tools to provide for real-time operational use for strategic airlift.
  - (U) Develop artificial intelligence planning and scheduling tools for imprecise environments.
  - (U) Demonstrate generative planning and intelligent automated assistance for both planning and monitoring of joint air campaign.
  - (U) Demonstrate strategies for efficient planning scenario generation in various military domains.
- (U) $1,400 Develop and demonstrate knowledge-based technologies that support the evolution and adaptation of software systems.
  - (U) Complete Knowledge-Based Software Assistant (KBSA) advanced development model, supporting process representation, configuration management, text generation, instrumentation, and project management. Evaluate in mission critical application.
  - (U) Develop knowledge-based evolutionary design tools for software and system development.
- (U) $3,159 Total

(U) FY 1998 ($ in Thousands):

- (U) $200 Develop and demonstrate knowledge-based technologies to support active robust, real-time, large-scale intelligent information systems.
  - (U) Test systematic tools and evaluation methodology for collaborative intelligent information systems capable of coordination, cooperation, and negotiation.
  - (U) Develop knowledge-based acquisition tools to guide users in augmenting systems and deriving knowledge for large quantities of distributed data for active information systems.
- (U) $1,423 Develop and demonstrate knowledge-based technologies in continuous planning to allow rapid, accurate, and efficient plan generation.
  - (U) Develop the test plan and feasibility estimation for both planning and monitoring of joint air campaigns.
  - (U) Test artificial intelligence planning and scheduling tools for imprecise environments.
  - (U) Integrate generative planning and intelligent automated assistance for both planning and monitoring of joint air campaign.
  - (U) Test strategies for efficient planning scenario generation in various military domains.
  - (U) Develop knowledge-based technologies in continuous planning to allow rapid, accurate, and efficient plan generation.
- (U) $1,149 Develop and demonstrate knowledge-based technologies that support the evolution and adaptation of software systems.
  - (U) Test knowledge-based evolutionary design tools for software and system development in military applications.
  - (U) Develop knowledge-based acquisition capabilities that assist in monitoring and evaluating the satisfaction and capture of requirements and rationale for software systems.
- (U) $2,772 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997	
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology	PROJECT 2532

(U) FY 1999 ($ in Thousands):

- (U) $214 Develop and demonstrate knowledge-based technologies to intelligent information warfighting applications for large-scale intelligent information systems.
  - (U) Integrate systematic tools and evaluation methodology for collaborative intelligent information systems capable of coordination, cooperation, and negotiation.
  - (U) Test knowledge-based acquisition tools to guide users in augmenting systems and deriving knowledge for large quantities of distributed data for active information systems.
- (U) $1,514 Develop and demonstrate knowledge-based technologies for planning in large imprecise environments.
  - (U) Demonstrate the feasibility estimation for both planning and monitoring of joint air campaigns.
  - (U) Demonstrate artificial intelligence planning and scheduling tools for imprecise environments.
  - (U) Complete generative planning and intelligent automated assistance for both planning and monitoring of joint air campaign.
  - (U) Demonstrate strategies for efficient planning scenario generation in various military domains.
  - (U) Test knowledge-based technologies in continuous planning to allow rapid, accurate, and efficient plan generation.
  - (U) Develop tools for advisable planning and visual demonstration including distributed planning cells.
- (U) $1,241 Develop and demonstrate knowledge-based technologies that support the evolution and adaptation of software systems.
  - (U) Demonstrate knowledge-based evolutionary design tools for software and system development in military applications.
  - (U) Test knowledge-based acquisition capabilities that assist in monitoring and evaluating the satisfaction and capture of requirements and rationale for software.
- (U) $2,969 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology PROJECT 2532

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	4,170	3,312	3,146	3,193	Cont
(U) Current Budget Submit/FY 1998 PB	3,371	3,159	2,772	2,969	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0604740F, Computer Resource Management.
- (U) PE 0701112F, Inventory Control Point Operation.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603789F C3 Advanced Development

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	14,199	12,580	12,897	13,501	13,979	16,099	16,043	16,481	Continuing	Continuing
2335 Advanced C3 Technology	5,055	4,265	4,636	4,119	4,269	5,414	5,363	5,511	Continuing	Continuing
4072 Correlation and Fusion	6,777	6,124	6,841	6,941	7,146	7,917	7,846	8,051	Continuing	Continuing
4216 Warfighter Information Usage, Management, and Integration Technologies	2,367	2,191	1,420	2,441	2,564	2,768	2,834	2,919	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, PE 0603238F, Global Surveillance and Communications, has been incorporated as Project 4216, Warfighter Information Usage, Management, and Integration Technologies, within this PE. The total PE costs shown for FY 1996 and FY 1997 reflect this consolidation.

(U) A. Mission Description and Budget Item Justification: This Advanced Technology Development program develops and demonstrates ground and aerospace Command, Control, and Communications (C3) technology required to maintain Air Force capabilities in a fast-paced, sophisticated, high threat, and intense jamming environment. Enhanced surveillance and communications technology must be developed to counteract an enemy's jamming and to restore critical communications links to the warfighter. The technologies developed in this program include detection, identification, and tracking of hostile targets at long ranges on C2 and Intelligence platforms under combat conditions. Additionally, this project develops reliable, secure, jam-resistant communications, and battle management technology that assimilates crucial C3 information into a form which facilitates and supports the military leader's combat decisions in response to the changing dynamics of the battlefield. Note: In FYs 1999 and out, additional emphasis has been placed on Command, Control, and Communications technologies and correlation and fusing technologies to meet future user requirements.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	14,352	13,188	14,605	15,291	Cont
(U) Appropriated Value	15,100	13,188			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-316	-307			
b. SBIR	-312	-289			
c. Omnibus/Other Above Threshold Reprogrammings	-239	-12			
d. Below Threshold Reprogrammings	-34				
(U) Current Budget Submit/FY 1998 PB	14,199	12,580	12,897	13,501	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 2335

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2335 Advanced C3 Technology	5,055	4,265	4,636	4,119	4,269	5,414	5,363	5,511	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops Command, Control, and Communications (C3) technology for contingency and joint operations focusing on the concepts of force deployment, sustainment, and employment. Dynamic, hostile battlefield environments demand near instantaneous transmission and processing of vast amounts of C3 information for real-time decision making. This project develops and integrates technologies for: low probability of intercept/anti-jam transmission; modular, programmable, multi-level secure communications; secure survivable networks; advanced displays and interfaces; and battle management decision support capabilities for survivable, distributed Command and Control (C2) facilities. Multiband/multimode programmable radios will be enhanced to address the transmission link requirements of joint combat theater communications.

(U) FY 1996 ($ in Thousands):

- (U) $3,094 Developed and demonstrated critical ground and aerospace communications technology advances in programmable devices and monolithic microwave integrated circuits to provide survivable radios and transceivers.
  - (U) Performed final test and delivered Phase 1 SPEAKEASY advanced development model.
  - (U) Established Phase 2 SPEAKEASY programmable radio architecture and modular definition supporting development of a reprogrammable, multiband, multimode capability.
  - (U) Plan for a two-channel Phase 2 SPEAKEASY programmable radio in a four-channel unit with limited capability in a mobile vehicle.
- (U) $695 Demonstrated advanced networking technologies to provide efficient, secure, interoperable, and deployable communications networks.
  - (U) Revised the tactical switch low-rate interface module specifications and develop protocols for survivable asynchronous transfer mode.
  - (U) Completed design and development of translation interface between tactical and commercially compatible switches to support operational voice user requirements.
- (U) $1,266 Demonstrated theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities.
  - (U) Completed the first brassboard operations and surveillance integration design and demonstrated it; developed a concept design for the second operations and surveillance integration brassboard.
  - (U) Developed and demonstrated selected Phase 1 approaches of integrated information management technology for air operations center applications to improve warfighter situational awareness.
- (U) $5,055 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 2335

(U) FY 1997 ($ in Thousands):

- (U) $2,412 Develop and demonstrate critical ground and aerospace communications technology advances in programmable devices and monolithic microwave integrated circuits to provide survivable radios and transceivers.
  - (U) Demonstrate a two-channel Phase 2 SPEAKEASY unit with limited capability in a mobile vehicle.
  - (U) Demonstrate voice and data routing between military radios using Phase 2 SPEAKEASY programmable radio module.
- (U) $760 Demonstrate advanced networking technologies to provide efficient, secure, interoperable, and deployable communications systems.
  - (U) Based on revised specification, develop, integrate, and test field management system survivability and security features for survivable asynchronous transfer mode in an existing standards-based management platform system.
  - (U) Establish under the survivable asynchronous transfer mode effort, baseline management system requirements for military quality-of-service, survivability, and performance measures.
  - (U) Develop for survivable asynchronous transfer mode, a standard management system interface allowing seamless interoperation with other standards-based military and commercial systems.
- (U) $1,093 Demonstrate theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities.
  - (U) Demonstrate the completed operations and surveillance integration brassboard designs; complete preliminary/final acceptance test in an operational environment; and host the operations and surveillance integration brassboard technology demonstration to the user.
  - (U) Complete final acceptance tests on an integrated information management capability for the Air Operations Center. Conduct the Operations/Intelligence Integration brassboard technology demonstration to the user.
  - (U) Develop user coordinated concept plan for developing an air Defensive Planning and Execution (DPE) brassboard which integrates the use of air and ground surveillance and weapon systems assets; design algorithms and paradigms to support an automated functional process.
- (U) $4,265 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 2335

(U) FY 1998 ($ in Thousands):

- (U) $2,436 Develop and demonstrate critical ground and aerospace communications technology advances in programmable devices and monolithic microwave integrated circuits to provide survivable radios and transceivers.
  - (U) Demonstrate benefits and capabilities of Phase 2 SPEAKEASY system employing an advanced radio-frequency (with co-site mitigation) and Smart Radio functions in field tests.
- (U) $1,437 Demonstrate advanced networking technologies to provide efficient, secure, interoperable, and deployable communications systems.
  - (U) Develop an integrated (theater level) Self-Healing Network capability.
  - (U) Demonstrate integrated protocols and network management capability for survivable asynchronous transfer mode on standards-based platforms.
- (U) $763 Demonstrate theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities.
  - (U) Implement a limited brassboard capability for Defensive Planning and Execution (DPE). Employ the baseline capability to test and demonstrate knowledge-based decision support and artificial intelligence tools to facilitate automated DPE capabilities.
- (U) $4,636 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,839 Develop and demonstrate critical ground and aerospace communications technology advances in programmable devices and monolithic microwave integrated circuits to provide survivable radios and transceivers.
  - (U) Acceptance test of Phase 2 SPEAKEASY advanced development models (final size with complete software waveform suite) in internetworking relationships with government furnished equipment radios.
- (U) $1,511 Demonstrate advanced networking technologies to provide efficient, secure, interoperable, and deployable communications systems.
  - (U) Demonstrate dynamic Integrated Self-healing Networking, incorporating mobile ground/air communications elements, tactical ground elements, and satellite capability.
- (U) $769 Demonstrate theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities.
  - (U) Complete final acceptance and host the DPE brassboard technology demonstration to the user. Continue the transition process by extending the functional capabilities and developing interface software supporting the first release to Theater Battle Management Core System (TBMCS).
- (U) $4,119 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 2335

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	5,055	4,478	5,400	5,480	Cont
(U) Current Budget Submit/FY 1998 PB	5,055	4,265	4,636	4,119	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603617F, C3 Applications.
- (U) PE 0603737D, Advanced Research Projects Agency.
- (U) PE 0603006A, C3 Technology.
- (U) PE 0602702F, C3.
- (U) PE 0602232N, C3 Technology.
- (U) PE 0603726F, C3 Subsystems Integration.
- (U) PE 0603728F, Advanced Computer Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603789F C3 Advanced Development — PROJECT: 4072

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4072 Correlation and Fusion	6,777	6,124	6,841	6,941	7,146	7,917	7,846	8,051	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** The Air Force must be able to detect, positively identify, and track hostile targets in combat to gain maximum advantage of all strategic and tactical warning sensors and beyond-visual-range weapons to ensure maximum target engagement ranges and a first-shot, first-kill capability. Effective sensor processing improvements using advanced open architecture processors, spatial coordinate, and time adaptive processing techniques, tracking/fusion algorithms, bistatic sensor technology, and correlation techniques will be pursued to enhance target detection and tracking ranges. Indirect hostile target identification capabilities are essential to achieve high-confidence identification to control the air battle and provide the warfighter with the necessary information to use beyond-visual-range weapons. This project develops and integrates the necessary suite of complementary passive and active hostile target identification capabilities for command and control platforms. These technologies will enhance the performance of identification and threat assessment systems for improved acquisition, tracking, and target engagement ranges for theater operations.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4072

(U) FY 1996 ($ in Thousands):

- (U) $3,322 Developed high-confidence hostile airborne target identification and tracking technologies and concepts.
  - (U) Installed multi-sensor integration algorithm on an operational surveillance platform for FY 1997 demonstration testing.
  - (U) Completed advanced surveillance tracking algorithms utilizing advanced radar processing techniques to improve target tracking and the incorporation of new concepts that determine target attitude (position, direction, altitude).
  - (U) Conducted phase one bench testing of installation of active radar identification technology on-board an operational surveillance platform for an FY 1999 demonstration test.
- (U) $848 Developed and demonstrated advanced passive sensor technologies and concepts for increased survivability of fielded systems and assured detection and tracking of combat threats.
  - (U) Integrated and evaluated the hardware and algorithms of a 64-channel bistatic ground testbed which supports passive system performance evaluations and future airborne test risk reduction efforts.
  - (U) Developed design concept for an airborne bistatic testbed.
- (U) $2,607 Developed and demonstrated advanced sensor technologies and concepts for assured detection and tracking of hostile ground targets using multiple off-board sensors.
  - (U) Demonstrated multiple observation and information platform data fusion using enhanced surveillance algorithms (based on off-board sensor inputs) operating in a workstation environment to detect, track, and identify targets with data from existing surveillance platforms.
  - (U) Assessed detection, track, and fusion enhancement gains via real-time laboratory demonstration, defining the radar processing elements and fusion requirements to support real-time parallel processing.
  - (U) Developed and tested 20-billion-operations-per-second real-time signal processor enhancement Standard Electronic Module - E format board required to demonstrate real-time high resolution processing.
- (U) $6,777 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4072

(U) FY 1997 ($ in Thousands):

- (U) $2,694 Develop and demonstrate advanced sensor technologies and concepts for assured detection and tracking of hostile airborne targets using multiple off-board sensors.
  - (U) Complete installation of multi-sensor integration algorithm on an operational surveillance platform and demonstrate on-board and off-board platform sensor fusion and integration.
  - (U) Complete bench testing of active radar identification technology on-board an operational surveillance platform for a FY 1999 demonstration and test.
  - (U) Develop preliminary acoustic analysis algorithms to passively identify hostile targets for FY 2000 demonstration.
- (U) $911 Develop and demonstrate advanced passive sensor technologies and concepts for increased survivability of fielded systems and assured detection and tracking of combat threats.
  - (U) Complete ground-based evaluations of the 64-channel bistatic ground testbed capability and identify areas which require further development to reduce technical risks of future airborne bistatic technology demonstrations.
  - (U) Complete design of an airborne bistatic testbed.
- (U) $2,519 Develop and demonstrate advanced sensor technologies and concepts for assured detection and tracking of hostile ground targets using multiple off-board sensors.
  - (U) Complete evaluations of high performance computer parallel processing technology applications which employ real-time cueing and correlation techniques to enhance wide area surveillance, time-critical-target detection and tracking.
  - (U) Conduct initial field demonstration tests of real-time signal processor enhancement hardware to perform sensory management, and enhanced/inverse synthetic aperture radar algorithm functions on an operational systems testbed.
- (U) $6,124 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4072

(U) FY 1998 ($ in Thousands):

- (U) $2,986 Develop and demonstrate advanced sensor technologies and concepts for assured detection and tracking of hostile airborne targets using multiple off-board sensors.
  - (U) Develop and assess first generation intelligent techniques that exploit the inherent heuristic knowledge of an operator's cognitive process to pro-actively assimilate dynamic track and intelligence data with a-priori static databases.
  - (U) Integrate active radar identification technology on-board an operational surveillance platform.
  - (U) Develop and assess second generation acoustic analysis algorithms to passively identify hostile targets.
- (U) $996 Develop and demonstrate advanced passive sensor technologies and concepts for increased survivability of fielded systems and assured detection and tracking of combat threats.
  - (U) Integrate and test bistatic airborne testbed.
- (U) $2,859 Develop and demonstrate advanced sensor technologies and concepts for assured detection and tracking of hostile ground targets using multiple off-board sensors.
  - (U) Develop a preliminary real-time airborne design concept which demonstrates the use of all source advanced correlation capability for the detection and tracking of time-critical-targets.
  - (U) Complete test and demonstration of real-time signal processor enhancement hardware running algorithms on operational systems testbed.
- (U) $6,841 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4072

(U) FY 1999 ($ in Thousands):

- (U) $3,058 Develop and demonstrate advanced sensor technologies and concepts for assured detection and tracking of hostile airborne targets using multiple off-board sensors.
  - (U) Develop and assess second generation intelligent techniques that exploit the inherent heuristic knowledge of an operator's cognitive process to pro-actively assimilate dynamic track and intelligence data with a-priori static databases.
  - (U) Complete integration of active radar identification technology on-board an operational surveillance platform before conducting a demonstration and test.
  - (U) Develop and assess third generation acoustic analysis algorithms to passively identify hostile targets for a demonstration on-board an intelligence collection platform.
- (U) $983 Develop and demonstrate advanced passive sensor technologies and concepts for increased survivability of fielded systems and assured detection and tracking of combat threats.
  - (U) Complete bistatic airborne testbed integration and test.
- (U) $2,900 Develop and demonstrate advanced sensor technologies and concepts for assured detection and tracking of hostile ground targets using multiple off-board sensors.
  - (U) Continue design of real-time airborne demonstration of all source advanced correlation capability for the detection and tracking of time-critical targets.
  - (U) Develop teraflop signal processor technology for existing and future operational surveillance platform applications.
- (U) $6,941 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4072

(U) B. **Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	6,914	6,417	6,801	7,220	Cont
(U) Current Budget Submit/FY 1998 PB	6,777	6,124	6,841	6,941	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. **Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0603742F, Combat Identification Technology.
- (U) PE 0603726F, C3 Subsystems Integration.
- (U) PE 0603728F, Advanced Computer Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. **Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 1997
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603789F C3 Advanced Development — PROJECT: 4216

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4216 Warfighter Information Usage, Management, and Integration Technologies	2,367	2,191	1,420	2,441	2,564	2,768	2,834	2,919	Continuing	Continuing

Note: Beginning in FY 1998, PE 0603238F, Global Surveillance and Communications, has been incorporated as Project 4216, Warfighter Information Usage, Management, and Integration Technologies, within this PE. The total PE costs shown for FY 1996 and FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This project will develop, demonstrate, and integrate the advanced technologies (i.e., information management, reachback communications, network and bandwidth management, and communications protocols) required to implement an interoperable, worldwide Information for the Warrior (IFTW) network capable of supporting near real-time multimedia (i.e., voice, data, video, and imagery) multifrequency information exchange between ground and airborne platforms. The IFTW network will provide "reachback" to controlling headquarters, updated information and mission changes, and "in-transit visibility" of the aircraft and cargo status. This program focuses on communications hardware/software, network and information management hardware/software, and transmission systems to provide the warfighter secure, survivable access to information services and the emerging commercial international information network. The IFTW capabilities will be enhanced through the incremental development, demonstration, and integration of advanced information management, airborne and ground communications, network and bandwidth management, communications protocols, and communications transmission systems technologies. It will address interoperation across echelon, Service, and multi-national force boundaries, as well as provide support for mobile command and control, and sensor-to-shooter operations. This program directly responds to user needs as expressed by the Joint Staff (Command, Control, Communications, Computers, and Intelligence for the Warrior), the Air Force (Theater Deployable Communications), Air Mobility Command (Air Mobility Master Plan and Airborne Situational Awareness), and the Defense Information Systems Agency (Far-Term Defense Information Systems Network).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4216

(U) FY 1996 ($ in Thousands):

- (U) $950 Designed, developed, demonstrated, and integrated advanced information management technologies.
  - (U) Completed Information for the Warrior (IFTW) target and information architecture models.
  - (U) Completed IFTW network and information bandwidth requirements analysis.
  - (U) Completed IFTW database management tool design.
- (U) $400 Designed, developed, demonstrated, and integrated advanced airborne and super-high frequency communications technologies.
  - (U) Completed development of operational scenarios.
  - (U) Completed low data rate global candidate evaluation of commercial-off-the-shelf and government-off-the-shelf tools.
  - (U) Completed selection of enhanced ultra-high frequency and super-high frequency commercial equipment.
- (U) $1,017 Designed, developed, demonstrated, and integrated advanced network and bandwidth management and communications protocol technologies.
  - (U) Completed development of knowledge-based rules definitions.
  - (U) Completed development of the "in-transit visibility" mission-based management objective architecture.
  - (U) Completed the development of a top level network model.
  - (U) Completed development of a protocol baseline
- (U) $2,367 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4216

(U) FY 1997 ($ in Thousands):

- (U) $902 Design, develop, demonstrate, and integrate advanced information management technologies.
  - (U) Demonstrate integrated access to multiple operational command data bases and information structures.
  - (U) Demonstrate intelligent retrieval of information from operational command data structures.
  - (U) Develop and integrate capabilities for presentation of a coherent picture of the retrieved data to the user.
- (U) $507 Design, develop, demonstrate, and integrate advanced airborne and super-high frequency communications technologies.
  - (U) Perform the low data rate global communications ground test.
  - (U) Complete the enhanced ultra high frequency and super-high frequency in-flight demonstration of commercial technologies.
  - (U) Perform an improved data processing assessment using the selected global broadcast service equipment suite.
- (U) $782 Design, develop, demonstrate, and integrate advanced network and bandwidth management and communications protocol technologies.
  - (U) Demonstrate a distributed network management system with asynchronous transfer mode functionality.
  - (U) Develop proxy agents and demonstrate interoperability.
  - (U) Develop and demonstrate mission-based management.
  - (U) Develop and demonstrate a mobility management module.
  - (U) Complete the protocols laboratory demonstration.
- (U) $2,191 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4216

(U) FY 1998 ($ in Thousands):

- (U) $680 Design, develop, demonstrate, and integrate advanced information management technologies.
  - (U) Demonstrate an integrated capability for data retrieval, transfer, and presentation to the user.
  - (U) Integrate Information For The Warrior (IFTW) demonstration with information management technologies.
- (U) $405 Design, develop, demonstrate, and integrate advanced airborne and super-high frequency communications technologies.
  - (U) Develop and demonstrate the improved higher data rate data processing demonstration -- global broadcast service integration brassboard.
  - (U) Complete the improved higher data rate data processing demonstration -- global broadcast service in-flight demonstration.
  - (U) Integrate of advanced communications technologies into the IFTW Advanced Technology Demonstration.
- (U) $335 Design, develop, demonstrate, and integrate advanced network and bandwidth management and communications protocol technologies.
  - (U) Develop and demonstrate the network planning module.
  - (U) Integrate network and bandwidth management technologies into the IFTW Advanced Technology Demonstration.
  - (U) Conduct initial integration studies of incorporating new asynchronous transfer mode technology and emerging wireless asynchronous transfer mode techniques into the IFTW operational command environment.
- (U) $1,420 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4216

(U) FY 1999 ($ in Thousands):

- (U) $ 754 Design, develop, demonstrate, and integrate advanced information management technologies.
  - (U) Assess preliminary concept for development and integration of mediation technologies and techniques.
  - (U) Conduct initial application assessment of Information For The Warrior (IFTW) information management technologies to joint task force and international interoperability environments.
- (U) $ 842 Design, develop, demonstrate, and integrate advanced airborne and super-high frequency communications technologies.
  - (U) Conduct ground demonstration of "low-cost" solution for airframe Ku/Ka band electronically steered phased array antenna.
  - (U) Conduct preliminary investigation of "low-cost" solutions for airframe Ku/Ka band electronically steered phased array antenna.
  - (U) Conduct preliminary investigation of future super-high frequency communications systems ability to provide additional in-transit visibility and reachback capabilities.
- (U) $ 845 Design, develop, demonstrate, and integrate advanced network and bandwidth management and communications protocol technologies.
  - (U) Demonstrate advanced asynchronous transfer mode technology in an IFTW operational command environment.
  - (U) Conduct preliminary development of smart agents to transparently route communications through seamless connections throughout the network.
  - (U) Conduct preliminary application assessment of IFTW network and bandwidth management and protocol technologies for joint task force and international interoperability environments.
  - (U) Demonstrate emerging wireless asynchronous transfer mode techniques in an IFTW operational command environment.
- (U) $2,441 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603789F C3 Advanced Development	PROJECT: 4216

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	2,383	2,293	2,204	2,591	Cont
(U) Current Budget Submit/FY 1998 PB	2,367	2,191	1,420	2,441	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to budget constraints and priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.

(U) Related Activities:

- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0603726F, C3 Subsystems Integration.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0208030F WRM Ammunition

PROJECT: 670A

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
670A Ordnance Technology	0	0	0	5,944	0	0	0	0	0	5,944
Quantity of RDT&E Articles	0	0	0	10($25)	0	0	0	0	0	10

(U) A. **Mission Description and Budget Item Justification**

The Hard Target Smart Fuze (HTSF) program satisfies the requirement for a void sensing capability in the Advanced Fuze Family. HTSF is an all-electronic fuze designed for penetrator warheads. Currently, HTSF can operate in void-sensing, layer counting, or depth of penetration detonation modes for BLU-109 warheads. HTSF is also qualified for first void, plus time-detonation for the BLU-113 warhead. This program is in budget activity 4 - Demonstration and Validation, Research Category 6.3B because it funds the development of a Mil-Std-1760 interface, BLU-113 void-sensing/counting algorithms, and sled and flight testing.

(U) FY 1996 ($ in Thousands):
- (U) $0 Total

(U) FY 1997 ($ in Thousands):
- (U) $0 Total

(U) FY 1998 ($ in Thousands):
- (U) $0 Total

(U) FY 1999 ($ in Thousands):
- (U) $ 2,219 Plan, design, develop, and integrate electronic component modules to satisfy desired detonation modes
- (U) $ 2,975 Plan and conduct sled and flight testing
- (U) $ 500 Engineering support
- (U) $ 250 Program office support
- (U) $ 5,944 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0208030F WRM Ammunition	PROJECT 670A

(U) B. **Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	0	0	0	6,000	0
(U) Appropriated Value	0	0	0	0	0
(U) Adjustments to Appropriated Value	0	0	0	0	0
a. Cong Gen Reductions					
b. SBIR					
c. Omnibus or Other Above Threshold Reprogram					
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB				56	5,944
(U) Current Budget Submit/President's Budget				5,944	5,944

(U) Change Summary Explanation:

Funding: Funding provided to develop the BLU-113 void sensing algorithm in the HTSF.

Schedule: N/A

Technical: N/A

(U) C. **Other Program Funding Summary ($ in Thousands)** Not Applicable

(U) D. **Schedule Profile** Not Applicable

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0208030F WRM Ammunition

PROJECT: 670A

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) a. Contractor	0	0	0	2,219
(U) b. Government				
testing	0	0	0	2,975
contractor support	0	0	0	500
management support	0	0	0	250
(U) Total	0	0	0	5.944

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Motorola	T&M	TBD	N/A	N/A	0	0	0	0	2,219	0	2,219
Support and Management Organizations											
TEAS/TEAMS	CP	TBD	N/A	N/A	0	0	0	0	500	0	500
ASC/YHP	CP	TBD	N/A	N/A	0	0	0	0	250	0	250
Test and Evaluation Organizations											
46th Test Wing		TBD	N/A	N/A	0	0	0	0	2,975	0	2,975

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0208030F WRM Ammunition PROJECT 670A

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: Not Applicable

	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development	0	0	0	0	2,219	0	2,219
Subtotal Support and Management	0	0	0	0	750	0	750
Subtotal Test and Evaluation	0	0	0	0	2,975	0	2,975
Total	0	0	0	0	5,944	0	5,944

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603260F Intelligence Advanced Development

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	4,680	4,686	4,738	4,709	4,728	4,655	4,737	4,860	Continuing	TBD
3479 Advanced Sensor Exploitation	864	812	851	838	837	824	868	873	Continuing	TBD
3480 Automated Imagery Exploitation	1,387	1,311	1,374	1,354	1,352	1,329	1,396	1,403	Continuing	TBD
3481 Knowledge Based Tech For Intelligence	1,518	1,437	1,335	1,373	1,381	1,361	1,428	1,446	Continuing	TBD
3482 Science & Tech Intelligence Methodology	911	1,126	1,178	1,144	1,158	1,141	1,045	1,138	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification

(U) Intelligence Advanced Development (IAD) demonstrates and validates advanced technology intelligence systems capabilities and techniques to support tactical and strategic commanders and National Command Authority needs for timely all source intelligence information. (IAD) is composed of four software projects developed for the Air Force at Rome Lab (RL). IAD's projects expand and improve data storage, retrieval and handling capabilities; satisfy needs for near-real-time data processing, exploitation and dissemination from present and future intelligence systems. RL works directly with users, employing a rapid prototyping evolutionary approach, integrating finished modules directly into the field. The programs are oriented toward specific shortfalls and deficiencies as documented by the major commands (MAJCOMS), unified commands, and intelligence organizations in their mission and function area plans. The goal of this program is to expedite technology transition from the laboratory to operational use via rapid prototyping and simulation. The program is in Demonstration and Validation, Budget Activity because it demonstrates and validates advanced technology which enhances intelligence systems capabilities and techniques.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603260F Intelligence Advanced Development

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY97 President's Budget	4,781	4,878	4,947	4,862	TBD
(U) Appropriated Value	5,109	4,878			
U) Adjustments to Appropriated Value					
a. Cong Reductions	-100	-101			
b. Small Business Innovative Research	-116	-91			
c. Omnibus and other Above Threshold Reprogrammings	-162				
d. BTR	-1				
e. Rescissions	-50				
(U) Adjustments to Budget Year Since 1997 PB			-209	-153	
(U) FY 1998/1999 Biennial Budget	4,680	4,686	4,738	4,709	TBD

(U) Change Summary Explanation:

Funding: N/A

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Not Applicable

(U) Related RDT&E:

62720F C3I Exploratory Development: optical storage, speech processing, signals exploitation, data handling, sensor exploitation

63789F C3 Advanced Technology Development: correlation, fusion, signal processing

63726F C3 Subsystem Integration: mass storage, hypermedia database, voice translation, mapping and charting

64750F Intelligence Equipment: modeling and simulation

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Analytical Tools for Targeting Completed				X												
(U) Correlation & Fusion Algorithms Completed				X												
(U) Imagery Exploitation 2000 Conf Man & Application Initiated				X												
(U) Image Aim Point Graphic Completed	X															
(U) Video Digital Exploitation Initiated		X														
(U) Multi-Processor for Imagery/Video Exploitation Initiated		X														
(U) Airborne Range Imagery Algorithm Initiated			X													
(U) Bomb Damage Assessment Completed			X													
(U) Generic Intelligence Processor Completed			X													
(U) Intelligence Analysts Productivity Initiated			X													
(U) Machine Learning Prototype Initiated			X													
(U) Mass Storage System Initiated			X													
(U) Vision Pointer Initiated			X													
(U) Document Content Analysis & Retrieval System Completed				X												
(U) Advanced Intelligence Information System Completed				X												
(U) Applied Deception Techniques Initiated				X												
(U) Intelligence Analysts Associate Initiated				X												

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603260F Intelligence Advanced Development

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Consistent Operational Picture Initiated						X										
(U Enhanced Analytical Tools Initiated						X										
(U) Imagery Exploitation 2000 Conf Man & Applications Completed							X									
(U) Virtual Data Access Initiated							X									
(U) Video Digital Exploitation Completed							X									
(U) Airborne Range Imagery Algorithms Completed							X									
(U) Multi-Level Security for Image Cyphering Initiated							X									
(U) Mass Storage System Completed								X								
(U) Vision Pointer Completed								X								
(U) Multimedia for Information Access Initiated								X								
(U) Intelligence Application Browser Interface Initiated								X								
(U) Multisource Intelligence Notification Systems Prototype Initiated								X								
(U) Predictive Fusion Algorithms Initiated									X							
(U) Multi-Spectral/Hyper Spectral Image Exploitation Initiated										X						
(U) Multi Spectral Data Reduction Algorithms Initiated											X					
(U) Autonomous Management of Integrated Multiple Sensors Initiated												X				
(U) Consistent Operational Picture Completed													X			
(U) Enhanced Analytical Tools Completed														X		
(U) Multi-Processor for Image Exploitation Completed															X	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603260F Intelligence Advanced Development**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Multi Spectral Data Reduction Algorithms Completed																X
(U) Enhancing Intelligence Analysts Productivity Completed																X
(U) Intelligence Application Browser Interfaces Completed																X

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603260F Intelligence Advanced Development

PROJECT: 3479

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3479 Advanced Sensor Exploitation	864	812	851	838	837	824	868	873	Continuing	TBD
Quantity of RDT&E Articles										

(U) A. Mission Description and Budget Item Justification

(U) There is an Air Force and Army need to correlate various sources of intelligence reports (Communications Intelligence - COMINT, Electronic Intelligence - ELINT, Image Intelligence - IMINT) within seconds as opposed to hours with current manual methods. Project includes development of data correlation and predictive intelligence algorithms, target analysis and prioritization, air order of battle updates and tactical analysis techniques. This computerized approach will speed up the correlation of data from diverse sources of intelligence information, including COMINT, ELINT, and IMINT; providing faster situational awareness and threat assessment and replace manual systems with automated capabilities.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development
	PROJECT 3479

(U) FY 1996 ($ in Thousands):
- (U) $ 464 Complete Analytical Tools for Targeting.
- (U) $ 400 Complete Correlation & Fusion Algorithms for predictive intelligence
- (U) $ 864 Total

(U) FY 1997 ($ in Thousands):
- (U) $ 412 Initiate Consistent Operational Picture for global awareness
- (U) $ 400 Initiate Enhanced Analytical Tools for targeting
- (U) $ 812 Total

(U) FY 1998 ($ in Thousands):
- (U) $ 400 Continue Consistent Operational Picture for global awareness
- (U) $ 200 Continue Enhanced Analytical Tools for targeting
- (U) $ 251 Initiate Predictive Fusion Algorithms for predictive intelligence
- (U) $ 851 Total

(U) FY 1999 ($ in Thousands):
- (U) $ 400 Complete Consistent Operational Picture for global awareness
- (U) $ 200 Complete Enhanced Analytical Tools for targeting
- (U) $ 238 Continue Predictive Fusion Algorithms for predictive intelligence
- (U) $ 838 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development PROJECT 3479

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY97 President's Budget	864	846	858	846	TBD
(U) Appropriated Value	886	846			
(U) Adjustments to Appropriated Value					
a. Cong Reductions	-17	-18			
b. Small Business Innovative Research		-16			
c. Omnibus and other Above Threshold Reprogrammings	-9				
(U) Adjustments to Budget Year Since FY 1997 PB			-7	-8	
(U) FY 1998/1999 Biennial Budgets	860	812	851	838	TBD

(U) Change Summary Explanation:

Funding: N/A

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Not Applicable

(U) Related RDT&E:

62720F C3I Exploratory Development: optical storage, speech processing, signals exploitation, information handling, sensor exploitation
63789F C3 Advanced Technology Development: correlation, fusion, signal processing
63726F C3 Subsystem Integration: advanced image/information, advanced optical memory technology
64750F Intelligence Equipment: modeling and simulation

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development
	PROJECT 3479

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Correlation & Fusion Algorithms Delivered				X												
(U) Analytical Tools Delivered				X												
(U) Consistent Operational Picture Awarded						X										
(U) Enhanced Analytical Tools Awarded							X									
(U) Predictive Fusion Algorithms Awarded									X							
(U) Consistent Operational Picture Completed											X					
(U) Enhanced Analytical Tools Completed													X			

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development
	PROJECT 3479

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Correlation & Fusion Algorithms	400			
(U) Analytical Tools	464			
(U) Consistent Operational Picture		412	400	400
(U) Enhanced Analytical Tools		400	200	200
(U) Predictive Fusion Algorithms			251	238
(U) Total	864	812	851	838

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development PROJECT 3479

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Electic Computing Concepts 94-C-0064	CPFF	July 95			625	400	0	0	0	Cont	1,025
Sterling IMD, Inc 95-C-0225	CPFF	Sept 95			52	464	0	0	0	Cont	516
Contractor TBD	TBD	TBD					400	451	400	Cont	1,251
Contractor TBD	TBD	TBD					412	400	438	Cont	1,250

Support and Management Organizations - N/A

Test and Evaluation Organizations - N/A

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: N/A

Subtotal Product Development					677	864	812	851	838		4,042
Subtotal Support and Management											
Subtotal Test and Evaluation											
Total Project					677	864	812	851	838		4,042

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603260F Intelligence Advanced Development

PROJECT: 3480

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3480 Automated Imagery Exploitation	1,387	1,311	1,374	1,354	1,352	1,329	1,396	1,403	Continuing	TBD
Quantity of RDT&E Articles										

(U) A. **Mission Description and Budget Item Justification**

(U) This project demonstrates and validates the capability to more accurately and quickly interpret digital imagery by evaluating computer assisted techniques to manipulate and overlay imagery, cartographic data, signal intelligence (SIGINT), and on line intelligence data. The result of this effort will be more precise target locations and identifications, precise target reference scenes, and more accurate damage assessments; all developed for easy supportability on low cost commercially available computer workstations. This project will also develop data links which can be used to provide digital imagery to theater and tactical units.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development
PROJECT 3480	

(U) FY 1996 ($ in Thousands):
- (U) $ 350 Continue Image Exploitation 2000 Configuration Management and Application in support of imagery exploitation.
- (U) $ 75 Complete Image Aim Point Graphic in support of producing high quality target materials.
- (U) $ 290 Initiate Video Digital Exploitation for freeze frame analysis.
- (U) $ 260 Initiate multi-processor for expediting imagery and video exploitation.
- (U) $ 204 Initiate airborne range imagery algorithm to derive three dimensional geographic locations.
- (U) $ 208 Complete Bomb Damage Assessment techniques
- (U) $1,387 Total

(U) FY 1997 ($ in Thousands):
- (U) $ 448 Complete Image Exploitation (IE) 2000 Configuration Management and Application in support of imagery exploitation.
- (U) $ 145 Initiate Virtual Data Access for Image Exploitation.
- (U) $ 100 Complete Video Digital Image Exploitation for freeze frame analysis.
- (U) $ 375 Continue Multi-processor for Automated Image Exploitation
- (U) $ 134 Complete Airborne Range Imagery Algorithms to derive three dimensional geographic locations.
- (U) $ 109 Initiate Multi-Level Security for Image Cyphering.
- (U) $1,311 Total

(U) FY 1998 ($ in Thousands):
- (U) $ 400 Continue Virtual Data Access for Image Explotation
- (U) $ 300 Continue Multi-processor for Automated Image Exploitation
- (U) $ 300 Initiate Multi Spectral / Hyper Spectral Image Applications for Target Detection & Identification.
- (U) $ 179 Initiate Multi Spectral Data Reduction Algorithms
- (U) $ 195 Initiate Autonomous Management of Integrated Multiple Sensors
- (U) $1,374 Total

(U) FY 1999 ($ in Thousands):
- (U) $ 400 Continue Virtual Data Access for Image Explotation
- (U) $ 300 Complete Multi-processor for Automated Image Exploitation
- (U) $ 300 Continue Multi Spectral / Hyper Spectral Image Applications for Target Detection & Identification.
- (U) $ 160 Complete Multi Spectral Data Reduction Algorithms
- (U) $ 194 Continue Autonomous Management of Integrated Multiple Sensors.
- (U) $1,354 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603260F Intelligence Advanced Development

PROJECT: 3480

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY97 President's Budget	1,387	1,365	1,385	1,366	TBD
(U) Appropriated Value	1,430	1,365			
(U) Adjustments to Appropriated Value					
a. Cong Reductions	-28	-28			
b. Small Business Innovative Research		-26			
c. Omnibus and other Above Threshold Reprogramming	-15				
(U) Adjustments to Budget Year since 1997 PB			-11	-12	
(U) FY 1998/1999 Biennial Budget	1,387	1,311	1,374	1,354	TBD

(U) Change Summary Explanation:

Funding: N/A

Schedule:. N/A

Technical: N/A

(U) **C. Other Program Funding Summary ($ in Thousands)**

(U) Not Applicable

(U) Related RDT&E:

62720F C3I Exploratory Development: optical storage, speech processing, signals exploitation, information handling, sensor exploitation
63789F C3 Advanced Technology Development: correlation, fusion, signal processing
63726F C3 Subsystem Integration: advanced image/information applications, advanced optical memory technology
64750F Intelligence Equipment: modeling and simulation

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development
	PROJECT 3480

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Image Aim Point Graphic Completed				X												
(U) Imagery Exploitation (IE) 2000 Config & Management Awarded						X										
(U) Virtual Data Access Awarded							X									
(U) Video Digital Exploitation Completed							X									
(U) Bomb Damage Assessment Completed				X												
(U) Multi processors for Auto Image Exploitation Completed													X			
(U) Airborne Range Image Algo Completed						X										
(U) Multiple Level Security for Image Cyphering Completed							X									
(U) Multi Spectral / Hyper Spectral Image Applications Awarded									X							
(U) Multi Spectral Data Reduction Awarded									X							
(U) Autonomous Management of Integrated Multiple Sensors Awarded											X					

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development
	PROJECT 3480

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Imagery Exploitation 2000	350	448		
(U) Image Aim Point Graphic	75			
(U) Video Digital Image Exploitation	290	100		
(U) Bomb Damage Assessment Techniques	208			
(U) Multi Processor for Auto Image Exploit	260	375	300	300
(U) Airborne Range Imagery Algorithms	204	134		
(U) Multilevel Security for Image Cyphering		109		
(U) Virtual Data Access		145	400	400
(U) Multi Spectral / Hyper Spectral Image Applications			300	300
(U) Multi Spectral Data Reduction Algorithms			179	160
(U) Autonomous Management of Integrated Multiple Sensors			195	194
(U) Total	1,387	1,311	1,374	1,354

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development — PROJECT 3480

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Synectics 94 C 0127	CPFF	May 94			818	350	32	0	0	1200	2,400
Lockheed 95 C 0127	CPFF	Jan 95			33	75	0	0	0	108	216
TASC 96 C 0036	CPFF	Feb 96			90	290	0	0	0	380	760
Nichols 96 C 0083	CPFF	May 96			0	208	365	418	50	1041	2,082
MTL Systems Inc 96 C 0068	CPFF	Mar 96			0	464	125	0	0	589	1,178
Contractor TBD	TBD	TBD			0	0	489	556	652	Cont.	1,697
Contractor TBD	TBD	TBD			0	0	300	400	652	Cont.	1,352

Support and Management Organizations - N/A

Test and Evaluation Organizations - N/A

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development	PROJECT 3480

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: N/A

Subtotal Product Development	941	1,387	1,311	1,374	1,354	3,318	9,685
Subtotal Support and Management							
Subtotal Test and Evaluation							
Total Project	941	1,387	1,311	1,374	1,354	3,318	9,685

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development PROJECT 3481

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3481 Knowledge Based Tech For Intelligence	1,518	1,437	1,335	1,373	1,381	1,361	1,428	1,446	Continuing	TBD
Quantity of RDT&E Articles										

(U) A. **Mission Description and Budget Item Justification**

(U) This project will reduce manpower and warning times for respective Strategic Command (STRATCOM), Air Combat Command (ACC), Air Force Space Command (AFSPC), Air Intelligence Agency (AIA), and 497th Intelligence Group data handling systems. The development of the analytical aids is based on artificial intelligence techniques. The increased timeliness, efficiency and effectiveness derived will provide warning time and accuracy, allowing national/military authorities a greater range of options to avert, diminish or control a crisis.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development PROJECT 3481

(U) FY 1996 ($ in Thousands):
- (U) $ 279 Complete Generic Intelligence Process Enhancements in support of message handling.
- (U) $ 300 Initiate Enhancing Intelligence Analysts Productivity at AIA.
- (U) $ 300 Initiate Machine learning Prototype, expert system and neural network technologies to support real-time analysis of timelines
- (U) $ 167 Initiate Enhanced Mass Storage System to satisfy the growing need to store and retrieve large digital files representing imagery, charts, maps, text, etc.
- (U) $ 472 Initiate the Vision Pointer application which analyzes collected signals and characterizes signals to differentiates between specific platforms.
- (U) $1,518 Total

(U) FY 1997 ($ in Thousands):
- (U) $ 369 Continue Enhancing Intelligence Analysts Productivity at AIA.
- (U) $ 400 Continue Machine Learning Prototype, expert system and neural network technologies to support real-time analysis of timeliness.
- (U) $ 183 Complete Enhanced Mass Storage System to satisfy the growing need to store and retrieve large digital files representing imagery, charts, maps, text, etc.
- (U) $ 183 Complete the Vision Pointer application which analyzes collected signals and characterizes signals to differentiates between specific platforms.
- (U) $ 240 Initiate Multimedia for information Access for analysts at AIA and users of IPA.
- (U) $ 62 Initiate Intelligence Application Browser Interfaces for analysts at ACC and AIA.
- (U) $1,437 Total

(U) FY 1998 ($ in Thousands):
- (U) $ 360 Continue Enhancing Intelligence Analysts Productivity at AIA.
- (U) $ 390 Continue Machine Learning Timeline Analysis in support of AIA, AFSPC, and STRATCOM.
- (U) $ 380 Continue Multimedia for information Access for analysts at AIA and users of IPA.
- (U) $ 205 Continue Intelligence Application Browser Interfaces for analysts at ACC and AIA.
- (U) $1,335 Total

(U) FY 1999 ($ in Thousands):
- (U) $ 360 Complete Enhancing Intelligence Analysts Productivity at AIA.
- (U) $ 370 Continue Machine Learning Timeline Analysis in support of AIA, AFSPC, and STRATCOM.
- (U) $ 380 Continue Multimedia for information Access for analysts at AIA and users of IPA.
- (U) $ 263 Complete Intelligence Application Browser Interfaces for analysts at ACC and AIA.
- (U) $1,373 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development
	PROJECT 3481

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY97 President's Budget	1,567	1,496	1,517	1,496	TBD
(U) Appropriated Value	1,564	1,496			
(U) Adjustments to Appropriated Value					
a. Cong Reduction	-30	-31			
b. Small Business Innovative Research		-28			
c. Omnibus and other Above Threshold Reprogrammings	-16				
(U) Adjustments to Budget Year since 1997 PB			-182	-123	
(U) FY 1998/1999 Biennial Budget	1,518	1,437	1,335	1,373	TBD

(U) Change Summary Explanation:

Funding: FY98 & 99 reductions due to ZBT for AFMC O & M.

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary ($ in Thousands)

(U)Not Applicable

(U) Related RDT&E:

62720F C3I Exploratory Development: optical storage, speech processing, signals exploitation, data handling, sensor exploitation
63789F C3 Advanced Technology Development: correlation, fusion, signal processing
63726F C3 Subsystem Integration: mass storage, hypermedia database, voice translation, mapping and charting
64750F Intelligence Equipment: modeling and simulation

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development PROJECT 3481

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Generic Intel Processor Delivered		X														
(U) Intel Analyst Productivity Awarded		X														
(U) Machine Learning Prototype Awarded			X													
(U) Enhanced Mass Storage System Awarded			X													
(U) Vision Pointer Initiated				X												
(U) Enhanced Mass Storage System Completed								X								
(U) Vision Pointer Completed								X								
(U) Multimedia Information Access Initiated								X								
(U) Intelligence Application Browser Interfaces Initiated								X								
(U) Intel Analysts Productivity Completed																X
(U) Intelligence Application Browser Interfaces Completed																X

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development
	PROJECT 3481

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Generic Intelligence Process Enhancements	279			
(U) Intelligence Analysts Productivity	300	369	360	360
(U) Machine Learning Prototype	300	400	390	390
(U) Enhanced Mass Storage System	167	183		
(U) Vision Pointer	472	183		
(U) Multimedia for Information Access		240	380	380
(U) Intelligence Applications Browser Interfaces		62	205	263
(U) Total	1,518	1,437	1,335	1,373

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development PROJECT 3481

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Sterling Inc 94 C 009	CPFF	Jul 94			575	279	0	0	0	854	1,708
Harris Corp 94 D 0055	CPFF	Feb 96			0	475	0	0	0	475	950
GTE 96 C 0085	CPFF	May 96			0	406	424	40	0	870	1,740
Booz Allen 96 C 0092	CPFF	Jun 96			0	358	383	309	0	1050	2,100
Contractor TBD	TBD	TBD			0	0	330	586	573	Cont.	1,489
Contractor TBD	TBD	TBD			0	0	300	400	800	Cont.	1,500

Support and Management Organizations - N/A

Test and Evaluation Organizations - N/A

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: N/A

Subtotal Product Development					575	1,518	1,437	1,335	1,373	3,249	9,487
Subtotal Support and Management											
Subtotal Test and Evaluation											
Total Project					575	1,518	1,437	1,335	1,373	3,249	9,487

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1997
BUDGET ACTIVITY: 4 - Demonstration and Validation	PE NUMBER AND TITLE: 0603260F Intelligence Advanced Development		PROJECT: 3482

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3482 Science & Tech Intelligence Methodology	911	1,126	1,178	1,144	1,158	1,141	1,045	1,138	Continuing	TBD
Quantity of RDT&E Articles										

(U) A. **Mission Description and Budget Item Justification**

(U) Demonstrates and validates intelligence methodologies and techniques for operational employment of simulation models in support of Air Intelligence Agency (AIA) requirements. The methods and techniques will help AIA improve their analysis of current and future foreign weapon systems, and prevent technological surprises with regard to the capabilities of these systems. The program is Demonstration and Validation, Budget Activity 4.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development
	PROJECT 3482

(U) FY 1996 ($ in Thousands):
- (U) $ 313 Complete Document Content Analysis and Retrieval System (DCARS) text retrieval system.
- (U) $ 181 Complete option for operational development of the Advanced Intelligence Information System.
- (U) $ 320 Continue Information Warfare Integration to Sensor Ace.
- (U) $ 43 Award Applied Deception Techniques for manipulation deception of foreign signal collection systems.
- (U) $ 54 Award Intelligence Analyst Associate (Build 2) for automated information extraction from text using natural language understanding.
- (U) $ 911 Total

(U) FY 1997 ($ in Thousands):
- (U) $ 410 Continue Applied Deception Techniques for manipulative deception of foreign signal collection systems.
- (U) $ 450 Continue Intelligence Analyst Associate (Build 2) for automated information extraction from text using natural language understanding.
- (U) $ 266 Award Multisource Intelligence Notification Systems (MINS) Prototype.
- (U) $1,126 Total

(U) FY 1998 ($ in Thousands):
- (U) $ 400 Continue Applied Deception Techniques for Manipulative Deception of Foreign Signal Collection Systems
- (U) $ 400 Continue Intelligence Analyst Associate (Build 2) for Automated Information Extraction
- (U) $ 378 Continue Multisource Intelligence Notification Systems (MINS) Prototype.
- (U) $1,178 Total

(U) FY 1999 ($ in Thousands):
- (U) $ 400 Complete Applied Deception Techniques for Manipulative Deception of Foreign Signal Collection Systems
- (U) $ 400 Continue Intelligence Analyst Associate (Build 2) for Automated Information Extraction
- (U) $ 344 Continue Multisource Intelligence Notification Systems (MINS) Prototype.
- (U) $1,144 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development
	PROJECT 3482

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY97 President's Budget	1,226	1,171	1,187	1,154	TBD
(U) Appropriated Value	1,226	1,171			
(U) Adjustments to Appropriated Value					
a. Cong Reductions	-23	-24			
b. Small Business Innovative Research	-116	-21			
c. Omnibus and other Above Threshold Reprogrammings	-126				
d. Rescissions	-50				
(U) Adjustments to Budget Year since 1997 PB			-9	-10	
(U) FY 1998/1999 Biennial Budget	911	1,126	1,178	1,144	TBD

(U) Change Summary Explanation:

Funding: N/A

Schedule: N/A

Technical N/A

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Not Applicable

(U) Related RDT&E:

62720F C3I Exploratory Development: optical storage, speech processing, signals exploitation, data handling, sensor exploitation
63789F C3 Advanced Technology Development: correlation, fusion, signal processing
63726F C3 Subsystem Integration: mass storage, hypermedia database, voice translation, mapping and charting
64750F Intelligence Equipment: modeling and simulation

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603260F Intelligence Advanced Development

PROJECT: 3482

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Advanced Intelligence (AI) Information System Delivered				X												
(U) Document Content Analysis and Retrieval System Delivered				X												
(U) Intel Analyst Associate (Build 2) Awarded			X													
(U) Applied Deception Techniques Awarded		X														
(U) Multisource Intelligence Notification System (MINS) Prototype Awarded							X									
(U) Information Warfare Integration Delivered					X											

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603260F Intelligence Advanced Development	PROJECT 3482

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Advanced Intelligence Information System	181			
(U) Document Content Analysis Retrieval System	313			
(U) Information Warfare for Sensor Ace	320			
(U) Applied Deception Techniques	43	410	400	400
(U) Intelligence Analysts Associate (Build 2)	54	450	400	400
(U) Multisource Intelligence Notofocation System (MINS) Prototype		266	378	344
(U) Total	911	1,126	1,178	1,144

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603260F Intelligence Advanced Development

PROJECT: 3482

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Calspan 93 C 0101	CPFF	Sep 93			959	258	0	0	0	1217	2,434
Questech 94 C 0100	CPFF	May 95			72	300	128	0	0	500	1,000
Calspan 96 C 0108	CPFF	Jun 96			0	353	416	388	30	Cont.	1,187
Contractor TBD	TBD	TBD			0	0	382	490	400	Cont.	1,272
Contractor TBD	TBD	TBD			0	0	200	300	714	Cont.	1,214

Support and Management Organizations - N/A

Test and Evaluation Organizations - N/A

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: N/A

Subtotal Product Development					1,031	911	1,126	1,178	1,144	1,717	7,107
Subtotal Support and Management											
Subtotal Test and Evaluation											
Total Project					1,031	911	1,126	1,178	1,144	1,717	7,107

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603319F Airborne Laser Program

PROJECT: 4269

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4269 Airborne Laser	20,360	54,227	157,136	296,596	322,607	156,670	183,317	444,633	866,300	2,501,846
Quantity of RDT&E Articles	0	0	0	0	0	1*	0	1*	0	2

* Articles not separately priced in contract

(U) A. Mission Description and Budget Item Justification: The Airborne Laser (ABL) Program is an ACAT 1D program which will design, build and test a weapon system to acquire, track and kill Theater Ballistic Missiles (TBMs) in the boost phase. Two contractors are successfully executing the Concept Design phase (FY94-FY97) awarded in May 1994. The program recently awarded the ABL Program Definition and Risk Reduction (PDRR) contract to Boeing (Seattle) team in Nov 96, who will design, fabricate, integrate, and test the ABL design. The PDRR phase began in November 1996 and culminates with a lethality demonstration against a boosting TBM representative target. The PDRR phase will integrate and test all key technologies for a fully operational system, allowing the Air Force to advance to EMD in the FY2003 time frame. This program is in budget activity 4 - Demonstration and Validation since it is a major defense acquisition program which has been authorized to enter PDRR as of the Milestone I, Nov 96.

(U) Acquisition Strategy
(U) Milestone (MS) I decision was Nov 96 authorizing entry into PDRR; MS II for Engineering Manufacturing and Development in FY03; MS III Decision for Production in FY05. Program is designed to demonstrate technical risk reduction achievements at key junctures in the PDRR phase. These will form the basis for two Authority-To-Proceed decisions during PDRR. PDRR culminates with a lethality demonstration against a boosting theater ballistic missile in FY02.

(U) FY 1996 ($ in Thousands):
- (U) $14,400 Continued both contractor Concept Design efforts: hardware/software, risk mitigation, modeling/simulations and specifications
- (U) $5,960 Government environmental impact study; facility utilization, SPO operational support, modeling/simulations and risk reductions
- (U) $20,360 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603319F Airborne Laser Program PROJECT 4269

(U) FY 1997 ($ in Thousands):
- (U) $12,000 Complete both Concept Design contracts
- (U) $29,300 Initiate Boeing PDRR contract effort for design, fabrication, integration, and test. of ABL
- (U) $255 Complete Environmental Impact Analysis contract
- (U) $3,995 FFRDC/SETA support for special studies, simulations and analyses, technical support, risk management, and an independent review team specializing in lasers, aircraft and aircraft integration
- (U) $8,677 In-house support for atmospheric characterization tests, labor, training, Integrated Product Team (IPT) participation, and other government agencies
- (U) $54,227 Total

(U) FY 1998 ($ in Thousands):
- (U) $144,921 Continue Boeing PDRR contract effort for design, fabrication, integration, and test of ABL
- (U) $700 Portion of PDRR funds for minor modification to Birk facility at Edwards AFB by PDRR contractor. Project number FSPM981305
- (U) $4,500 FFRDC/SETA support for special studies, simulations and analyses, technical support, risk management, and an independent review team specializing in lasers, aircraft, and aircraft integration
- (U) $6,965 In-house support for atmospheric characterization tests, labor, training, Integrated Product Team (IPT) participation, and other government agencies
- (U) $50 Government oversight of contractor modification to Birk facility at Edwards AFB. Project number FSPM981305
- (U) $157,136 Total

(U) FY 1999 ($ in Thousands):
- (U) $280,477 Continue Boeing PDRR contract effort for design, fabrication, integration, and test of ABL
- (U) $1,825 Portion of PDRR funds for minor modification to Birk facility at Edwards AFB by PDRR contractor. Project number FSPM981305
- (U) $5,500 FFRDC/SETA support for special studies, simulations and analyses, technical support, risk management, and an independent review team specializing in lasers, aircraft, and aircraft integration
- (U) $8,619 In-house support for atmospheric characterization tests, labor, training, Integrated Product Team (IPT) participation, and other government agencies
- (U) $175 Government oversight of contractor modification to Birk facility at Edwards AFB. Project number FSPM981305
- (U) $296,596 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603319F Airborne Laser Program
	PROJECT 4269

(U) B. **Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	19,954	56,828	96,654	215,404	388,840
(U) Appropriated Value	19,954	56,828			
(U) Adjustments to Appropriated Value					
a. Cong Reductions	-424	-1137			-1561
b. SBIR	-388	-1391			-1779
c. Omnibus or Other Above Threshold Reprogram	-154				-154
d. Below Threshold Reprogramming	1494				1494
e. Recission	-122	-73			-195
(U) Adjustments to Budget Years Since FY1997 PB			60,482	81,192	141,674
(U) Current Budget Submit/President's Budget	20,360	54,227	157,136	296,596	528,319

(U) Change Summary Explanation:

Funding: Added $141,674 over the FYDP to purchase a new 747-400F aircraft in lieu of a used 747-200 for PDRR. This provided cost avoidance in outyears by reducing total number of aircraft to be purchased. In addition, funding was rephased to execute the winning contractor's PDRR approach.

Schedule: No change.

Technical: The Air Force is procuring a new 747-400F aircraft for PDRR testing instead of 747-200 aircraft. This allows commonality between the research and development and production efforts. Both test aircraft can now be refurbished and delivered to ACC in production configuration.

(U) C. **Other Program Funding Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) PE 0603605F Advance Weapons Technology Project 3647 - High Energy Laser Technologies	11,601	11,401	10,021	7,674	7,414	7,570	7,820	8,000	TBD	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603319F Airborne Laser Program
	PROJECT 4269

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Concept Design Review 1		X														
(U) PDRR Request For Proposal Release			X													
(U) Concept Design Review 2					X											
(U) Award PDRR Contract					X											
(U) Flight-weighted Laser Module Demo											X					
(U) Preliminary Design Review											X					
(U) Begin PDRR Aircraft Modification														X		
(U) Lethality Demonstration FY02																
(U) Milestone II FY03																
(U) Milestone III FY05																

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603319F Airborne Laser Program
	PROJECT 4269

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Major Contracts (PDRR contract and Concept Design)	14,400	41,300	145,621	282,302
(U) Support Contracts (Technical Support, Analysis)	4,000	4,250	4,500	5,500
(U) In-House/Misc Support/Salaries/TDY/IPTs	1,960	8,677	7,015	8,794
(U) Total	20,360	54,227	157,136	296,596

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Boeing Defense & Space Group Seattle, WA	CPAF	12 Nov 96	1,117,612	1,117,612	0	0	29,300	145,621	282,302	TBD	1,117,612
Concept Design Contract (Rockwell International, CA)	CPFF	9 May 94	21,595	21,595	8,095	7,200	6,000			0	21,595
Concept Design Contract (Boeing Defense & Space Group, WA)	CPFF	9 May 94	21,589	21,589	7,689	7,200	6,000			0	21,589

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603319F Airborne Laser Program

PROJECT: 4269

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Support and Management Organizations											
Technical Support Contracts					2,096	4,000	4,250	4,500	5,500	TBD	TBD
Government In-House and Other External Support					5,220	1,960	8,477	6,415	4,664	TBD	TBD
Test and Evaluation Organizations											
Air Force Flight Test Center and Air Force Operational Test and Evaluation Center							200	600	4,130	TBD	TBD

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603319F Airborne Laser Program	PROJECT 4269

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: None.

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
Support and Management Property										
Subtotal Product Development				15,784	14,400	41,300	145,621	282,302	TBD	1,160,796
Subtotal Support and Management				7,316	5960	12,727	10,915	10,164	TBD	TBD
Subtotal Test and Evaluation						200	600	4,130	TBD	TBD
Total Project				23,100	20,360	54,227	157,136	296,596	TBD	TBD

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603430F Advanced MILSATCOM

PROJECT: 4050

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4050 Advanced MILSATCOM	29,155	30,453	41,448	59,507	58,507	224,912	497,569	516,599	2,186,780	3,666,604
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification**

Develop and acquire advanced extremely high frequency (EHF) Military Satellite Communications (MILSATCOM) satellites with necessary modifications to the mission control segment for survivable, jam-resistant, worldwide, secure communications for the strategic and tactical warfighter. Advanced EHF satellites will replenish the existing EHF (Milstar) system. It will use standardized spacecraft components which will be launched on a Medium Launch Vehicle (MLV). The Advanced EHF capability will be available for first launch not later than 2006. The activities funded under this program element implement the Secretary of Defense's 1993 MILSATCOM Bottom Up Review decision to field a lower cost, advanced MILSATCOM satellite. This program is in Budget Activity Research Category Demonstration and Validation based on direction from the FY95 Defense Planning Guidance. Acquisition streamlining approaches are being considered for implementation on the Advanced EHF Program. The Advanced EHF Program implements the architecture defined by the DoD Space Architect and directed by the Joint Space Management Board. In previous years, this program element included funds for the advanced SHF satellite; however, that funding has recently been moved to the Global Broadcast Service (GBS) program element, 63854F.

(U) FY 1996
- (U)$ 23,416 Continued validation of advanced EHF technologies.
- (U)$ 4,809 Developed architecture and requirements documentation for the Advanced MILSATCOM system.
- (U)$ 930 Continued basic Program Office support activities for advanced technology program.
- (U)$ 29,155 Total

(U) FY 1997
- (U)$ 14,353 Continue Validation of Advanced EHF Technologies.
- (U)$ 15,100 Initiate Processing Subsystem Engineering Model Program
- (U)$ 1,000 Continue Basic Program Office Support Activities for Advanced Technology Program
- (U)$ 30,453 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603430F Advanced MILSATCOM PROJECT 4050

(U) FY 1998

- (U)$ 4,099 Continue Validation of Advanced EHF Technologies
- (U)$ 36,000 Continue Processing Subsystem Engineering Model Program
- (U)$ 1,349 Continue Basic Program Office Support Activities for Advanced Technology Program
- (U)$ 41,448 Total

(U) FY 1999

- (U)$ 3,889 Continue Validation of Advanced EHF Technologies
- (U)$ 54,700 Continue Processing Subsystem Engineering Model Program
- (U)$ 918 Continue Basic Program Office Support Activities for Advanced Technology Program
- (U)$ 59,507 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget	29,143	31,643	43,311	109,238
(U) Appropriated Value		31,643		
(U) Adjustments to Appropriated Value				
a. Congressional General Reductions		-846		
b. SBIR		-344		
c. Omnibus and Other Above Threshold Reprogram	12			
d. Below Threshold Reprogram				
(U) Adjustments to Budget Years Since FY97 PB			-1,863	-49,731
(U) Current Budget Submit/President's Budget	29,155	30,453	41,448	59,507

(U) Change Summary Explanation:

Funding: Funding reduction in FY99 reflects revised Engineering Model cost estimate and elimination of funding for a military-unique SHF development from this PE. FY98 reduction also reflects termination of analog to digital converter and frequency synthesizer technology project contracts forcing the use of older technology with higher weight and cost.

Schedule: Not Applicable.

Technical: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603430F Advanced MILSATCOM
	PROJECT 4050

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost

(U) Not Applicable.

(U) Related RDT&E:
(U) PE #604479F, Milstar LDR/MDR Satellite Communications
(U) PE #604577N, EHF Satellite Communications
(U) PE#603432F, Polar Satellite Communications Program (Polar Adjunct)

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Technology Project Awards/Renewals		x				x				x				x		
(U) OSD IPT MILSATCOM Review	x															
(U) Start Processing Subsystem Engineering Model							x									
(U) Milestone II - Mid FY00																
(U) DoD MILSATCOM Architecture to JSMB				x												
(U) EHF program EMD Start - Mid FY01																
(U) EHF - First Delivery - FY06																

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603430F Advanced MILSATCOM

PROJECT: 4050

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) MILSATCOM Technology Validation Program	23,416	14,353	4,099	3,889
(U) Processing Subsystem Engineering Model	0	15,100	36,000	54,700
(U) Architecture & Requirements Definition	4,809	0	0	0
(U) Other Government Costs	930	1,000	1,349	918
(U) Total	29,155	30,453	41,448	59,507

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
MIT/LL	MIPR	Feb 95	6,258	6,258	1,900	2,400	2,000	458	0	0	6,758
Lockheed	CPFF	Jan 95	7,604	7,604	1,549	3,787	2,268	0	0	0	7,604
Hughes	CPFF	Jan 95	2,486	2,486	1,870	616	0	0	0	0	2,486
TRW	CPFF	Jan 95	4,850	4,850	1,505	1,903	1,442	0	0	0	4,850
TRW	CPFF	Feb 95	1,071	1,071	1,071	0	0	0	0	0	1,071
HSC/Loral	CPFF	Jan 95	4,777	4,777	1,398	1,798	1,581	0	0	0	4,777
Boeing	CPFF	Jan 95	3,648	3,648	1,272	1,507	869	0	0	0	3,648
TRW	CPFF	Feb 95	2,998	2,998	1,446	1,126	426	0	0	0	2,998
Texas Instruments	CPFF	Jan 95	3,215	3,215	1,043	1,409	763	0	0	0	3,215
MIT/LL	MIPR	Feb 95	3,800	3,800	1,000	1,400	1,200	0	0	0	3,600
Various Tech Proj	Various	Jan 95	29,886	29,886	7,220	7,470	3,804	3,641	3,889	0	26,024
Arch Requirements	Various	Jan 96	4,809	4,809	0	4,809	0	0	0	0	4,809
Engineering Model	Various	TBD	15,100	15,100	0	0	15,100	36,000	54,700	12,000	117,800
Future EMD	TBD	TBD	TBD	TBD	0	0	0	0	0	3,272,535	3,272,535

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)									DATE February 1997		
BUDGET ACTIVITY 4 - Demonstration and Validation					PE NUMBER AND TITLE 0603430F Advanced MILSATCOM						PROJECT 4050
Support and Management Organizations											
Various	Various	2 Qtr 95	N/A	N/A	400	930	1,000	1,349	918	199,832	204,429
Test and Evaluation Organizations											
TBD											
Government Furnished Property:											
None											
Subtotal Product Development					21,274	28,225	29,453	40,099	58,589	3,284,535	3,462,175
Subtotal Support and Management					400	930	1,000	1,349	918	199,832	204,429
Subtotal Test and Evaluation										TBD	TBD
Total Project					21,674	29,155	30,453	41,448	59,507	3,484,367	3,666,604

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603432F Polar Adjunct (Space)

PROJECT: 4052

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Polar Satellite Communications	58,458	59,537	29,585	30,643	14,019	9,737	4,568	497	TBD	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification**

The Program will provide protected communications services to U.S. forces operating in the northern polar region. In 1992, the Milstar program was restructured, and the requirement for Milstar to provide polar coverage was deleted. The Air Force was directed to find a more cost-effective solution to polar requirements. In Oct 94, the DoD identified an immediate need for protected polar communications, and in Jul 95, the Joint Requirements Oversight Council (JROC) validated the Polar MILSATCOM ORD which contained the interim requirements. In July 95, the Defense Acquisition Executive reviewed the Polar program and approved execution of an interim program to place a modified Extremely High Frequency (EHF) payload from the Navy's UHF Follow On (UFO) system onto a host satellite to provide limited requirements satisfaction while pursuing a long term solution. In Aug 96 the Joint Space Management Board (JSMB) addressed that long term solution by approving proposals from the DoD Space Architect to "sustain EHF Polar capability through about 2010 (24 hours)". Accordingly, in FY97 the Air Force is initiating planning and design for a second polar package to be launched in FY02. Air Force planning and costing for polar package number 3 to replenish polar number 1 is underway; funding is not yet included in this PE.

The Polar Satellite Communications Program is in Budget Activity 4, Demonstration and Validation, based on a 30 Mar 95 USD(A&T) memorandum to pursue the interim hosted solution (Interim Polar).

(U) FY 1996 ($ in Thousands):
- (U) $30,458 Continued design, parts procurement, and payload integration efforts for interim payload (Polar package number 1)
- (U) $13,000 Modified host satellite to accommodate the communications payload
- (U) $15,000 Fund integration and test activities during launch delay of host satellite caused by addition of the communications payload
- (U) $58,458 Total

(U) FY 1997 ($ in Thousands):
- (U) $20,831 Complete design, satellite modification, and payload integration and test for the interim payload.
- (U) $38,706 Continue integration and test activities during launch delay of host satellite caused by addition of the communications payload and initiate planning for Polar package number 2.
- (U) $59,537 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603432F Polar Adjunct (Space)
	PROJECT 4052

(U) FY 1998 ($ in Thousands):
- (U) $29,585 Continue Polar package 2 planning and design, procure parts, and develop payload
- (U) $29,585 Total

(U) FY 1999 ($ in Thousands):
- (U) $30,643 Continue Polar package 2 payload development and integration with host vehicle
- (U)$ 30,643 Total

(U) B. Program Change Summary ($ in Thousands)	FY 1996	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget	55,615	62,387	0	0
(U) Appropriated Value		62,387		
(U) Adjustments to Appropriated Value				
(U) a. Congressional General Reductions		-1,306		
(U) b. SBIR		-1,544		
(U) c. Omnibus & other Above Threshold Reprogramming	+23			
(U) d. Below Threshold Reprogramming	+2,820			
(U) Adjustments to Budget Years Since FY97 PB			+29,585	+30,643
(U) Current Budget Submit/President's Budget	58,458	59,537	29,585	30,643

(U) Change summary explanation: FY 98/99 increases add second Polar package.

(U) C. Other Program Funding Summary ($ in Thousands)
PE0302109N Navy SATCOM Ship Terminals.

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Launch Hosted Interim Payload (Polar Package 1)								X								
Polar Package 2 to be launched in FY02																

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603432F Polar Adjunct (Space) — PROJECT 4052

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Interim (Polar 1) Payload and Integration	30,458	20,831		
(U) Host Modifications for Interim (Polar 1)	13,000			
(U) Polar Package 1 Integration/Test During Launch Delay	15,000	38,706		
(U) Polar Package 2 Development and Integration			29,585	30,643
(U) Total	58,458	59,537	29,585	30,643

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Classified	Classified	June 95	Continuing	Continuing	14,999	58,458	59,537	29,585	30,643	TBD	TBD
Support and Management Organizations N/A											
Test and Evaluation Organizations N/A											
Government Furnished Property:											
Product Development Property - N/A											
Support and Management Property - N/A											
Test and Evaluation Property - N/A											
Subtotal Product Development					14,999	58,458	59,537	29,585	30,643	TBD	TBD
Subtotal Support and Management											
Subtotal Test and Evaluation											
Total Project					14,999	58,458	59,537	29,585	30,643	TBD	TBD

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)

PROJECT: 4056

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4056 National Polar-orbiting Operational Env. Sat. Syst.	17,371	27,668	51,504	113,234	125,088	183,940	290,300	333,821	TBD	TBD
Quantity of RDT&E Articles	0	0	0	0	0	1*	0	0	0	0

Note: $7,374 prior year funding.
* Initiation of spacecraft build activities.

(U) A. **Mission Description and Budget Item Justification**

The National Performance Review (NPR) and subsequent Presidential Decision Directive/NSTC-2 (May 1994) direct the Departments of Defense (DoD) and Commerce (DOC) and the National Aeronautics and Space Administration to establish a converged national weather satellite program. The converged program, called the National Polar-orbiting Operational Environmental Satellite System (NPOESS), will combine the follow-on to the DoD's DMSP program and the DOC's Polar-orbiting Operational Environmental Satellite (POES) program. An integrated tri-agency program office was established on 1 Oct 94 to manage the acquisition and operations of the converged satellite. PE #603434F funding reflects the DoD's share of the converged program funding. NPOESS will provide operational military commanders and civilian leaders timely, quality weather information to effectively employ weapon systems and protect national resources. The converged program will be the nation's single source of global weather data for operational DoD and DOC use. It will provide visible and infrared cloud cover imagery and other meteorological, oceanographic, and solar-geophysical information. At least three satellites will be required in sun synchronous 450 nm polar orbit at all times (sun synchronous means the satellites cross the equator at the same local sun time on each of their 14 orbits/day). This PE is in Budget Activity 4 (Demonstration and Validation) because it currently supports preparation for DoD/DOC convergence Program Definition and Risk Reduction efforts.

(U) FY 1996

- (U) $3,786 Support Program Definition and Risk Reduction in preparation of Milestone I review.
- (U) $8,275 Conduct Government-led risk reduction and technology development efforts.
- (U) $5,310 Converge command, control and communications for DMSP and POES at Suitland, MD, and begin NPOESS system architecture studies.
- (U)$17,371 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)
	PROJECT 4056

(U) FY 1997

–	(U) $ 3,200	Continue to support Program Definition and Risk Reduction efforts.
–	(U) $ 4,700	Continue system architecture studies.
–	(U) $ 9,700	Continue Government-led risk reduction and technology development efforts.
–	(U) $ 10,068	Conduct Milestone I Review, begin critical sensor and algorithm development with multiple contractors.
–	(U) $ 27,668	Total

(U) FY 1998

–	(U) $ 2,400	Continue to support Program Definition and Risk Reduction efforts.
–	(U) $ 4,800	Continue system architecture studies.
–	(U) $ 8,500	Continue Government-led risk reduction and technology development efforts.
–	(U) $ 35,804	Continue critical sensor/algorithm development efforts, and begin fabrication of sensors for risk reduction flights on DMSP and POES.
–	(U) $ 51,504	Total

(U) FY 1999

–	(U) $ 2,500	Continue to support Program Definition and Risk Reduction efforts.
–	(U) $ 4,900	Complete system architecture studies.
–	(U) $ 9,400	Continue Government-led risk reduction and technology development efforts.
–	(U) $ 91,034	Continue critical sensor development and fabrication for risk reduction flights.
–	(U) $ 5,400	Compete system definition contracts with multiple contractors.
–	(U) $113,234	Total

Department of Commerce (DOC) and Department of Defense (DoD) are funding NPOESS equally, by year, in FY97 and FY98.
This exhibit addresses only the DoD funding.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)
	PROJECT 4056

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget	17,691	34,024	53,320	184,669
(U) Appropriated Value		29,000		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions		-607		
b. SBIR		-725		
c. Omnibus or Other Above Threshold Reprogram	-320			
d. Below Threshold Reprogramming				
(U) Adjustments to Budget Years Since FY97 PB			-1,816	-71,435
(U) Current Budget Submit/President's Budget	17,371	27,668	51,504	113,234

(U) Change Summary Explanation:

Funding: Adjustments in 1998 to better align funding with program execution and revised inflation estimate. Adjustments in 1999 due to EXCOM approved program restructure and revised inflation estimate.

Schedule: Schedule adjustments for PDRR and subsequent milestones were made to allow the Integrated Program Office (IPO) to focus on sensor and ground system development early in phase I. Government led efforts to reduce risk and better define user requirements, system alternatives and architecture options will allow the IPO to efficiently execute the overall program. The EXCOM approved system restructure postponed Milestone I from April 1996 to March 1997. The first satellite need date was adjusted 25 months from late 2004 to 2007 based upon a reassessment of the health of current assets and the opportunity to reduce risk with this new acquisition strategy.

Technical: Restructured the program to develop selected NPOESS sensors earlier than the rest of the NPOESS satellite. Some of these sensors may be flown on DMSP and POES to reduce risk for NPOESS.

(U) C. Other Program Funding Summary ($ in Thousands)

Not Applicable.

Related RDT&E:

(U) PE #305160F, Defense Meteorological Satellite Program (DMSP)

(U) PE #305160N, DMSP (Navy funds, provided for Service specific studies)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)
	PROJECT 4056

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Integrated Operational Requirements Document I (IORD-1) Approved			X													
(U) Milestone 1 Review						X										
(U) Request for Proposal						X										
(U) Sensor and Algorithm Risk Reduction Contract Awards								X								
(U) Begin Fabrication for Risk Reduction Flights											X					
(U) Complete System Architecture Studies														X		
(U) Award NPOESS System Definition Contracts															X	

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)** PROJECT **4056**

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) System Architecture Studies and C3	5,310	4,700	4,800	4,900
(U) Government Led Risk Reduction/ Technology efforts	8,275	9,700	8,500	9,400
(U) Program Definition and Risk Reduction contracts/ Program Support	3,786	13,268	38,204	98,934
(U) Total	17,371	27,668	51,504	113,234

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Martin-Marietta*	C/CPAF	2QFY95*	0*	0*	0*					0*	0*
Lockheed	C/CPAF	2QFY95	4,489	4,489	4,489						4,489
*DOC funded contract total of $4.4M											
System Architecture & C3	C/CPFF	Sep 96	N/A	19,710	0	5,310	4,700	4,800	4,900	0	19,710
Program Definition and Risk Reduction	TBD	3QFY97	TBD	201,906	0	0	10,068	35,804	96,434	59,600	201,906
Gov't Led Studies	Gov. Orgs.	MISC.	TBD	46,250	275	8,275	9,700	8,500	9,400	10,100	46,250

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)

PROJECT: 4056

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Support and Management Organizations											
Integrated Program Office (IPO) Support	MISC.	MISC.	MISC.	MISC.	2,610	3,786	3,200	2,400	2,500	59,400	73,896
Test and Evaluation Organizations											
TBD										TBD	TBD

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property:

Not Applicable.

Subtotal Product Development*	4,764	13,585	24,468	49,104	110,734	TBD	TBD
Subtotal Support and Management	2,610	3,786	3,200	2,400	2,500	59,400	73,896
Subtoal Test and Evaluation							
Project Total	7,374	17,371	27,668	51,504	113,234	TBD	TBD

* Includes all program phases

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603441F Space Based IR Arch (Dem/Val) (Space)

COST (*In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	249,436	237,532	222,401	126,485	94,417	94,428	0	0	0	1,323,103
0007 SBIRS Low	233,825	230,747	219,441	126,485	94,417	94,428	0	0	0	1,292,547
0008 Cobra Brass	15,611	6,785	2,960	0	0	0	0	0	0	30,556
Quantity of RDT&E Articles	0	0	0	3	0	0	0	0		

Note: EMD activities are reflected in PE#604441F.
FY97 includes $3.7M that will be re-programmed to PE #604441F to continue MSTI on-orbit operations and program support.
For FY97 $3.99M will be reprogrammed from SBIRS Low (BPAC 640007) to Cobra Brass (BPAC 640008) but not reflected in above numbers.

(U) A. Mission Description and Budget Item Justification

(U) The purpose is to develop a system to provide increased performance to meet requirements in US Space Command's Capstone Requirements Document. The system's primary mission is to provide initial warning of a ballistic missile attack on the US, its deployed forces or its allies. The Space-Based InfraRed System (SBIRS) will incorporate new technologies that would enhance detection, improve reporting of ICBM, SLBM and tactical ballistic missiles, and provide critical mid-course tracking and discrimination data for national and theater missile defense. The system will consist of satellites in Geosynchronous Orbits (GEO), Highly Elliptical Orbits (HEO) and Low Earth Orbits (LEO) and an integrated, centralized ground station serving all space elements of the SBIRS system, as well as the Defense Support Program (DSP). PE #305911F funds DSP and PE #604441F funds SBIRS Engineering and Manufacturing Development activities.

(U) This PE funds the SBIRS Demonstration/Validation activities: SBIRS Low and Cobra Brass (CB). SBIRS Low is the Dem/Val effort for the LEO component of SBIRS; CB will provide data primarily for DIA/CMO, and secondarily for the GEO and HEO components. This program is in the Budget Activity 4, Demonstration and Validation, because it funds the risk reduction and an advanced technology demonstration system.

(U) Acquisition Strategy:

(U) The SBIRS program is managed through a single consolidated System Program Office (SPO) at the Space and Missile Systems Center, Los Angeles Air Force Base, CA. The SBIRS Low Flight Demonstration System (FDS) acquisition plan was approved in Aug 92. The Flight Demonstration System (FDS) contract was awarded to TRW in May 95, and the two FDS satellites are scheduled to be launched in FY99. In order to maintain competition for the EMD phase of the program, a second Dem/Val contract was competitively awarded (3 Sep 96) to Boeing to work on an alternative design concept and to demonstrate that concept on orbit in FY99.

(U) Cobra Brass, a sensor to explore the utility of staring, fast framing, multi-spectral electro-optical sensors for Theater Missile Defense (TMD), Technical Intelligence (TI), and Battlespace Characterization (BSC) missions is currently being developed by Sandia National Laboratory, Albuquerque, NM. The CB will be flown on a classified host satellite.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603441F Space Based IR Arch (Dem/Val) (Space)

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY97 PB)	199,663	120,151	122,212	131,254
(U) Appropriated Value		249,151		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions/adds		-5,793		
b. SBIR		-5,826		
c. Omnibus or Other Above Threshold Reprogram	49,773			
d. Below Threshold Reprogramming				
(U) Adjustments to Budget Years Since FY97 PB			100,189	-4,769
(U) Current Budget Submit/President's Budget	249,436	237,532	222,401	126,485

(U) Change Summary Explanation:

Funding: FY96-98 increases fund a competitive SBIRS Low Altitude Demonstration System (LADS), and a more robust Flight Demonstration System (FDS) test program.

FY97 decreases fund Congressionly mandated general reductions.

FY99 decrease reflects an earlier-than-planned transition of SBIRS Low from the Dem/Val phase to the pre-EMD phase to support National Missile Defense.

Schedule: No Changes

Technical: No Changes

(U) C. Other Program Funding Summary ($ in Thousands)

Not applicable

Related RDT&E:

(U) PE #604441F - SBIRS EMD

(U) PE #305911F - DSP

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603441F Space Based IR Arch (Dem/Val) (Space)

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) SBIRS Low FDS Preliminary Design Review (PDR)	X															
(U) SBIRS Low FDS Critical Design Review (CDR)					X											
(U) Cobra Brass Launch (classified)																
(U) SBIRS Low FDS Launch															X	
(U) SBIRS Low LADS Flight Rediness Review (FRR)													X			
(U) SBIRS Low LADS Launch															X	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603441F Space Based IR Arch (Dem/Val) (Space)

PROJECT: 0007

COST (*In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
0007 SBIRS Low	233,825	230,747	219,441	126,485	94,417	94,428	0	0	0	1,292,547
Quantity of RDT&E Articles				3						

Note: $3.99M was moved from SBIR Low (BPAC 640007) to Cobra Brass (BPAC 640008) but not reflected in above numbers.

(U) A. Mission Description and Budget Item Justification

(U) SBIRS Low represents the Low Earth Orbit (LEO) component of the Space Based InfraRed System (SBIRS). The objective SBIRS LEO constellation of Low-earth orbiting satellites will provide global, below- and above-the-horizon access to strategic and tactical ballistic missiles in boost, post-boost, and midcourse phases of flight, and also track missile targets during reentry. LEO will support the four SBIRS mission areas of Missile Warning, Missile Defense, Technical Intelligence, and Battle Space Characterization.

(U) Acquisition Strategy:

(U) The GEO component of the SBIRS program is a pilot for acquisition streamlining. For the GEO component, the traditional Defense Acquisition Board (DAB) documentation for an ACAT ID program was consolidated into a Single Acquisition and Management Plan (SAMP).

(U) While SBIRS Low and Cobra Brass are part of the overall SBIRS, there are on-going contracts for each of these efforts. The SBIRS Low Flight Demonstration System (FDS) acquisition plan was approved in Aug 92. The streamlined acquisition program established by the SBIRS GEO component pre-EMD phase will be used by SBIRS Low when it enters EMD. The existing SBIRS Single Acquisition Management Plan (SAMP) will be updated to reflect the LEO component.

(U) The developing organization for the SBIRS Low FDS satellites is the Air Force Space and Missile Center, Los Angeles AFB, CA. On 2 May 95, the FDS flyer contract was awarded to TRW, Redondo Beach, CA, to design and build two FDS satellites to be launched in FY99. Boeing North America, formerly Rockwell International Space Systems Division, Downey, CA, was awarded an FDS non-flyer contract. On 3 Sep 96, Boeing North America, Downey, CA, was awarded a competitive Dem/Val contract as well.

(U) The FDS Non-flyer contract with Boeing was terminated in Dec 1996 in favor of the competitive Dem/Val contract

(U) Pre-EMD activities will begin in late FY99 with up to two pre-EMD study contracts. The purpose of pre-EMD is to develop specifications and designs for the SBIRS LEO EMD phase. This period will be used to re-optimize the SBIRS HEO, GEO, LEO constellations and to revalidate the AFSPC Operational Requirements Document. Pre-EMD contractors will compete for an EMD contract to be awarded in FY01. The same streamlined acquisition approach being used currently for the GEO EMD will be used as a baseline for the LEO EMD. First launch of the operational constellation will occur in FY04.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603441F Space Based IR Arch (Dem/Val) (Space)
	PROJECT 0007

(U) FY 1996 ($ in Thousands)

- (U) $96,862 Continue SBIRS Low FDS satellite and ground segment development.
- (U) $2,370 Continue work for non-flying contractor.
- (U) $20,000 Add Long Wave Infrared (LWIR) to FDS
- (U) $65,000 Schedule Recovery
- (U) $10,000 LEO Tech Risk Mitigation
- (U) $13,249 Program office activities.
- (U) $1,700 Space-Based Visible (SBV)
- (U) $9,644 Simulation, Discrimination, and computer support.
- (U) $15,000 Low Altitude Demonstration System (LADS)
- (U) $233,825 Total

(U) FY 1997 ($ in Thousands)

- (U) $104,164 Continue SBIRS Low FDS satellite and ground segment development.
- (U) $96,600 Low Altitude Demonstration System (LADS)
- (U) $4,400 Technologies
- (U) $13,293 Program office activities.
- (U) $1,400 Space-Based Visible (SBV)
- (U) $3,200 Simulation, Discrimination, and computer support.
- (U) $3,700 Transfer to PE #604441F
- (U) $3,990 Transfer to BPAC 640008, Cobra Brass
- (U) $230,747 Total

(U) FY 1998 ($ in Thousands)

- (U) $108,521 Continue SBIRS Low FDS satellite and ground segment development
- (U) $84,900 Low Altitude Demonstration System (LADS)
- (U) $10,000 Technologies
- (U) $12,700 Program office activities.
- (U) $3,320 Simulation, Discrimination, and computer support.
- (U) $219,441 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603441F Space Based IR Arch (Dem/Val) (Space)
	PROJECT 0007

(U) FY 1999 ($ in Thousands)

- (U) $51,100 Continue SBIRS Low FDS satellite and ground segment development
- (U) $35,800 Low Altitude Demonstration System (LADS)
- (U) $10,000 Technologies
- (U) $15,000 Targets
- (U) $13,185 Program office activities.
- (U) $1,400 Simulation, Discrimination, and computer support.
- (U) $126,485 Total

(U) B. Program Change Summary ($ in Thousands)	FY 1996	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY97)	184,052	113,221	119,227	131,254
(U) Appropriated Value		242,221		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions/adds		-5,648		
b. SBIR		-5,826		
c. Omnibus or Other Above Threshold Reprogram	49,773			
d. Below Threshold Reprogramming				
(U) Adjustments to Budget Years Since FY97 PB			100,214	-4,769
(U) Current Budget Submit/President's Budget	233,825	230,747	219,441	126,485

(U) Change Summary Explanation:

Funding: FY96-98 increases fund a competitive SBIRS Low Altitude Demonstration System (LADS), and a more robust Flight Demonstration System (FDS) test program.

FY97 decreases fund Congressionally mandated general reductions

FY99 decrease reflects the earlier-than-planned transition of SBIRS Low from the Dem/Val phase to the pre-EMD phase to support National Missile Defense.

Schedule: Not Applicable

Technical: Not Applicable

(U) C. Other Program Funding Summary ($ in Thousands)

Not Applicable

Related RDT&E:

(U) PE #604441F - SBIRS EMD

(U) PE #305911F - DSP

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 1997
BUDGET ACTIVITY: 4 - Demonstration and Validation	PE NUMBER AND TITLE: 0603441F Space Based IR Arch (Dem/Val) (Space) — PROJECT: 0007

(U) **D. Schedule Profile**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) SBIRS Low FDS PDR	X															
(U) SBIRS Low FDS CDR					X											
(U) SBIR Low FDS Launch															X	
(U) LADS Flight Rediness Review (FRR)													X			
(U) LADS Launch															X	

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603441F Space Based IR Arch (Dem/Val) (Space)

PROJECT: 0007

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FDS satellite and ground segment	$96,862	108,154	108,521	51,100
(U) Non-flying contractor	2,370	0	0	0
(U) Add LWIR to FDS	20,000	0	0	0
(U) Schedule Recovery	65,000	0	0	0
(U) Technologies	10,000	4,400	10,000	10,000
(U) Program office activities	13,249	13,293	12,700	13,185
(U) Space-Based Visible (SBV)	1,700	1,400	0	0
(U) Sim., Discrim., & computer support	9,644	3,200	3,320	1,400
(U) Targets	0	0	0	15,000
(U) Low Altitude Demonstration System	15,000	100,300	84,900	35,800
(U) Total	233,825	230,747	219,441	126,485

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
FDS - TRW*	CPAF	May 95	521,114	513,114	156,624	185,239	91,600	105,000	43,600	28,200	610,263
SETA Support	Various	Various				1,504	1,664	1,364	1,364	2,728	8,624
SPO Support	N/A	N/A				11,731	11,628	11,290	11,765	25,100	71,514
Misc. Contracts	Various	Various				9,981	19,055	10,187	29,356	112,117	180,696
Non-Flyer - RI	CPAF	May 95	130,643	130,643	128,273	2,370	0	0	0	0	130,643
LADS - Boeing	CPAF	Sep 96	TBD	TBD	0	15,000	98,400	83,600	32,000	2,700	231,700
* EAC does not include award fee and performance incentive											
Support and Management Organizations											
Aerospace		Various			8,307	8,000	8,400	8,000	8,400	18,000	59,107

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)											DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation				PE NUMBER AND TITLE 0603441F Space Based IR Arch (Dem/Val) (Space)							PROJECT 0007
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Test and Evaluation Organizations											
Not Applicable											

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: Not Applicable.

Subtotal Product Development	284,897	225,825	222,347	211,441	118085	170,845	1,233,440
Subtotal Support and Management	8,307	8,000	8,400	8,000	8,400	18,000	59,107
Subtotal Test and Evaluation	0	0	0	0	0		
Total Project	293,204	233,825	230,747	219,441	126,485	188,845	1,292,547

Note: Where applicable, totals do not include funds previous to FY95 which all came from outside this PE

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603441F Space Based IR Arch (Dem/Val) (Space)

PROJECT: 0008

COST (*In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
0008 Cobra Brass	15,611	6,785	2,960	0	0	0	0	0	0	30,556
Quantity of RDT&E Articles										

(U) A. Mission Description and Budget Item Justification

(U) The Cobra Brass (CB) Program is a DIA/CMO (Central MASINT Office) Research and Development program to explore the utility of staring, fast framing, multi-spectral electro-optical sensors. Cobra Brass is a sensor package designed by the Sandia National Laboratory to fly on a classified host satellite. CB has been combined into the SBIRS program as a result of the Feb 95 DAE review. This approach represents a significant departure from the traditional approach of scanning, slow framing, single band sensors which have traditionally been used for Tactical Warning and Attack Assessment (TW/AA).

(U) Previous CB sensors have demonstrated the ability of this technology to contribute to both the Theater Missile Defense (TMD), Technical Intelligence (TI), and Battlespace Characterization (BSC) missions. A major emphasis of this program will be to increase the timeliness of sensor tasking and reporting. This will allow CB data to be processed in real-time through the existing theater infrastructure. CB will also support the GEO and HEO component of the SBIRS.

(U) FY 1996 ($ in Thousands)
- (U) $11,211 Payload.
- (U) $1,000 Test Unit.
- (U) $2,900 Ground Station Build.
- (U) $500 Satellite Integration & Checkout
- (U) $15,611 Total

(U) FY 1997 ($ in Thousands)
- (U) $5,175 Payload.
- (U) $1,500 Satellite Integration & Checkout.
- (U) $4,100 Ground Station Build.
- (U) -$3,990 To be transfered from BPAC 0007, SBIRS Low
- (U) $6,785 Total

(U) FY 1998 ($ in Thousands)
- (U) $2,960 Ground Station testing.
- (U) $2,960 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603441F Space Based IR Arch (Dem/Val) (Space)
	PROJECT 0008

(U) FY 1999 ($ in Thousands)
- (U) $0 Not applicable

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget	15,920	6,930	2,985	0
(U) Appropriated Value	15,920	6,930		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions	-309	-145		
b. SBIR				
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
(U) Adjustments to Budget Years Since FY97 PB			-25	
(U) Current Budget Submit/President's Budget	15,611	6,785	2,960	0

(U) Change Summary Explanation:
Funding: Not Applicable
Schedule: Not Applicable
Technical: Not Applicable

(U) C. Other Program Funding Summary ($ in Thousands): Not Applicable

Related RDT&E:
(U) PE #604441F - SBIRS EMD
(U) PE #305911F - DSP

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Payload Consent to Ship Decision						X										
(U) Grd Station Build 1 Testing Complete at Sandia								X								
(U) Grd Station Build 1 Installed at Ground Site								X								

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603441F Space Based IR Arch (Dem/Val) (Space)
	PROJECT 0008

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) CB Launch (classified)																

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603441F Space Based IR Arch (Dem/Val) (Space)

PROJECT: 0008

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Payload	11,211	5,175	0	
(U) Ground Station	2,900	4,100	2,985	
(U) Test Unit	1,000	0	0	
(U) Satellite I&CO	500	1,500	0	
(U) Adjustment		-3,990	-25	
(U) Total	15,611	6,785	2,960	0

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Sandia Nat'l Labs	Various	Various			5,200	15,611	10,775	2,960	0	0	30,556
Support and Management Organizations											
Not Applicable											
Test and Evaluation Organizations											
Not Applicable											

Government Furnished Property: Not Applicable

Subtotal Product Development	5,200	15,611	10,775	2,960	0	0	30,556
Subtotal Support and Management	0	0	0	0	0	0	
Subtotal Test and Evaluation	0	0	0	0	0	0	
Adjustment			-3,990				
Project Total	5,200	15,611	6,785	2,960	0	0	30,556

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603617F Command Control & Communications Applications

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	6,041	4,179	7,650	7,926	8,170	8,279	8,438	8,631	Continuing	TBD
2314 Tactical Air Surveillance	1,003	1,014	803	457	469	474	480	489	Continuing	TBD
2317 Tactical Air Information Production & Distribution	1,383	530	2,808	3,142	3,233	3,275	3,341	3,418	Continuing	TBD
2321 Tactical Battle Information Management	3,394	2,385	3,894	4,118	4,237	4,295	4,369	4,469	Continuing	TBD
3804 Tactical Air Forces Systems Integration	261	250	145	209	231	235	248	255	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification:

This program is designed to rapidly transition development efforts in the science and technology base directly to warfighting commands. Projects are directly responsive to operational requirements for improved battle management, communications, theater missile defense (TMD), and surveillance capability. Takes advantage of advanced technology developments throughout the services and industry as well as off-the-shelf technology. The program also defines system architectures and develops communications technology for modernization and improving the Air Force portion of the Tri-Service communications networks which the Defense Information Systems Agency (DISA) oversees. This research is in Category 4, Demonstration and Validation, because its products are primarily advanced development models, rapid prototype efforts, and software developed through evolutionary acquisition methods.

(U) Acquisition Strategy:

All major contracts within this Program Element were awarded after full open competition. (When restricted technologies are involved, foreign competition is not allowed.) Most contracts are of the cost plus fixed fee (CPFF) type, but when it is deemed appropriate by procurement officials, award fee contracts or firm-fixed price contracts are utilized.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications

(U) B. **Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY 1997 President's Budget	6,437	4,378	7,941	8,164	TBD
(U) Appropriated Value	6,437	4,378			
(U) Adjustments to Appropriated Value					
a. Congressional Reductions	-161	-114			
b. Small Business Innovative Research	-110	-85			
c. Omnibus/Other Above Threshold Reprogramming	-124				
d. Below Threshold Reprogramming	-1				
(U) Adjustments to Budget Years Since FY 1997 PB			-291	-238	
(U) FY 1998/1999 Biennial Budget	6,041	4,179	7,650	7,926	TBD

(U) Change Summary Explanation:

Funding: See individual projects.

Schedule: N/A

Technical: See individual projects.

(U) C. **Other Program Funding Summary ($ in Thousands)** - See individual projects.

(U) D. **Schedule Profile** - See individual projects.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603617F Command Control & Communications Applications** PROJECT **2314**

COST *($ In Thousands)*	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2314 Tactical Air Surveillance	1,003	1,014	803	457	469	474	480	489	Continuing	TBD

(U) A. **Mission Description and Budget Item Justification** Develops advanced technology and demonstrates equipment improvements to the Theater Air Control System (TACS) ground surveillance radars. Investigates non-radar and/or adjunct radar sensors to address the Combat Air Forces (CAF) surveillance, detection, and tracking requirements not satisfied by an active radar. Develops advanced surveillance technology in support of next generation sensors and sensor signal processing.

(U) FY 1996 ($ in Thousands):
- (U) $1,003 Continue development of tube based transmitter panel for AN/TPS-75.
- **(U) $1,003 Total**

(U) FY 1997 ($ in Thousands):
- (U) $ 232 Complete tube based transmitter panel for AN/TPS-75.
- (U) $ 60 Initiate and complete tube based transmitter panel performance evaluation.
- (U) $ 11 Initiate and complete analysis of solid state versus tube based transmitter for AN/TPS-75 Radar Set
- (U) $ 515 Initiate waveform and signal processor design and evaluation.
- (U) $ 196 Initiate development of Radar Siting Tool for Tactical Surveillance Radar
- **(U) $1,014 Total**

(U) FY 1998 ($ in Thousands):
- (U) $ 90 Initiate Track Before Detect for Theater Missile Defense (TMD) with adaptive elevation angle estimation
- (U) $ 103 Initiate Mode S integration study for AN/TPS-75 Radar Set
- (U) $ 75 Complete development of Radar Siting Tool for Tactical Surveillance Radar
- (U) $ 535 Complete waveform and signal processor design and evaluation
- **(U) $ 803 Total**

(U) FY 1999 ($ in Thousands):
- (U) $ 457 Continue Track Before Detect for TMD
- **(U) $ 457 Total**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603617F Command Control & Communications Applications

PROJECT: 2314

(U) B. **Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY 1997 President's Budget	998	1,057	810	461	TBD
(U) Appropriated Value	1,039	1,057			
(U) Adjustments to Appropriated Value					
a. Congressional Reductions	-20	-22			
b. Small Business Innovative Research		-21			
c. Omnibus/Other Above Threshold Reprogramming	-16				
(U) Adjustments to Budget Years Since FY 1997 PB			-7	-4	
(U) FY 1998/1999 Biennial Budget	1,003	1,014	803	457	TBD

(U) Change Summary Explanation:

Funding: N/A

Schedule: N/A

Technical: Radar Siting Tool, Mode S, and Track Before Detect for TMD developments added as next highest priority activities planned.

(U) C. **Other Program Funding Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) RDT&E, AF (0602204F, Project 2002)	8,682	8,784	10,046	9,529	9,314	10,863	10,344	10,598	Cont	TBD
(U) RDT&E, AF (0603789F, Project 4072)	6,777	6,124	6,841	6,941	7,146	7,917	7,846	8,051	Cont	TBD
(U) RDT&E, AF (0207412)	535	590	393	440	487	471	460	451	Cont	TBD
(U) Other Procurement, AF (0207412)	17,633	9,947	28,178	26,516	24,973	19,860	20,845	20,925	Cont	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications PROJECT 2314

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Tube-based transmitter development							X									
(U) Tube-based transmitter panel performance and R&M testing							*	X								
(U) Tube-based versus solid-state eval							*	X								
(U) Develop waveform signal processor						*						X				
(U) Radar Siting Tool for Tactical Surveillance Radar						*					X					
(U) Integrate Mode S into AN/TPS-75										*		X				
(U) Track Before Detect for TMD									*							

* Indicates the start of an activity; X indicates the completion.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications PROJECT 2314

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Primary Hardware Development	815	899	685	338
(U) Government Engineering Support	168	100	103	104
(U) Travel	20	15	15	15
(U) Total	**1,003**	**1,014**	**803**	**457**

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Hughes	C/CPFF	June 95	n/a	n/a	345	834	204	0	0	0	1,383
TBD	TOA	Apr 97	n/a	n/a	0	0	470	435	0	0	905
Support and Management Organizations											
Rome Laboratory	In-house	N/A	n/a	n/a	Cont.	169	190	243	207	Continuing	TBD
Miscellaneous	Various	Various	n/a	n/a	0	0	150	125	250	Continuing	TBD

Test and Evaluation Organizations - Not Applicable.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603617F Command Control & Communications Applications** PROJECT **2314**

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: Not Applicable.

Subtotal Product Development	345	834	674	435	0	0	2,288
Subtotal Support and Management	Cont.	169	340	368	457	Cont.	TBD
Subtotal Test and Evaluation	0	0	0	0	0	Cont.	TBD
Total Project	**Cont.**	**1,003**	**1,014**	**803**	**457**	**Cont.**	**TBD**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603617F Command Control & Communications Applications

PROJECT: 2317

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2317 Tactical Air Information Production & Distribution	1,383	530	2,808	3,142	3,233	3,275	3,341	3,418	Continuing	TBD

(U) A. Mission Description and Budget Item Justification: Transitions advanced communications to the Theater Deployable Communications (TDC) program in support of Theater Battle Management (TBM) command and control enhancements. The goal is to reduce the risk of transitioning advanced government or commercial off-the-shelf technology into military communications systems. Capabilities developed include modular programmable radio technologies and improvements to survivability, deployability, interoperability, and control of communications networks.

(U) FY 1996 ($ in Thousands):
- (U) $1,383 Continue Secure Survivable Communications Network (SSCN) Phase II.
- **(U) $1,383 Total**

(U) FY 1997 ($ in Thousands):
- (U) $ 500 Complete SSCN Phase II/Conduct Joint Demonstration.
- (U) $ 30 Initiate Plan for Speakeasy airborne-transportable radio development.
- **(U) $ 530 Total**

(U) FY 1998 ($ in Thousands):
- (U) $1,300 Initiate Speakeasy airborne-transportable radio ruggedization.
- (U) $1,200 Initiate Speakeasy airborne-transportable radio antenna development.
- (U) $ 308 Initiate Speakeasy airborne-transportable radio electro-magnetic interference/compatability tests.
- **(U) $2,808 Total**

(U) FY 1999 ($ in Thousands):
- (U) $ 142 Complete Speakeasy airborne-transportable radio ruggedization.
- (U) $1,200 Complete Speakeasy airborne-transportable radio antenna development.
- (U) $1,000 Complete Speakeasy airborne-transportable radio electro-magnetic interference/compatability tests.
- (U) $ 800 Complete Speakeasy airborne-transportable radio control development.
- **(U) $3,142 Total**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications PROJECT 2317

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY 1997 President's Budget	1,383	569	2,844	3,188	TBD
(U) Appropriated Value	1,581	569			
(U) Adjustments to Appropriated Value					
a. Congressional Reductions	-56	-28			
b. Small Business Innovative Research	-110	-11			
c. Omnibus/Other Above Threshold Reprogramming	-32				
(U) Adjustments to Budget Years Since FY 1997 PB			-36	-46	
(U) FY 1998/1999 Biennial Budget	1,383	530	2,808	3,142	TBD

(U) Change Summary Explanation:

Funding: N/A

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) RDT&E, AF (0602702F, Project 4519)	11,886	12,300	11,550	12,964	10,886	12,514	12,009	12,360	Cont	TBD
(U) RDT&E, AF (0603789F, Project 2335)	5,055	4,265	4,636	4,119	4,269	5,414	5,363	5,511	Cont	TBD
(U) RDT&E, AF (0603238F, Project 4216)	2,367	2,191	0	0	0	0	0	0	0	TBD
(U) RDT&E, AF (0603789F, Project 4216)	0	0	1,420	2,441	2,564	2,768	2,834	2,919	Cont	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603617F Command Control & Communications Applications** PROJECT **2317**

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Secure Survivable Comm Net Phase II																
- Transition Plan			*					X								
- Development								X								
- Joint Demonstration								*				X				
(U) Speakeasy Radio System Development																
- Ruggedization									*				X			
- Antenna Development										*					X	
- Electro-magnetic Interference and Compatability Tests											*					X
- Control Development													*			X

* Indicates the start of an activity; X indicates the completion.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603617F Command Control & Communications Applications** PROJECT **2317**

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Primary Hardware Development	1,053	190	2,618	3,042
(U) Government Engineering Support	60	50	60	60
(U) Travel	40	40	40	40
(U) Contractor Engineering Support	230	250	90	0
(U) Total	**1,383**	**530**	**2,808**	**3,142**

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
ESC	PD	Various	n/a	n/a	0	210	230	0	0	0	440
SOCOM	PD	Sept 96	n/a	n/a	0	392	0	0	0	0	392
TBD (Speakeasy)	TBD	TBD	n/a	n/a	0	0	0	2,508	2,842	Cont.	TBD
Support and Management Organizations											
Rome Laboratory	In-house	n/a	n/a	n/a	Cont.	392	139	300	300	Cont.	TBD
Miscellaneous	Various	Various	n/a	n/a	Cont.	389	161	0	0	Cont.	TBD

Test and Evaluation Organizations - Not Applicable

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications PROJECT 2317

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: Not Applicable

Subtotal Product Development	0	602	230	2,508	2,842	Cont.	TBD
Subtotal Support and Management	Cont.	781	300	300	300	Cont.	TBD
Subtotal Test and Evaluation	0	0	0	0	0	Cont.	TBD
Total Project	**Cont**	**1,383**	**530**	**2,808**	**3,142**	**Cont.**	**TBD**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603617F Command Control & Communications Applications

PROJECT: 2321

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2321 Tactical Battle Information Management	3,394	2,385	3,894	4,118	4,237	4,295	4,369	4,469	Continuing	TBD

(U) A. **Mission Description and Budget Item Justification:** Designs and integrates improvements to system software and C3 applications modules via rapid prototyping and maximum user participation in all design activities. Current focus is the functional development and rapid prototyping of the Force Level Execution (FLEX) system, which will assist the combat operations personnel in an AOC to quickly replan or reallocate resources based on real-time threat inputs, including time critical targets (TCTs) and changes in the wartime scenario. The Defensive Planning and Execution system will provide an automated system that aids the air defense duty officers in planning the integrated employment of Defensive Counter-Air and Active and Passive Defenses in conjunction with Offensive Counter-Air, to destroy or neutralize enemy aircraft and theater missiles.

(U) FY 1996 ($ in Thousands):
- (U) $2,967 Continue FLEX development.
- (U) $ 427 Continue TBM systems integration evaluations.
- **(U) $3,394 Total**

(U) FY 1997 ($ in Thousands):
- (U) $1,620 Continue FLEX development and initiate integration into TBM Core Systems.
- (U) $ 640 Initiate accelerated Defensive Planning and Execution software development for joint use
- (U) $ 125 Complete TBM systems integration evaluations.
- **(U) $2,385 Total**

(U) FY 1998 ($ in Thousands):
- (U) $2,435 Complete initial FLEX integration into TBMCS V1.0 and TBMCS remote terminals.
- (U) $1,169 Continue Defensive Planning and Execution software development
- (U) $ 290 Initiate FLEX airborne applications via TBMCS remote terminals (i.e. AWACS, JSTARS, ABCCC).
- **(U) $3,894 Total**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications PROJECT 2321

(U) FY 1999 ($ in Thousands):
- (U) $ 895 Complete FLEX airborne application integration into TBMCS remote terminals.
- (U) $3,223 Initiate itegration of Defensive Planning and Execution as a TBMCS application.
- **(U) $4,118 Total**

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY 1997 President's Budget	3,394	2,485	3,926	4,156	TBD
(U) Appropriated Value	3,533	2,485			
(U) Adjustments to Appropriated Value					
a. Congressional Reductions	-69	-52			
b. Small Business Innovative Research		-48			
c. Omnibus/Other Above Threshold Reprogramming	-70				
(U) Adjustments to Budget Years Since FY 1997 PB			-32	-38	
(U) FY 1998/1999 Biennial Budget	3,394	2,385	3,894	4,118	TBD

(U) Change Summary Explanation:

Funding: N/A

Schedule: N/A

Technical: Defensive Planning and Execution software development added as next highest priority activity planned.

(U) C. Other Program Funding Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) RDT&E, AF (0603789F, Project 2335)	5,055	4,265	4,636	4,119	4,269	5,414	5,363	5,511	Cont	TBD
(U) RDT&E, AF (0207438F, Project 4287)	18,425	23,970	12,886	9,222	8,765	6,847	11,522	11,879	Cont	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603617F Command Control & Communications Applications**
	PROJECT **2321**

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) TBM Systems Integration Evaluation						X										
(U) FLEX																
- TBMCS V1.0 integration						X										
- Airborne application									*						X	
(U) Defensive Planning and Execution software development						*										
- Evolutionary Prototype (EP) #1										X						
- EP #2												X				
- EP #3														X		
- Advanced Technology Demonstration															X	
- Functional Validation Model #1																X

* Indicates the start of an activity; X indicates the completion.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications PROJECT 2321

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Software Development	2,587	1760	3,039	3,418
(U) Government Engineering Support	360	250	430	200
(U) Travel	79	150	150	200
(U) Contractor Engineering Support	368	225	275	300
(U) Total	**3,394**	**2,385**	**3,894**	**4,118**

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Logicon	C/CPFF	June 94	n/a	n/a	3,084	2,420	818	1,775	0	0	8,097
TBD (DPE)	C/CPAF	Mar 94	n/a	n/a	0	0	650	650	2,500	3,400	7,200
Support and Management Organizations											
Rome Laboratory	In-house	n/a	n/a	n/a	Cont	779	604	955	1,025	Cont	TBD
Miscellaneous	Various	Various	n/a	n/a	Cont	195	313	514	593	Cont	TBD

Test and Evaluation Organizations - Not Applicable

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications PROJECT 2321

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: Not Applicable

Subtotal Product Development	3,084	2,420	1,468	2,425	2,500	3,400	15,297
Subtotal Support and Management	0	0	917	1,469	1,618	Cont	TBD
Subtotal Test and Evaluation	0	0	0	0	0	Cont	TBD
Total Project	**Cont**	**3,394**	**2,385**	**3,894**	**4,118**	**Cont**	**TBD**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications PROJECT 3804

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3804 Tactical Air Forces Systems Integration	261	250	145	209	231	235	248	255	Continuing	TBD

(U) A. **Mission Description and Budget Item Justification**: Provides systems engineering and integration support to the Combat Air Forces (CAF) or to other development efforts. Project addresses integration and interoperability issues associated with TBM General Officers Steering Group (GOSG) directed efforts, makes recommendations, identifies deficiencies, and establishes requirements for development efforts.

(U) FY 1996 ($ in Thousands):
- (U) $ 105 Continue support of TBM core systems integration.
- (U) $ 60 Complete analysis of Defensive Planning and expand to Management of Aggregated Sensors.
- (U) $ 96 Continue evaluation of Force Level joint interoperability issues.
- **(U) $ 261 Total**

(U) FY 1997 ($ in Thousands):
- (U) $ 100 Prepare for AOC Defensive Planning Development.
- (U) $ 150 Complete Sensor Management analysis.
- **(U) $ 250 Total**

(U) FY 1998 ($ in Thousands):
- (U) $ 75 Support and Analyze TBMCS Theater Integration
- (U) $ 70 Evaluate Defensive Planning and Execution Prototype
- **(U) $ 145 Total**

(U) FY 1999 ($ in Thousands):
- (U) $ 109 Evaluate Defensive Planning advanced technology demonstration prototype
- (U) $ 100 Initiate transition of Defensive Planning and Execution System to TBMCS
- **(U) $ 209 Total**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603617F Command Control & Communications Applications**
	PROJECT **3804**

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY 1997 President's Budget	262	267	361	359	TBD
(U) Appropriated Value	284	267			
(U) Adjustments to Appropriated Value					
a. Congressional Reductions	-16	-12			
b. Small Business Innovative Research		-5			
c. Omnibus/Other Above Threshold Reprogramming	-6				
d. Below Threshold Reprogramming	-1				
(U) Adjustments to Budget Years Since FY 1997 PB			-216	-150	
(U) FY 1998/1999 Biennial Budget	261	250	145	209	TBD

(U) Change Summary Explanation:

Funding: N/A

Schedule: N/A

Technical: Reduced technical analysis provided to the Headquarters Air Combat Command user.

(U) **C. Other Program Funding Summary ($ in Thousands)**: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications PROJECT 3804

(U) D. **Schedule Profile**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Analysis of TBM Core Systems theater integration	*				X											
(U) Defensive Planning																
- Analysis	X															
- Develop Plan					*		X									
(U) TBM Force Level System prototype Evaluations																
- AOC Combat Operations					X											
- Joint Operations					*				X							
(U) Evaluate DPE Prototype											*					X
(U) DPE Transition to TBMCS																*

* Indicates the start of an activity; X indicates the completion.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603617F Command Control & Communications Applications**
	PROJECT **3804**

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Systems Engineering	150	189	120	180
(U) Government Engineering Support	54	11	25	29
(U) Contractor Engineering Support	57	50	0	0
(U) Total	**261**	**250**	**145**	**209**

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations - Not Applicable.											
Support and Management Organizations											
MITRE	SS/TO&P	Various	n/a	n/a	Cont.	150	189	120	180	Continuing	TBD
Rome Laboratory	In-house	n/a	n/a	n/a	Cont.	54	11	25	29	Continuing	TBD
Miscellaneous	Various	Various	n/a	n/a	Cont.	57	50	0	0	Continuing	TBD
Test and Evaluation Organizations - Not Applicable.											

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603617F Command Control & Communications Applications PROJECT 3804

Government Furnished Property: Not Applicable.

Subtotal Product Development	Cont.	0	0	0	0	Continuing	TBD
Subtotal Support and Management	Cont.	261	250	145	209	Continuing	TBD
Subtotal Test and Evaluation	Cont.	0	0	0	0	Continuing	TBD
Total Project	**Cont.**	**261**	**250**	**145**	**209**	**Continuing**	**TBD**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603790F NATO Cooperative Research and Development

PROJECT: 64

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
64 Nato Coop R&D	0	9,783	13,433	11,341	11,567	12,253	12,426	12,718	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	2 (150)	0	0	0	0	0	0

***This program element was previously funded under OSD PE 0603790D which will be used to fund DoD-wide priority agreements. FY97 is the first year of funding for PE 0603790F.**

(U) A. **Mission Description and Budget Item Justification**

These funds will be used to help implement international cooperative research, development, and acquisition (ICRD&A) agreements with NATO and major non-NATO allies (Australia, Egypt, Israel, Japan, and Korea). The program implements the provisions of Title 10 U.S. Code, Section 2350a on NATO Cooperative Research and Development (R&D). The program was established to improve what Congress perceived as inadequate cooperation among NATO nations, and later major non-NATO allies, in research, development, and production. The legislation authorized funds to significantly improve US and allied conventional defense capabilities by leveraging the world's best defense technologies, eliminating costly duplication of research and development efforts, accelerating the availability of defense systems, and promoting US and allied interoperability or commonality. Candidate projects are reviewed and approved by the USD(A&T). An international agreement defining project objectives, responsibilities and costs is required prior to release of funds. These funds will help implement Air Force agreements that directly support the Air Force and DoD Science and Technology community, Major Commands, Joint Vision 2010, and the Air Force's Strategy of Global Engagement. The planned program is shown below. The final program will be reported separately as required by Title 10 U.S. Code, Section 2350a(f).

Justification for Budget Activity Assignment

This program element funds the implementation of Air Force ICRD&A agreements in (1) Basic Research (2) Applied Research (3) Advanced Technology Development (4) Demonstration and Validation (5) Engineering and Manufacturing Development and (6) RDT&E Management Support.

(U) FY 1996 ($ in Thousands):

- (U) $
- (U) $
- (U) $
- (U) $0 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603790F NATO Cooperative Research and Development PROJECT 64

(U) FY 1997 ($ in Thousands): Funds will be allocated for continuing projects initiated in FY95 and FY96 under PE0603790D and new projects:

(U) Continuing Projects Initiated in FY95 and FY96 Under PE 0603790D:

- (U) $475 **Image Information Reformatter (IIR)** (Rome Laboratory/France) - Cooperative project to define, develop, test, and evaluate an Advanced Development Model (ADM) IIR for the purpose of establishing interoperability among allied tactical imagery reconnaissance systems. In FY97 Phase One Definition activities will be completed and a Phase Two program to build and demonstrate the IIR will be outlined. If both countries agree with the proposed Phase Two program, Rome Laboratory will competitively award a procurement contract to develop and demonstrate the US portion of the Phase Two IIR capability.
- (U) $2,700 **Experimental Air Operations Center (EAOC)** (Electronics Systems Center/United Kingdom) - Cooperative research and advanced development project into an EAOC using the US Contingency Theater Automated Planning System (CTAPS) as a baseline. In FY97 the project will conduct research and advanced development into key command and control (C2) areas of Combined Air Operations Center (CAOC) functionality: the US will develop an Enhanced Monitoring and Execution tool and conduct studies on Enhanced Human Computer Interfaces (HCI); the US and United Kingdom will jointly develop a Battle Space Display (BSpD); and the United Kingdom will provide a Master Battle Planning (MBP) tool and War Gaming/Exercise support.
- (U) $2,600 **Vista Warrior** (Armstrong Laboratory/United Kingdom) - Cooperative project to develop and evaluate advanced helmet-mounted tracker and display (HMT/D) technologies, multi-sensory virtual interface concepts, and virtual display and control devices for incorporation into advanced aircraft. In FY97 the project will demonstrate the monocular Helmet-Vehicle Interface (HVI), and the corresponding improvements in reliability, safety and commonality, with an advanced HMT/D in an F-15C; evaluate alternative control and display technologies for use in advanced cockpits; assess the utility of color symbology for HMT/Ds in the US Synthesized Immersion Research Environment (SIRE) facility; and conduct risk reduction studies on eye tracker technologies.
- (U) $700 **Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems** (Phillips Laboratory/United Kingdom) - Cooperative project to leverage complementary high-latitude ionospheric sensors and data to develop capabilities for timely warning of ionospheric disturbances that disrupt C3I systems. In FY97 the project will develop techniques to exploit Global Positioning System-Meteorological (GPS-Met) satellite data to validate and drive sensor-driven ionosphere specification models; incorporate Defense Meteorological Satellite Program (DMSP) sensor data into displays to alert C3I-system operators of disruptive ionospheric scintillation conditions; and assess the viability of using UK ionospheric tomography data for large area ionospheric specification.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603790F NATO Cooperative Research and Development
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- (U) $700 **Future Multiband, Multiwaveform Modular Tactical Radio (FM3TR)** (Rome Laboratory/France, Germany, United Kingdom) - Cooperative project to provide international capabilities in the area of interoperable and quickly reconfigurable communication systems using the US Speakeasy system as the baseline. In FY97 the project will continue the first phase of designing and developing a common test waveform which will be hosted into each of the international demonstrator testbeds. The final waveform description has been agreed upon and distributed to the development organizations in each of the countries, demonstration and test plans are being worked, and the US is modifying the first phase of the Speakeasy system to incorporate the FM3TR waveform.
- (U) $100 **Single Mode Optical Fibers for Array Imaging and for Environmental Sensing** (Phillips Laboratory/United Kingdom) - Cooperative project to enhance the performance of single mode optical fibers for ultra-high angular resolution imaging in support of space surveillance needs. In FY97 the project will evaluate wavefront sensing techniques to characterize the wavefront that will be coupled in the single mode fiber. This evaluation and characterization will help design and build prototypes of a fiber bundle or Multi-Core Single Mode Fiber (MCSMF).

(U) New Projects:

- (U) $200 **Dense Metal Case Penetrating Weapon (DMCPW)** (Wright Laboratory/United Kingdom) - Cooperative project to develop and demonstrate technology for a dense metal penetrating warhead, that is compatible with guidance kits such as PAVEWAY III and the Joint Deep Attack Munition (JDAM). This technology offers a two-fold increase in hard target defeat over current warhead case designs. The warhead will be compatible for carriage and release with future smaller aircraft, and stand-off weapons such as cruise missiles. Technology demonstration will be through subscale and full scale dynamic ground impact testing (sled and/or powder gun) with an option for flight demonstrations using PAVEWAY III guidance kits. In FY97 the project will identify the most promising DMCPW concepts and initiate US PAVEWAY III flight demonstration guidance kit and United Kingdom weaponization design studies.
- (U) $400 **Free Piston Shock Tunnel/High Enthalpy Goettingen Project** (Arnold Engineering and Development Center/Germany) - Cooperative project to significantly reduce the cost of acquiring technologies and ground test capabilities for the development of hypersonic flight systems by combining the complementary efforts of the US Free Piston Shock Tunnel and Germany's High Enthalpy Goettingen facilities. In FY97 the project will establish test configurations and conditions, begin facility calibration testing, and exchange instrumentation and diagnostic systems.
- (U) $500 **Programmable Integrated Ordnance Suite (PIOS)** (Wright Laboratory/United Kingdom) - Cooperative project to develop and demonstrate integrated missile ordnance technologies, including imaging infrared target detection devices (TDD), mass-focused or directional warheads, and advanced initiation fireset. The primary goal is to improve counter-air lethality against advanced fighter, bomber, helicopter, and cruise missile targets. In FY97 the project will focus on developing, integrating and checking-out models and simulations for engineering analysis; exercising the simulations, analyzing their results and determining what TDD/warhead concept combination provides the best performance within acceptable development risk.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603790F NATO Cooperative Research and Development
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- (U) $280 **Cooperation in Infrared Spectral Imaging for Low Observable Signatures** (Arnold Engineering and Development Center/Canada) - Cooperative project to pool the spatial and spectral advances of both the US and Canada, and develop a high-resolution sensor system capable of acquiring the infrared signatures of rockets and aircraft, detecting and identifying chemical warfare agents, and detecting and identifying illicit materials. In FY97 the project will survey available components and state-of-the-art technology for focal plane arrays, interferometers, and data acquisition hardware; develop the preliminary design for a high-resolution sensor system; order long lead components; and report on the initial conceptual design.
- (U) $200 **Adaptive Flexible Structures for Air Vehicle Applications** (Wright Laboratory/Australia) - Cooperative project to analyze, develop and demonstrate an approach to suppressing buffet load-induced vibrations on vertical tail aircraft. In FY97 the project will attach a US developed buffet load alleviation (BLA) control system to an F-18 test aircraft and install the aircraft in Australia's International Follow-On Structural Testing Project (IFOSTP) facility. The performance and benefits of the BLA control system will be demonstrated in FY97 and FY98 and reports will be prepared documenting the development and test results of the BLA control system.
- (U) $578 **Advanced Flooding Agent** (Wright Laboratory/United Kingdom) - Cooperative project to develop replacement agent(s) for Halon 1301 in fire suppression systems that protect human-occupied spaces in mission critical equipment and facilities. In FY97 the project will review prior phosphonitrilic (PN) and silicon fire suppressant development; apply Quantitative Structure Property Relationship (QSPR) analysis to forecast compounds for synthesis; and evaluate synthesis routes for PN and silicon compounds for yield and cost.
- (U) $350 **Strengthening of Concrete Structures for Enhanced Structural Survivability** (Wright Laboratory/Israel) - Cooperative project to develop rapid, inexpensive construction process to significantly increase the strength and resistance of existing or new conventional concrete and mason structures to terrorist vehicle bombs or tactical ballistic missile threats. Meets requirement to upgrade mission critical air base structures at both contingency and fixed bases, thereby reducing the need for new military construction. In FY97 the project will evaluate and select materials for further testing; test modules and components of structures under blast loadings in the US and Israel; and conduct tests on complete structures, reinforced with advanced composite materials, in Israel.
- (U) $9,783 Total

(U) FY 1998 ($ in Thousands): Funds will be allocated for both continuing and new projects.

(U) Continuing Projects Initiated in FY95 and FY96 Under PE 0603790D:

- (U) $1,600 **Image Information Reformatter (IIR)** (Rome Laboratory/France) - Cooperative project to define, develop, test, and evaluate an Advanced Development Model (ADM) IIR for the purpose of establishing interoperability among allied tactical imagery reconnaissance systems. In FY98 the project will begin implementing the Phase Two development of an ADM-IIR consisting of core and input/output components capable of interfacing with selected US and French reconnaissance imagery collection and ground exploitation systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603790F NATO Cooperative Research and Development
	PROJECT 64

- (U) $550 **Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems** (Phillips Laboratory/United Kingdom) - Cooperative project to leverage complementary high-latitude ionospheric sensors and data to develop capabilities for timely warning of ionospheric disturbances that disrupt C3I systems. In FY98 the project will couple sensor-driven Parameterized Ionosphere Specification Model (PRISM) to UK analytic ray tracing code for radio wave propagation prediction applications; develop algorithms to couple Global Position System-Meteorological (GPS-Met) satellite data into PRISM; and with the UK demonstrate the use of multiple sensor data to provide real-time (ionospheric) range corrections for surveillance radars.
- (U) $100 **Single Mode Optical Fibers for Array Imaging and for Environmental Sensing** (Phillips Laboratory/United Kingdom) - Cooperative project to enhance the performance of single mode optical fibers for ultra-high angular resolution imaging in support of space surveillance needs. In FY98 the project will test and improve a Multi-Core Single Mode Optical Fiber (MCSMF) that offers the potential for transmitting light and images more efficiently.
- (U) $2,528 **Vista Warrior** (Armstrong Laboratory/United Kingdom) - Cooperative project to develop and evaluate advanced helmet-mounted tracker and display (HMT/D) technologies, multi-sensory virtual interface concepts, and virtual display and control devices for incorporation into advanced aircraft. In FY98 the project will demonstrate Helmet-Vehicle Interface (HVI) for binocular HMT/Ds; develop color monocular HMT/D for use in fast-jets for air-to-air and air-to-ground missions; begin development of flight-worthy eye tracker for airborne eye pointing/targeting; finalize selection of advanced controls and displays for demonstration in aircraft.

(U) Continuing Projects Initiated in FY97 Under PE 0603790F:

- (U) $1,300 **Dense Metal Case Penetrating Weapon (DMCPW)** (Wright Laboratory/United Kingdom) - Cooperative project to develop and demonstrate technology for a dense metal penetrating warhead that is compatibile with guidance kit such as PAVEWAY III and the Joint Deep Attack Munition (JDAM). This technology offers a two-fold increase in hard target defeat over current warhead case designs. The warhead will be compatible for carriage and release with future smaller aircraft, and stand-off weapons such as cruise missiles. Technology demonstration will be through subscale and full scale dynamic ground impact testing (sled and/or powder gun) with an option for flight demonstrations using PAVEWAY III guidance kits. In FY98 the project will complete preliminary design of the DMCPW, US PAVEWAY III flight demonstration guidance kit, and United Kingdom weaponization design studies; begin DMCPW detailed design, development, and ground testing; and initiate procurement of PAVEWAY III flight demonstration guidance kits.
- (U) $750 **Advanced Flooding Agent** (Wright Laboratory/United Kingdom) - Cooperative project to develop a replacement agent(s) for Halon 1301 in fire suppression systems that protect human-occupied spaces in mission critical equipment and facilities. In FY98 the project will evaluate fire suppression effectiveness of candidate compounds; assess toxicological endpoints of candidate compounds; determine global warming and ozone depletion potentials of candidates; and assess delivery system requirements for candidate compounds.

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– (U) $280 **Cooperation in Infrared Spectral Imaging for Low Observable Signatures** (Arnold Engineering and Development Center/Canada) - Cooperative project to pool the spatial and spectral advances of both the US and Canada, and develop a high-resolution sensor system capable of acquiring the infrared signatures of rockets and aircraft, detecting and identifying chemical warfare agents, and detecting and identifying illicit materials. In FY98 the project will develop a brass board for concept checkout and incorporate improvements into an advanced design.

– (U) $450 **Strengthening of Concrete Structures for Enhanced Structural Survivability** (Wright Laboratory/Israel) - Cooperative project to develop rapid, inexpensive construction process to significantly increase the strength and resistance of existing or new conventional concrete and mason structures to terrorist vehicle bombs or tactical ballistic missile threats. Meets requirement to upgrade mission critical air base structures at both contingency and fixed bases, thereby reducing the need for new military construction. In FY98 the project will continue to evaluate and select materials for further testing; test modules and components of structures under blast loading in the US and Israel; and conduct tests on complete structures, reinforced with advanced composite materials, in Israel.

– (U) $500 **Free Piston Shock Tunnel/High Enthalpy Goettingen Project** (Arnold Engineering and Development Center/Germany) - Cooperative project to significantly reduce the cost of acquiring technologies and ground test capabilities for the development of hypersonic flight systems by combining the complementary efforts of the US Free Piston Shock Tunnel and Germany's High Enthalpy Goettingen facilities. In FY98 the project will complete the testing and supporting computational fluid dynamics analyses.

– (U) $500 **Programmable Integrated Ordnance Suite (PIOS)** (Wright Laboratory/United Kingdom) - Cooperative project to develop and demonstrate integrated missile ordnance technologies, including imaging infrared target detection devices (TDD), mass-focused or directional warheads, and advanced initiation fireset. The primary goal is to improve counter-air lethality against advanced fighter, bomber, helicopter, and cruise missile targets. In FY98 the project will continue exercising simulations, analyzing their results, and begin developing a preliminary engineering design of the integrated ordnance suite based on the selected TDD/warhead concept.

(U) Continuing Projects Initiated in FY97 Under PE 0603790D:

– (U) $1,150 **Regional/Sector Air Operations Center (R/SAOC) Modernization Program** (Electronic Systems Center/Canada) - Cooperative project to modernize existing R/SAOC computing and display capabilities to better support designated North American Aerospace Defense (NORAD) Command missions. In FY98 the project will continue integrating R/SAOC with the Theater Battle Management Core System (TBMCS), Global Command and Control System (GCCS), and the Defense Information Infrastructure/Common Operating Environment (DII/COE).

– (U) $100 **Effects of the Ionosphere on Communication and Surveillance Systems** (Phillips Laboratory/France) - Cooperative project to leverage complementary equatorial ionospheric sensors and data to develop techniques for reliable warning of equatorial ionosphere disturbances that disrupt communication, surveillance, and Global Positioning System (GPS) navigation. In FY98 the project will incorporate French equatorial ionosphere data from Africa with Phillips Laboratory data from South America to characterize ionospheric scintillation conditions that disrupt communications, surveillance, and navigation systems

(U) New Projects:

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
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- (U) $500 **Observations and Modeling for Space Weather** (Phillips Laboratory/Germany) - Cooperative project involving US and German satellite sensors and experiments to provide coordinated observations and modeling of solar impact on space environment to forecast the global ionosphere and satellite drag.
- (U) $100 **Cooperative Space Measurements** (Phillips Laboratory/Germany) - Cooperative project to fly a Department of Defense developed space plasma ion drift meter aboard a German scientific spacecraft in 1999. Joint exchange and analysis of scientific data from this mission will be used to develop better descriptive and predictive models of the space environment, enhancing the reliability of space-based communications and navigation capabilities for the US and its allies.
- (U) $180 **Project Refractive Turbulence** (Phillips Laboratory/Australia) - Cooperative project to obtain accurate, statistically significant, world wide turbulence measurements. The turbulence data base will be used in studies that evaluate atmospheric refraction propagation effects on the Airborne Laser (ABL), Airborne Warning and Control System (AWACS), Joint Surveillance Target Attack Radar System (JSTARS), and high-altitude Unmanned Aerial Vehicles (UAVs).
- (U) $100 **Metal Matrix Composites for Aerospace Applications** (Wright Laboratory/United Kingdom) - Cooperative project to improve the properties and processing of silicon carbide-reinforced Titanium (Ti) - alloy and Aluminum (Al) - alloy metal matrix composites for aerospace applications.
- (U) $300 **Advanced Combustor Chamber Concepts Program** (Wright Laboratory/France) - Cooperative project to develop and demonstrate a composite combustor structure suitable for use in advanced hypersonic weapon systems operating to Mach 8 on liquid hydrocarbon fuels. Resulting engines will be simpler, easier to cool, lower weight, and more durable than baseline metallic designs.
- (U) $500 **Integrated Tactical Aircraft Control (ITAC) Program** (Wright Laboratory/France) - Cooperative project to develop, test and evaluate a cooperative control architecture for a multi-ship strike package of manned fighters and reusable, Unmanned Combat Air Vehicles (UCAVs).
- (U) $400 **Anthropometric Accommodation in Crew Systems** (Armstrong Laboratory/The Netherlands) - Cooperative project to establish (a) a collection of three-dimensional (3-D) anthropometric data which accurately and consistently describes the variability of men and women in both Europe and the US (b) high quality methods for accommodation and interoperability assessment of crew systems and (c) methods for combining the data base with the assessment methods to assure accommodation and interoperability is achieved in the design process.
- (U) $395 **Transatlantic Research into Air Combat Engagements (TRACE) Phase 2** (Wright Laboratory/Germany) - Cooperative project to (a) integrate combat pilot aiding systems on both sides and evaluate their effectiveness; (b) link an active combat range and evaluate the potential of the TRACE network to provide an essential research capability between test ranges and high fidelity simulations separated by long distance.
- (U) $450 **Aging Aircraft Life Prediction /Extension** (Wright Laboratory/Australia) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs of metallic structures, widespread fatigue damage including multiple-element damage and multiple site damage, techniques for predicting the effects of corrosion and the interaction with fatigue loads, and sensors for structural health monitoring.

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- (U) $400 **Structural Integrity of Aging Aircraft** (Wright Laboratory/Canada) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs for metallic structures, widespread fatigue damage, life extension techniques for metallic structures, corrosion and its interaction with fatigue, structural dynamics with emphasis on weapon bay acoustics, and structural health monitoring with emphasis on sensor development.
- (U) $300 **Airworthiness of Aging Aircraft** (Wright Laboratory/United Kingdom) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs for metallic structures, techniques for predicting the effects of corrosion and the interaction with fatigue loads, and structural life extension techniques for metal structures, such as the fastener-hole cold expansion process.
- (U) $13,433 Total

(U) FY 1999 ($ in Thousands):

- (U) $11,341 The allocation of FY99 funds has not yet been determined. Projects being considered for funding include potential new starts plus the following continuations: Effects of the Ionosphere on Command, Control, Communications and Intelligence (C3I) Systems (Phillips Laboratory/United Kingdom); Vista Warrior (Armstrong Laboratory/United Kingdom); Dense Metal Case Penetrating Weapon (DMCPW) (Wright Laboratory/United Kingdom); Programmable Integrated Ordnance Suite (PIOS) (Wright Laboratory/United Kingdom); Advanced Flooding Agent (Wright Laboratory/United Kingdom); Cooperation in Infrared Spectral Imaging for Low Observable Signatures (Arnold Engineering and Development Center/Canada); Effects of the Ionosphere on Communications and Surveillance Systems (Phillips Laboratory/France); Free Piston Shock Tunnel/High Enthalpy Goettingen Project (Arnold Engineering and Development Center/Germany); Observations and Modeling for Space Weather (Phillips Laboratory/ Germany); Advanced Hybrid Tactical Propulsion (Phillips Laboratory/Japan); Transatlantic Research into Air Combat Engagements (TRACE) Phase II (Wright Laboratory/Germany); Integrated Tactical Aircraft Control (ITAC) Program (Wright Laboratory/France); Advanced Crew Ejection Seat (ACES) II - Ejection Seat Improvements (Human Systems Center/Japan); Advanced Combustor Chamber Concepts Program (Wright Laboratory/France); Metal Matrix Composites for Aerospace Applications (Wright Laboratory/United Kingdom); Anthropometric Accommodation in Crew Systems (Armstrong Laboratory/The Netherlands); Project Refractive Turbulence (Phillips Laboratory/Australia); Air Battle Management Capabilities (Electronic Systems Center/United Kingdom); Air Command, Control, Communications and Intelligence Capabilities (Electronic Systems Center/NATO C3 Agency); Cooperative Space Measurements (Phillips Laboratory/Germany); Aging Aircraft Life Prediction/Extension Program (AALPE) (Wright Laboratory/Australia); Airworthiness of Aging Aircraft (Wright Laboratory/United Kingdom); and Structural Integrity of Aging Aircraft (Wright Laboratory/Canada).
- (U) $11,341 Total

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(U) **Acquisition Strategy:**

A principal goal of the NATO Cooperative R&D program is to effectively utilize the aggregate resources invested by the US and our allies in conventional defense R&D. This program element provides the critical funding incentive needed to pursue international cooperative research, development, and acquisition (ICRD&A) agreements and helps to (a) leverage USAF and allied resources through cost sharing and economies of scale; (b) exploit the best US and allied technologies for equipping coalition forces; (c) demonstrate areas of commonality or interoperability with our allies; and (d) accelerate the availability of defense technology and systems. To obtain these funds and ensure service commitment, projects are selected from existing or new RDT&E programs funded in the Future Years Defense Plan (FYDP). Project offices must show matching funds and contributions from associated program elements and equitable allied funding. As appropriate, funding responsibility for out-year requirements and follow-on efforts are transferred to the project office and associated program elements.

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	N/A	10,233	10,533	7,733	
(U) Appropriated Value		10,233			
(U) Adjustments to Appropriated Value					
a. Cong Reductions		-215			
b. SBIR		-235			
c. Omnibus or Other Above Threshold Reprogram					
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			2,900	3,608	
(U) Current Budget Submit/President's Budget		9,783	13,433	11,341	

(U) Change Summary Explanation:

(U) Funding: Prior to FY97 OSD funded NATO Cooperative R&D agreements under PE 0603790D. In FY97 responsibility for funding the NATO Cooperative R&D agreements will be shared with the Services. This program element will fund Air Force ICRD&A agreements certified by the USD(A&T).

The Air Force plans to reallocate a total of $2,308,000 in FY97 for the following projects previously programmed in OSD PE0603790D and the 1996 Annual Report to Congress on International Cooperative Research and Development: Free Piston Shock Tunnel/High Enthalpy Goettingen Project (Arnold Engineering and Development Center/Germany): $400,000; Cooperation in Infrared Spectral Imaging for Low Observable Signatures (Arnold Engineering and Development Center/Canada): $280,000; Adaptive Flexible Structures for Air Vehicle Applications (Wright Laboratory/Australia): $200,000; Advanced Flooding Agent (Wright Laboratory/United Kingdom: $578,000); Programmable Integrated Ordnance Suite (PIOS) (Wright Laboratory/United Kingdom): $500,000; Strengthening of Concrete Structures for Enhanced Structural Survivability (Wright Laboratory/Israel): $350,000.

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The reallocation sources will come from:

- $1,333,000 from Dense Metal Case Penetrating Weapon (DMCPW) (Wright Laboratory/United Kingdom), since activities have been rescheduled;
- $775,000 from Image Information Reformatter (Rome Laboratory/France), since the French have experienced scheduling delays;
- $200,000 from Very High Resolution Imaging by Interferometry (Phillips Laboratory/France), since the proposed agreement has been placed on hold;

(U) Schedule: Dense Metal Case Penetrating Weapon (DMCPW)(Wright laboratory/United Kingdom) - Original planning with the United Kingdom led to the development of a schedule which would culminate in a weapon demonstration in late FY98 to early FY99. Subsequent planning and coordination with the United Kingdom has moved the demonstration to late FY99.

Image Information Reformatter (IIR) (Rome Laboratory/France) - The Phase II development and fabrication of the Advanced Development Model IIR has been rescheduled due to French delays in starting their portion of the Phase I concept definition studies.

Very High Resolution Imaging by Interferometry (Phillips Laboratory/France) - The project has been put on hold pending completion of an OSD review.

(U) Technical: N/A

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) N/A										

Related RDT&E:
(U) This program element complements OSD NATO Cooperative R&D PE 0603790D which funds the first year only of any new DoD agreement. It also provides ICRD&A funds for USAF Laboratory 6.1 through 6.3 programs and USAF Product, Test, and Logistics Center 6.4 through 6.5 programs. Management support for Air Force NATO Cooperative R&D PE0603790F is funded in Air Force International Activities PE1001004F at the level of $300,000 per fiscal year.

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(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Image/Information Reformatter (IIR)**																
(U) Concept definition activities	X	X	X	X	X											
(U) Draft program implementation plan				X	X											
(U) Request for proposal released						X										
(U) Contract award								X								
(U) Development and fabrication of Advanced Development Model IIR and interfaces								X	X	X	X	X	X	X	X	
(U) **Experimental Air Operations Center (EAOC)**																
(U) Agreement signed		X														
(U) Project definition, database development, configuration management			X	X												
(U) Research and advanced development into key command and control (C2) areas of Combined Air Operations Center (CAOC) functionality					X	X	X	X	X	X	X	X	X	X	X	X
(U) Early fielding in Theater Battle Management Core System (TBMCS) core releases								X				X				
(U) Project demonstration										X						

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

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	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Vista Warrior**																
(U) Agreement signed				X												
(U) Develop and demonstrate advanced technologies and interface concepts in labs and simulators				X	X	X	X	X	X	X	X	X	X			
(U) Demonstrate the technology developed on operational fast jet aircraft									X	X	X	X	X	X	X	X
(U) **Effects of the Ionosphere on C3I Systems**																
(U) Agreement signed		X														
(U) US provide the Parameterized Ionospheric-specification Model (PRISM)				X												
(U) UK provide the Jamming and Interception Evaluation (JIVE) System				X												
(U) Validate Global Positioning System (GPS)-Meteorological data to drive sensor driven ionospheric models						X										
(U) Assess near real-time UK ionospheric tomography data in the US PRISM model								X								
(U) UK provide the latest Ray-Tracing algorithms for use with the PRISM									X							
(U) Assess UK oblique sounder system									X							
(U) Couple US PRISM model to UK Ray-Tracing Code											X					
(U) Develop algorithms to couple GPS-Meteorological data into PRISM model												X				

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603790F NATO Cooperative Research and Development**
	PROJECT **64**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Future Multiband, Multi-waveform Modular Tactical Radio (FM3TR)**																
(U) Agreement signed			X													
(U) Waveform description completed		X														
(U) Waveform definition completed			X		X											
(U) Demonstration plan completed			X	X												
(U) Waveform hosting								X								
(U) US demonstration									X							
(U) International demos											X	X	X			
(U) **Single Mode (SM) Optical Fibers for Array Imaging and for Environmental Sensing**																
(U) Agreement Signed				X												
(U) SM fiber optical signal demonstration, identification of key parameters, development of control loops				X	X											
(U) Evaluation of Wavefront Sensing (WFS) techniques and characterization of Multi-Core SM Fiber (MCSMF)					X	X	X	X								
(U) Test and evaluation of MCSMF									X	X	X	X				
(U) Construction of fiber sensor and prototype													X	X	X	X

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603790F NATO Cooperative Research and Development

PROJECT: 64

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Adaptive Flexible Structures for Air Vehicle Applications**																
(U) Agreement signed							X									
(U) US deliver and install buffet load alleviation (BLA) control system								X								
(U) Australia attach facility sensors								X								
(U) Australia install test aircraft in facility								X								
(U) Australia conduct open-loop test									X							
(U) US reduce and distribute open-loop data									X							
(U) Develop control algorithms									X							
(U) Australia conduct closed-loop test									X							
(U) Prepare interim report										X						
(U) Ground test coordination										X						
(U) Additional ground tests											X					
(U) **Dense Metal Case Penetrating Weapon (DMCPW)**																
(U) Agreement signed						X										
(U) Concept definition						X	X									
(U) Preliminary design							X	X	X	X	X					
(U) Sub System design and development											X	X	X	X		
(U) Sub System integration, development, and tests														X	X	X
(U) UK subscale and full scale penetrator trials					X	X		X	X	X	X	X	X	X		
(U) US ground sled demonstration tests														X		
(U) US flight weapon demonstration tests																X
(U) Analysis and material tests					X	X	X	X	X	X	X	X	X	X	X	X

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	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Advanced Flooding Agent**																
(U) Agreement signed							X									
(U) Candidate agent(s) survey/identified								X								
(U) Agent(s) synthesis/small scale, laboratory testing														X		
(U) **Cooperation in Infrared Spectral Imaging for Low Observable Signatures**																
(U) Agreement signed							X									
(U) Preliminary design							X									
(U) Concept checkout									X							
(U) Interim report											X					
(U) Advanced design												X				
(U) Prototype development															X	
(U) Delivery of prototype imaging spectrometer																X

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603790F NATO Cooperative Research and Development**
	PROJECT **64**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Effects of the Ionosphere on Communications and Surveillance Systems**																
(U) Agreement signed						X										
(U) US provide ionosphere model							X									
(U) France provide equatorial ionosphere data							X									
(U) US and France specify requirements for low power digital ionospheric sounder (LPDIS)									X							
(U) France provide high frequency signal data to test model												X				
(U) US will assess efficacy of French high frequency ionospheric sounding techniques												X				
(U) Develop engineering specifications for LPDIS													X			
(U) **Free Piston Shock Tunnel/High Enthalpy Goettingen Project**																
(U) Agreement signed						X										
(U) Specify testing conditions, test articles, instrumentation and diagnostics						X	X									
(U) Calibration, fabrication of models, testing							X		X	X	X					
(U) Exchange consultations						X	X	X	X							
(U) Exchange instrumentation and diagnostic articles								X	X			X	X			
(U) Final report														X		

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603790F NATO Cooperative Research and Development**

PROJECT **64**

	FY 1996				FY1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Programmable Integrated Ordnance Suite (PIOS)**																
(U) Agreement signed						X										
(U) Model and evaluate concept ordnance suites						X	X	X	X							
(U) Preliminary design of best ordnance suite concept										X	X	X				
(U) Perform detailed design, fabrication, and laboratory tests and evaluation of counter air ordnance components													X	X	X	X
(U) **Observations and Modeling for Space Weather**																
(U) Agreement signed									X							
(U) Exchange existing data									X	X						
(U) Analyze existing data									X	X	X					
(U) Upgrade models									X	X	X	X	X	X	X	X
(U) Prepare and launch US and German satellite experiments										X	X	X		X	X	X
(U) Support on-orbit operations												X	X	X	X	X
(U) Analysis of satellite data													X	X	X	X
(U) **Regional/Sector Air Operations Center (R/SAOC) Modernization Program**																
(U) Agreement signed				X												
(U) Request for proposal released					X											
(U) Contract award						X										
(U) Early fielding										X						

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BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603790F NATO Cooperative Research and Development

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	FY 1996				FY1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Strengthening of Concrete Structures for Enhanced Structural Survivability**																
(U) Agreement signed						X										
(U) Materials evaluation and selection						X	X	X	X							
(U) Structural component evaluation						X	X	X	X	X						
(U) Full structure field tests						X			X				X			
(U) Initial operational capability														X		
(U) **Cooperative Space Measurements**																
(U) Preliminary design				X	X	X										
(U) Detailed design						X	X									
(U) Agreement signed								X								
(U) Development and Test							X	X	X	X						
(U) Delivery to spacecraft integrator											X					
(U) Launch															X	
(U) Data collection															X	X
(U) **Project Refractive Turbulence**																
(U) Design probe supports					X	X										
(U) Build probe mounts						X										
(U) Build turbulence probes						X										
(U) Aircraft certification						X										
(U) Agreement signed							X									
(U) Test measuring systems on aircraft							X									
(U) Flight measurements								X	X			X	X			X
(U) Field measurement reports										X				X		
(U) Data reduction									X	X	X	X	X	X	X	X
(U) Data analysis									X	X	X	X	X	X	X	X

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
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	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Metal Matrix Composites (MMCs) for Aerospace Applications**																
(U) Agreement signed							X									
(U) Concept definition							X	X								
(U) Produce and evaluate MMCs									X	X	X	X	X	X	X	X
(U) Specify improved MMCs														X	X	X
(U) Produce and evaluate improved MMC																X
(U) **Advanced Combustor Chamber Concepts Program**																
(U) Agreement signed								X								
(U) Combustor conceptual design									X	X	X	X	X	X	X	X
(U) Material/fabrication sample tests										X	X	X				
(U) Cooled panel tests															X	X
(U) Evaluate design approach																X

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PROJECT: 64

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Integrated Tactical Aircraft Control (ITAC) Program**																
(U) Agreement signed							X									
(U) System design and development								X	X	X	X	X	X	X	X	X
(U) Detailed design														X	X	X
(U) **Anthropometric Accommodation in Crew Systems**																
(U) Agreement signed								X								
(U) Conduct anthropometric survey									X	X	X	X	X	X	X	X
(U) Assess subjects in actual crew station										X	X	X	X	X	X	X
(U) Assess one type of human model in two crew stations													X	X	X	X
(U) **Transatlantic Research into Air Combat Engagements (TRACE) Phase 2**																
(U) Program preparation									X	X	X	X				
(U) Evaluation of pilot aids											X	X	X			
(U) Network Wright Laboratory with test range													X	X	X	X
(U) Link Germany into US test range															X	X
(U) Assessment Simulations																X
(U) Report and analysis															X	X

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603790F NATO Cooperative Research and Development**
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	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Aging Aircraft Life Prediction/ Extension**																
(U) Agreement Signed							X									
(U) Document widespread fatigue damage experience									X							
(U) Coordinate with US													X			
(U) Develop corrosion/fatigue analysis techniques										X						
(U) Document composite patch service experience								X								
(U) Evaluate existing composite patch analysis techniques for metallic structures								X								
(U) Identify health monitoring sensors								X								
(U) Prepare for flight tests										X						
(U) **Airworthiness of Aging Aircraft**																
(U) Agreement signed							X									
(U) Develop life enhancement analysis techniques													X			
(U) Conduct experiments															X	
(U) Document corrosion/fatigue service experience										X						
(U) Document composite patch service experience								X								
(U) Evaluate existing composite patch analysis techniques for metallic structures									X							

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BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603790F NATO Cooperative Research and Development**
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	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) **Structural Integrity of Aging Aircraft**																
(U) Agreement signed								X								
(U) Document widespread fatigue damage service experience										X						
(U) Develop widespread fatigue damage analytical models														X		
(U) Develop corrosion/fatigue analysis techniques												X				
(U) Evaluate existing composite patch analysis techniques for metallic structures										X						
(U) Identify candidate solutions for dynamic control														X		
(U) Develop health monitoring brassboard models													X			
(U) Identify fatigue life enhancement techniques																X

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603790F NATO Cooperative Research and Development**
	PROJECT **64**

(U) A. Project Cost Breakdown ($ in Thousands)

***Prior to FY97 OSD funded NATO Cooperative R&D agreements under PE0603790D. In FY97 responsibility for funding NATO Cooperative R&D agreements will be shared with the Services. Prior OSD cost information for Air Force projects is not shown.**

Firm information regarding the use of NATO Cooperative R&D funds is not available for proposed agreements, since they are still being staffed or negotiated. In addition, future funding for continuing agreeements is not available in all instances because the funds are used as needed to supplement a project office's related 6.1 through 6.5 RDT&E appropriations and the allocation of FY99 funds has not yet been determined. Information is available for the following continuing projects:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Image Information Reformatter (IIR)		475	1,600	0
(U) Experimental Air Operations Center (EAOC)		2,700	0	0
(U) Vista Warrior		2,600	2,528	Cont
(U) Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems		700	550	Cont
(U) Future Multiband, Multiwaveform Modular Tactical Radio (FM3TR)		700	0	0
(U) Single Mode Optical Fibers for Array Imaging and for Environmental Sensing		100	100	0
(U) Other International Agreements		2,508	8,655	Cont
(U) Total		9,783	13,433	11,341

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603790F NATO Cooperative Research and Development PROJECT 64

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Lockheed Martin Salt Lake City, UT	CPFF	Sep 95					120	0	0	0	120
TBD	CPFF	Sep 97					200	1,300	0	0	1,500
Lockheed Martin Colorado Springs, CO	CPAF	Oct 95					1,000	0	0	0	1,000
Logicon San Pedro, CA	CPFF	Jun 94					1,000	0	0	0	1,000
McDonnell Douglas St Louis, MO	CPIF	May 94					1,450	878	TBD	0	TBD
Sytronics Dayton, OH	CPFF	Sep 93					2	0	0	0	2
Logicon San Pedro, CA	CPFF	Jan 94					1,104	1,600	TBD	0	TBD
Boston College Boston, MA	CFSR	Mar 97					50	50	TBD	TBD	TBD
RADEX Bedford, MA	CPFF	Mar 97					150	100	TBD	TBD	TBD

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)											DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation				PE NUMBER AND TITLE 0603790F NATO Cooperative Research and Development							PROJECT 64
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Pacific Sierra Research Santa Monica CA	CPFF	Mar 97					60	50	TBD	TBD	TBD
CPI Fairfax VA	CPFF	Mar 97					50	50	TBD	TBD	TBD
University of Massachusetts Lowell, MA	CFSR	Apr 97					100	100	TBD	TBD	TBD
KEO Consultants Brookline, MA	CPFF	Mar 97					100	50	TBD	TBD	TBD
Northwest Research Associates Bellevue, WA	CPFF	Apr 97					115	115	TBD	TBD	TBD
Rome Research Corporation Rome, NY	CPFF	Oct 96					500	0	0	0	500
Support and Management Organizations											
Rome Laboratory, NY							155	150	0	0	305
Rome Laboratory, NY	AF 616						80	0	0	0	80
MITRE Bedford, MA							300	0	0	0	300
Electronic Systems Center, MA							320	0	0	0	320

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE: February 1997
BUDGET ACTIVITY: 4 - Demonstration and Validation	PE NUMBER AND TITLE: 0603790F NATO Cooperative Research and Development	PROJECT: 64

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Armstrong Laboratory, OH							44	50	TBD	0	TBD
Phillips Laboratory, MA							75	35	TBD	TBD	TBD
Rome Laboratory, NY							100	0	0	0	100
BMDO	MIPR						50	50	0	0	TBD
Rockwell Power Systems, NM							20	20	0	0	TBD
Phillips Laboratory, NM							30	30	0	0	TBD
Test and Evaluation Organizations											
TBD	TBD							150	0	0	150
Rome Laboratory, NY	MIPR						100	0	0	0	100

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603790F NATO Cooperative Research and Development**

PROJECT **64**

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development						N/A	N/A	N/A	N/A	Cont
Subtotal Support and Management						N/A	N/A	N/A	N/A	Cont
Subtotal Test and Evaluation						N/A	N/A	N/A	N/A	Cont

Firm information regarding the use of NATO Cooperative R&D funds is not available for proposed agreements, since they are still being staffed or negotiated. In addition, future funding for continuing agreeements is not available in all instances because the funds are used as needed to supplement a project office's related 6.1 through 6.5 RDT&E appropriations and the final allocation of FY99 funds has not yet been determined. Project cost breakdowns and subtotals are not available for the following dollar amounts:

To Be Defined	2,508	8,655	11,341	Cont	Cont
Total Project	9,783	13,433	11,341	Cont	Cont

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603800F Joint Adv Strike Tech Program

PROJECT: 2025

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2025 Joint Advanced Strike Technology (JAST) -- JSF	81,277	252,043	458,052	465,611	245,439	23,641	0	0	0	1,609,843
Quantity of RDT&E Articles	0	0	0	0	4*	0	0	0	0	

*** Unit cost of RDT&E articles not separately priced.**

(U) **A. Mission Description and Budget Item Justification**

The Joint Strike Fighter (JSF) Program (formally JAST) will develop and field an affordable, highly common family of next generation strike aircraft for the USN, USMC, USAF and allies. Current program emphasis is on facilitating the evolution of fully validated and affordable joint operational requirements, and demonstrating cost leveraging technologies and concepts to lower risk prior to entering Engineering and Manufacturing Demonstration (E&MD) in FY 2001. This is a joint program with no executive service. Navy and Air Force each provide approximately equal shares of annual funding for the program effective in FY 1995. The Defense Advanced Research Projects Agency (DARPA) and the United Kingdom (UK) contribute funding effective in FY 1996. The Netherlands, Norway and Denmark will contribute funding effective in FY 1997 under a Multi-Lateral Agreement.

This program is funded under DEMONSTRATION & VALIDATION because it integrates hardware for test related to specific ship or aircraft applications.

(U) FY 1996 ($ in Thousands) (Breakout reflects Navy, Air Force, DARPA and UK funding):

- (U) $60,768 Completed concept definition and design research for weapon system concepts for a tri-service family of aircraft; received contractors' preferred weapon system concepts and recommended development and demonstration plans; and continued affordability analyses.
- (U) $7,000 Conducted Phase I of the Alternate Engine Program, including study efforts and preliminary design risk reduction activities.
- (U) $111,587 Completed technology maturation concept definition and design research; continued demonstrations and assessments in the areas of airframe, flight systems, manufacturing and producibility, propulsion, mission systems and supportability.
- (U) $7,101 Continued strategy-to-task analysis and strike warfare demonstrations and assessments to facilitate the Services' joint requirements definition.
- (U) $5,065 Continued modeling and simulation activities to support strike warfare mission area analysis.
- (U) $5,502 Completed Advanced Short Takeoff and Vertical Landing (ASTOVL) risk mitigation efforts, integrated with JAST Program Concept Development tasks.
- (U) $7,152 Supported program operations, including program office functions.
- (U) $204,175 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603800F Joint Adv Strike Tech Program PROJECT 2025

(U) FY 1997 ($ in Thousands) (Breakout reflects Navy, Air Force, DARPA, UK and Multi-Lateral funding):

- (U) $411,620 Competitively awarded contracts to Boeing and Lockheed Martin for ground and flight demonstrations and continued concept refinement for a tri-service family of aircraft that meets the Services' needs and optimizes commonality among the variants to minimize life cycles costs (LCC); award contract to Pratt & Whitney for supporting propulsion efforts.
- (U) $25,000 Commence Phase II of the Alternate Engine Program, which continues detailed design and begins hardware testing.
  (a) Within this amount, $10M has been included for early risk reduction on critical technologies for the alternative engine.
  (b) The Department is evaluating acceleration of the alternative engine to meet a Lot 4 production introduction.
- (U) $6,308 Continue requirements analysis efforts including Cost & Operational Trades (COPT) to facilitate the Services' joint requirements definition.
- (U) $10,292 Continue modeling and simulation activities to support strike warfare mission area analysis.
- (U) $172,695 Continue technology maturation demonstrations and assessments in the areas of airframe, flight systems, manufacturing and producibility, propulsion, mission systems, and supportability. Commence systems engineering support for the Concept Demonstration Phase in the areas of system test, air vehicle analysis and integration, advanced cost estimating, survivability, integrated flight and propulsion control and carrier suitability.
- (U) $9,525 Support program operations, including program office functions; Congressionally directed OSD Force Structure Analysis.
- (U) $6,035 USN portion of program reduced for transfer to Small Business Innovative Research assessment in accordance with 15 U.S.C. 638.
- (U) $12,809 Anticipated USAF & DARPA general reductions.
- (U) $654,284 Total

(U) FY 1998 ($ in Thousands) (Breakout reflects Navy, Air Force, DARPA, UK and Multi-Lateral funding):

- (U) $718,261 Continue Concept Demonstration efforts by Boeing, Lockheed Martin and Pratt & Whitney for ground and flight demonstrations and continued concept refinement for a tri-service family of aircraft.
- (U) $20,000 Continue the Alternate Engine Program.
- (U) $7,287 Continue requirements analysis efforts including Cost & Operational Trades (COPT) to facilitate the Services' joint requirements definition.
- (U) $11,913 Continue modeling and simulation activities to support strike warfare mission area analysis.
- (U) $231,591 Continue technology maturation demonstrations and assessments in the areas of airframe, flight systems, manufacturing and producibility, propulsion, mission systems, and supportability. Continue systems engineering support for the Concept Demonstration Phase in the areas of system test, air vehicle analysis and integration, advanced cost estimating, survivability, integrated flight and propulsion control and carrier suitability.
- (U) $6,355 Support program operations, including program office functions.
- (U) $995,407 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603800F Joint Adv Strike Tech Program
	PROJECT 2025

(U) FY 1999 ($ in Thousands) (Breakout reflects Navy, Air Force, DARPA, UK and Multi-Lateral funding):

- (U) $702,484 Continue Concept Demonstration efforts by Boeing, Lockheed Martin and Pratt & Whitney for ground and flight demonstrations and continued concept refinement for a tri-service family of aircraft.
- (U) $23,000 Continue the Alternate Engine Program.
- (U) $5,776 Continue requirements analysis efforts including Cost & Operational Trades (COPT) to facilitate the Services' joint requirements definition; receive Joint Operational Requirements Document (JORD) from the Services.
- (U) $9,424 Continue modeling and simulation activities to support strike warfare mission area analysis.
- (U) $203,749 Continue technology maturation demonstrations and assessments in the areas of structures and material, flight systems, manufacturing and producibility, propulsion, mission systems, and supportability. Continue systems engineering support for the Concept Demonstration Phase in the areas of system test, air vehicle analysis and integration, advanced cost estimating, survivability, integrated flight and propulsion control and carrier suitability.
- (U) $6,300 Support program operations, including program office functions.
- (U) $950,733 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	151,186	263,836	431,057	458,527	1,576,014
(U) Appropriated Value	85,686	263,836			
(U) Adjustments to Appropriated Value					
a. Cong Reductions	-1,678	-5,541			
b. SBIR	-1,649	-6,252			
c. Omnibus or Other Above Threshold Reprogram	-529				
d. Below Threshold Reprogramming	-44				
e. Rescissions	-509				
(U) Adjustments to Budget Years Since FY 1997 PB			+26,995	+7,084	
(U) Current Budget Submit/FY1998 PB	81,277	252,043	458,052	465,611	1,609,843

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603800F Joint Adv Strike Tech Program
	PROJECT 2025

(U) Change Summary Explanation:

Funding:

- (U) FY 1996: Decremented by $1,678 thousand for General Congressional Reductions (FY96 Appr Act Sec 8125, 8129 & 8101), $1,649 thousand for SBIR, $529 thousand for Bosnia I Reduction, $455 thousand for Bosnia II/Jordanian Recission, $54 thousand for 1996 Administrative & Personnel Rescission, $18 thousand for #0604851F - McClellan Nuclear Reactor, and $26 thousand for Bosnia shortfalls.
- (U) FY 1997: Decremented by $5,525 thousand for General Congressional Reductions (FY97 Appr Act Sec 8136 & 8138), $7 thousand for FFRDC, $9 thousand for non-FFRDC, and $6,252 thousand for SBIR.
- (U) FY 1998: Increased by $28,800 thousand to reflect the replacement of funding formerly provided by DARPA. Decremented by $121 thousand for O&M adjustments, and $1,684 thousand for inflation savings.
- (U) FY 1999: Increased by $9,500 thousand to reflect the replacement of funding formerly provided by DARPA. Decremented by $150 thousand for O&M adjustments, and $2,266 thousand for inflation savings.

Schedule: No change. Program schedule is consistent with recent PDRR contract awards.

Technical: Not Applicable

(U) C.a. Other Program Funding Summary ($ in Thousands): This is a joint program with no executive service. The United Kingdom is a full collaborative partner in the program in accordance with a Memorandum of Understanding (MOU) signed in December 1995. The Netherlands, Norway and Denmark will become associate partners in the program in accordance with a Multi-Lateral Memorandum of Agreement (MOA) to be signed in the second quarter of FY 1997.

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) RDT&E 0603800N	79,981	246,076	448,855	443,522	249,429	25,448	0	0	0	1,621,099
(U) RDT&E 0603800E	28,917	76,865	23,900	0	0	0	0	0	0	129,682
(U) United Kingdom	14,000	71,000	55,000	34,000	26,000	0	0	0	0	200,000
(U) Multi-Lateral	0	8,300	9,600	7,600	5,000	1,700				

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603800F Joint Adv Strike Tech Program
	PROJECT 2025

(U) C.b. Related Program Funding Summary ($ in Thousands): Milestone II for E&MD of the Joint Strike Fighter (JSF) is planned in FY 2001.

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) RDT&E 0604800F	0	0	0	0	0	560,234	1,399,882	1,915,720	TBD*	TBD*
(U) RDT&E 0604800N	0	0	0	0	0	558,184	1,398,026	1,913,742	TBD*	TBD*

* Pending initial SAR approval, 3QTR FY97

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Commenced Concept Development Phase -- Dec 1994																
(U) Released RFP for Concept Demonstration Phase -- Mar 1996		X														
(U) Designated a joint, DOD, Acquisition Category ID Program by USD(A&T) -- May 1996			X													
(U) Competitively awarded Concept Demonstration Contracts to Boeing and Lockheed Martin -- Nov 1996					X											
(U) Milestone II for JSF E&MD -- Mar 2001																

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603800F Joint Adv Strike Tech Program PROJECT 2025

(U) A. Project Cost Breakdown ($ in Thousands)

Project Cost Categories:	FY 1996	FY 1997	FY 1998	FY 1999
(U) a. Strike Warfare Systems Design Development	60,768			
(U) b. Weapon System Concept Demonstrations Contracts (including flying demonstrations)		411,620	718,261	702,484
(U) c. Alternate Engine Program	7,000	25,000	20,000	23,000
(U) d. ASTOVL	5,502			
(U) e. Technology Maturation and Systems Engineering Support Total	111,587	172,695	231,591	203,749
Breakout:				
Technology Maturation				
Airframe	10,417	13,083	24,900	21,200
Flight Systems	31,363	38,736	32,200	24,800
Manufacturing & Producibility	5,475	4,597	5,400	8,950
Propulsion	35,654	33,304	38,523	9,200
Mission Systems	24,237	36,874	63,197	77,580
Supportability	3,554	6,800	8,480	20,850
Core Team Support	887			
Subtotal - Technology Maturation	111,587	133,394	172,700	162,580
Plus: Systems Engineering Support	0	39,301	58,891	41,169
SUBTOTAL	111,587	172,695	231,591	203,749

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE: February 1997
BUDGET ACTIVITY: 4 - Demonstration and Validation	PE NUMBER AND TITLE: 0603800F Joint Adv Strike Tech Program			PROJECT: 2025
Project Cost Categories:	FY 1996	FY 1997	FY 1998	FY 1999
(U) f. Requirements Analysis Total	12,166	16,600	19,200	15,200
Breakout:				
Requirements Analysis (Analysis, Threat/Intelligence, Cost & Operational Performance Trades and Core Team Support)	7,101	6,308	7,287	5,776
Modeling and Simulation	5,065	10,292	11,913	9,424
(U) g. Program Operations	7,152	9,525	6,355	6,300
(U) h. USN SBIR		6,035		
(U) i. USAF/DARPA General Reductions		12,809		
(U) Total	204,175	654,284	995,407	950,733
Funding Resources:				
0603800N	79,981	246,076	448,855	443,522
0603800F	81,277	252,043	458,052	465,611
0603800E	28,917	76,865	23,900	0
United Kingdom	14,000	71,000	55,000	34,000
Multi-Lateral		8,300	9,600	7,600
(U) Total	204,175	654,284	995,407	950,733

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603800F Joint Adv Strike Tech Program PROJECT 2025

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/ Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development											
Strike Warfare Concept Studies (Total Prior to 1996)											
Miscellaneous	Various	Oct93 - Sep 94	11,467	11,467	11,467						11,467
Technology Maturation Concept Exploration Phase (Total Prior to 1996)											
Fld. Act.	Various	Oct93 - Sep 94	3,432	3,432	3,432						3,432
Strike Warfare Systems Design Development											
Boeing Seattle WA	C/CPFF	Oct 95	32,770	32,770	14,140	18,630					32,770
McAir St. Louis MO	C/CPFF	Oct 95	23,708	23,708	14,393	9,315					23,708
Northrop Pico Rivera CA	C/CPFF	Oct 95	21,358	21,358	12,043	9,315					21,358
Lockheed Fort Worth, TX	C/CPFF	Oct 95	28,311	28,311	9,950	18,361					28,311
Miscellaneous	Various	Various	1,121	1,121	821	300					1,121
Fld. Activ.	Various	Oct95-Sep96	8,322	8,322	3,475	4,847					8,322
SUBTOTAL					54,822	60,768					115,590

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)											DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation				PE NUMBER AND TITLE 0603800F Joint Adv Strike Tech Program							PROJECT 2025
Contractor or Government Performing Activity	Contract Method/ Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Weapon System Concept Demonstrations (including flying demonstrators and supporting propulsion efforts)											
Boeing	C/CPFF	Nov 96	661,802	661,802	*		67,208	199,827	238,684	156,083	661,802
Lockheed	C/CPFF	Nov 96	718,800	718,800	*		105,900	215,200	246,900	150,800	718,800
Pratt & Whitney West Palm Beach FL	SS/CPAF	Nov 96	832,046	832,046			238,512	303,234	216,900	73,400	832,046
SUBTOTAL			2,212,648	2,212,648			411,620	718,261	702,484	380,283	2,212,648
*includes government managed equipment											
Alternative Engine Program											
GE	SS/CPFF	Oct 97	105,000	105,000		7,000	25,000	20,000	23,000	30,000	105,000
ASTOVL											
Lockheed	SS/CPFF	Oct 95	16,416	16,416	14,067	2,349					16,416
Boeing	SS/CPFF	Oct 95	11,200	11,200	8,047	3,153					11,200
Miscellaneous	Various	Various	15,539	15,539	15,539	0					15,539
SUBTOTAL					37,653	5,502					43,155
Technology Maturation and Systems Engineering Support											
Airframe											
McAir	SS/CPFF	Oct 97	70,800	70,800	3,300	8,800	11,800	23,300	19,600	4,000	70,800
Miscellaneous	Various	Various	2,661	2,661	1,007	854		400	400		2,661
Fld. Activ.	Various	Oct97-Sep98	6,128	6,128	1,276	512	1,110	1,130	1,120	980	6,128
SUBTOTAL					5,583	10,166	12,910	24,830	21,120	4,980	79,589
Flight Systems											
Lockheed	C/CPFF	Oct 97	47,992	47,992	740	14,556	15,793	9,600	5,800	1,503	47,992
McAir	C/CPFF	Oct 97	64,821	64,821	1,186	13,515	16,600	18,000	14,400	1,120	64,821

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603800F Joint Adv Strike Tech Program

PROJECT: 2025

Contractor or Government Performing Activity	Contract Method/ Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Contracts Less Than $1.0M											
Various	CPFF	Various	9,229	9,229	6,397	501	1,131	400	400	400	9,229
Flight Systems (Cont.)											
Fld. Activ.	Various	Oct97-Sep98	22,453	22,453	3,175	2,751	5,112	4,090	4,080	3,245	22,453
SUBTOTAL					11,498	31,323	38,636	32,090	24,680	6,268	144,495
Manufacturing & Producibility											
Hughes Los Angeles CA	C/CPFF	Oct 97	18,400	18,400	1,397	1,638	2,030	635	2,800	9,900	18,400
Lockheed	C/CPFF	Oct 97	11,193	11,193	1,581	1,316	1,836	2,770	2,890	800	11,193
General Res. Corp. Huntsville AL	C/CPFF	Oct 95	1,945	1,945	465	1,480					1,945
New Contract	C/CPFF	Oct 97	4,600	4,600				1,100	2,200	1,300	4,600
Miscellaneous	Various	Various	6,101	6,101	1,724	1,031	731	685	845	1,085	6,101
SUBTOTAL					5,167	5,465	4,597	5,190	8,735	13,085	42,239
Propulsion											
Pratt/Whitney	C/CPFF	Oct 95	5,448	5,448	4,212	1,236					5,448
GE Cincinnati OH	SS/CPFF	Oct 95	5,681	5,681	4,331	1,350					5,681
Pratt/Whitney	SS/CPFF	Nov 95	30,000	30,000		30,000					30,000
Pratt/Whitney	SS/CPFF	Nov 97	60,854	60,854			22,681	33,173	5,000		60,854
GE	SS/CPFF	Nov 97	8,000	8,000			3,000	3,000	2,000		8,000
New Contract	SS/CPFF	Feb 97	5,000	5,000			5,000				5,000
Contracts Less Than $1.0M											
Various	CPFF	Various	13,195	13,195	11,263	1,632	300				13,195

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

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BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603800F Joint Adv Strike Tech Program

PROJECT: 2025

Contractor or Government Performing Activity	Contract Method/ Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Fld. Activ.	Various	Oct97-Sep98	8,967	8,967	803	1,411	2,293	2,310	2,150	0	8,967
SUBTOTAL					20,609	35,629	33,274	38,483	9,150	0	137,145
Mission Systems											
TI Plano TX	C/CPFF	Dec 95	2,464	2,464	1,413	1,051					2,464
Lockheed	SS/CPFF	Oct 97	7,506	7,506	740	2,266	2,250	2,250			7,506
McAir	SS/CPFF	Oct 97	7,174	7,174	740	1,934	2,250	2,250			7,174
Hughes	C/CPFF	Oct 97	54,637	54,637		4,653	8,619	14,002	23,832	3,531	54,637
Westinghouse Baltimore MD	C/CPFF	Oct 97	49,998	49,998		4,288	7,660	13,998	20,522	3,530	49,998
Boeing	C/CPFF	Oct 97	26,848	26,848		300	3,883	11,000	10,515	1,150	26,848
Lockheed	C/CPFF	Oct 97	26,791	26,791		300	3,826	11,000	10,515	1,150	26,791
New Contract	C/CPFF	Dec 97	25,150	25,150				2,900	5,000	17,250	25,150
Hughes	C/CPFF	Oct 98	3,681	3,681	1,019	1,609	1,053				3,681
Miscellaneous	Various	Various	19,698	19,698	15,656	3,197	45	200	200	400	19,698
Fld. Activ.	Various	Oct97-Sep98	35,364	35,364	6,573	4,409	6,797	5,517	6,906	5,162	35,364
SUBTOTAL					26,141	24,007	36,383	63,117	77,490	32,173	259,311
Supportability											
Classified											
Project 3	C/CPFF	Jan 98	15,262	15,262	770	1,492	3,000	4,000	1,000	5,000	15,262
Project 4	C/CPFF	Jan 98	7,418	7,418	800	238	2,000	1,480	1,000	1,900	7,418
New Contract	C/CPFF	Jan 98	26,900	26,900				1,800	8,000	17,100	26,900
New Contract	C/CPFF	Jan 99	20,841	20,841					7,800	13,041	20,841
Miscellaneous	Various	Various	2,227	2,227	1,914	213	100				2,227

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603800F Joint Adv Strike Tech Program

PROJECT: 2025

Contractor or Government Performing Activity	Contract Method/ Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Fld. Activ.	Various	Oct97-Sep98	12,780	12,780	1,523	1,521	1,586	1,200	3,050	3,900	12,780
SUBTOTAL					5,007	3,464	6,686	8,480	20,850	40,941	85,428
Core Team Support											
Fld. Activ.	Various	Oct 95 - Sep 96	2,522	2,522	1,635	887					2,522
Systems Engineering Support											
Contracts Less Than $1.0M											
Various	CPFF	Various	7,042	7,042			1,539	2,356	1,647	1,500	7,042
Fld. Activ.	Various	Oct97-Sep98	180,299	180,299			37,762	56,535	39,522	46,480	180,299
SUBTOTAL							39,301	58,891	41,169	47,980	187,341
Requirements Analysis											
Contracts Less Than $1.0M											
Various	CPFF	Various	20,342	20,342	3,293	4,005	3,366	3,919	3,042	2,717	20,342
Fld. Activ.	Various	Oct97-Sep98	19,351	19,351	5,809	2,985	2,712	3,138	2,484	2,223	19,351
SUBTOTAL					9,102	6,990	6,078	7,057	5,526	4,940	39,693
Modeling and Simulation											
Contracts Less Than $1.0M											
Various	CPFF	Various	31,539	31,539	1,223	3,118	6,907	8,208	6,441	5,642	31,539
Fld. Activ.	Various	Oct97-Sep98	13,398	13,398	249	1,558	2,985	3,455	2,733	2,418	13,398
SUBTOTAL					1,472	4,676	9,892	11,663	9,174	8,060	44,937

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)											DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation					PE NUMBER AND TITLE 0603800F Joint Adv Strike Tech Program						PROJECT 2025
Contractor or Government Performing Activity	Contract Method/ Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Program Operations											
Institute for Defense Anal	Grant	Jan 97	2,500	2,500			2,500				2,500
Fld. Activ.	Various	Oct97-Sep98	16,829	16,829	5,409	3,052	3,028	1,655	1,520	2,165	16,829
SUBTOTAL					5,409	3,052	5,528	1,655	1,520	2,165	19,329
Support and Management Organizations (CS)											
ANSER Arlington VA	SS/CPFF	Jan 97	12,253	12,253	6,192	3,601	2,460				12,253
New Contract	C/CPFF	Jan 98	12,745	12,745				4,160	4,250	4,335	12,745
Contracts Less Than $1.0M Various	CPFF	Oct97-Sep98	15,661	15,661	6,379	1,645	3,075	1,530	1,585	1,447	15,661
SUBTOTAL					12,571	5,246	5,535	5,690	5,835	5,782	40,659

Test and Evaluation Organizations: (included above)

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: N/A

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603800F Joint Adv Strike Tech Program	PROJECT 2025

	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development	198,997	198,929	629,905	989,717	944,898	570,875	3,533,321
Subtotal Support and Management	12,571	5,246	5,535	5,690	5,835	5,782	40,659
USN SBIR			6,035				6,035
USN/USAF/DARPA General Reductions			12,809				12,809
Subtotal Test and Evaluation							
Total Project	211,568	204,175	654,284	995,407	950,733	576,657	3,592,824

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603851F ICBM Dem/Val

	COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	19,690	46,037	32,837	31,951	34,986	47,644	45,632	50,973	Continuing	Continuing
1020	ICBM Guidance Applications	10,992	15,233	16,834	14,545	15,720	21,636	18,644	21,649	Continuing	Continuing
1021	ICBM Propulsion Applications	195	183	192	189	189	186	1,771	1,760	Continuing	Continuing
1022	ICBM Reentry Vehicle Applications	5,531	9,639	13,123	14,651	16,569	23,215	22,199	24,565	Continuing	Continuing
1023	Rocket System Launch Program (RSLP) Applications	28	17,838	31	32	34	36	34	35	Continuing	Continuing
1024	ICBM Command & Control (C2) Applications	195	1,051	192	189	189	186	466	463	Continuing	Continuing
4209	Long Range Planning (LRP)	2,749	2,093	2,465	2,345	2,285	2,385	2,518	2,501	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification

(U) Efforts identify methods to reduce life cycle costs, to improve nuclear safety and surety, to support international arms control agreements, and to ensure continued ICBM viability. Program includes demonstration and validation projects for ICBM guidance options, to support reentry vehicles beyond original design life, to provide an assessment of ICBM post-boost system, and develop enhancements to ensure command and control capabilities.

(U) This program is in Budget Activity 4 - Demonstration and Validation, Research Category 6.3, because the projects are demonstrate the general military utility and/or cost reduction potential of advanced technologies.

(U) **Acquisition Strategy:** Not applicable; only studies and analyses will be performed under this program element. Limited engineering and pre-prototype hardware development may be accomplished in support of these studies and analyses.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	19,533	30,644	37,279	40,505	Continuing
(U) Appropriated Value	31,765	48,344			
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions	-846	-1,062			
b. SBIR		-1,245			
c. Omnibus or Other Above Threshold Reprogram	-11,386				
d. Below Threshold Reprogramming	157				
(U) Adjustments to Budget Years Since FY 1997 PB			-4,442	-8,554	
(U) Current Budget Submit/President's Budget	19,690	46,037	32,837	31,951	Continuing

(U) Change Summary Explanation: See individual projects.

(U) **C. Other Program Funding Summary ($ in Thousands):**

Related RDT&E: PE 0605860F, Rocket System Launch Program (RSLP) (Space).

(U) **D. Schedule Profile:** See individual projects.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 4 - Demonstration and Validation	PE NUMBER AND TITLE: 0603851F ICBM Dem/Val — PROJECT: 1020

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1020 ICBM Guidance Applications	10,992	15,233	16,834	14,545	15,720	21,636	18,644	21,649	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**

(U) ICBM Guidance Application efforts implement the JROC-validated Mission Need Statement for Future Guidance Systems for Intercontinental Ballistic Missiles. The program focuses on disengagement strategies, significantly reducing guidance system life cycle cost, increasing nuclear surety, and evaluating/demonstrating the guidance instrument options that will keep ICBMs viable. This program also implements the Nuclear Posture Review recommendations to preserve guidance instrument technologies. The guidance applications project will demonstrate the utility and/or cost reduction potential of technologies applied to ICBM guidance systems, including future requirements.

(U) FY 1996 ($ in Thousands):

- (U) $1,720 Gyro Stabilized Platform Phase 0 activities including a cost options analysis.
- (U) $1,017 Integration of most promising advanced IMU designs into the Minuteman weapon system
- (U) $5,915 Advanced IMU concept prototype and begin sled test planning
- (U) $900 Advanced instrument technology prototypes
- (U) $400 Radiation hard parts design options study to determine risk areas and potential process improvements
- (U) $1,040 Other
- (U) $10,992 Total

(U) FY 1997 ($ in Thousands):

- (U) $1,312 Develop Gyro Stabilized Platform acquisition documents
- (U) $1,340 Continue integration assessment of advanced IMU design into Minuteman weapon system
- (U) $8,800 Conduct advanced IMU concept prototype sled test and evaluate results
- (U) $3,080 Conduct advanced instrument prototype design and test
- (U) $1,200 Continue radiation hard parts design options study and implementation of results
- (U) -$499 Other (includes -$542 adjustment for bills to be paid by RSLP Applications Project (BPAC 1023, this PE))
- (U) $15,233 Total

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(U) FY 1998 ($ in Thousands):

- (U) $580 Develop Gyro Stabilized Platform acquisition documentation
- (U) $8,220 Continue integration assessment of advanced IMU design into Minuteman weapon system
- (U) $1,900 Conduct advanced IMU concept prototype sled test and evaluate results
- (U) $3,125 Conduct advanced instrument prototype integration tests
- (U) $3,009 Continue radiation hardened parts efforts
- (U) $16,834 Total

(U) FY 1999 ($ in Thousands):

- (U) $3,045 Continue integration studies of advanced systems concepts into Minuteman weapon system
- (U) $8,500 Conduct design, test, and integration of advanced instruments
- (U) $3,000 Continue radiation hardened parts efforts
- (U) $14,545 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	11,032	15,998	19,075	18,814	Continuing
(U) Appropriated Value	11,544	15,998			
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions	-448	-363			
b. SBIR		-402			
c. Omnibus or Other Above Threshold Reprogram	-64				
d. Below Threshold Reprogramming	-40				
(U) Adjustments to Budget Years Since FY 1997 PB			-2,241	-4,269	
(U) Current Budget Submit/President's Budget	10,992	15,233	16,834	14,545	Continuing

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
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(U) Change Summary Explanation:

Funding: FY98-03 includes baseline extension and offset reductions to fund other AF and DoD priorities. FY97 spend plan revised based on FY96 accomplishments. FY96 funding adjusted by internal funding/reductions realignment.

Schedule: No significant impact.

Technical: No significant impact.

(U) C. Other Program Funding Summary ($ in Thousands):

Related RDT&E: None.

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Gyro Stabilized Platform Phase 0 Activities	X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	X				
(U) Advanced IMU Integration Assessments	X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	X				
(U) Alternate IMU Prototype Development/Integration		X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	X				
(U) Advanced Instrument Technology Prototyping		X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--->
(U) Radiation Hardened Parts Analysis		X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--->

* Started and/or Completed

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val
	PROJECT 1020

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Program Management Support	266	285	280	290
(U) Contract Systems Engineering	9,626	15,447	16,554	14,255
(U) Other	1,100	-499*		
(U) Total	10,992	15,233	16,834	14,545

* Includes -$542 adjustment for bills to be paid by RSLP Applications Project (BPAC 1023, this PE)

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Various	Various	Various	n/a	n/a	11,377	9,626	15,447	11,560	5,837	Continuing	53,847
Support and Management Organizations											
Various	Various	Various	n/a	n/a	401	266	285	280	290	Continuing	Continuing
Other						1,100	-499*				601
Test and Evaluation Organizations											
Various	Various	Various	n/a	n/a	0	0		4,994	8,418	Continuing	Continuing

* Includes -$542 adjustment for bills to be paid by RSLP Applications Project (BPAC 1023, this PE)

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val	PROJECT 1020

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Property										
None										
Support and Management Property										
None										
Test and Evaluation Property										
None										
Subtotal Product Development				11,377	9,626	15,447	11,560	5,837	Continuing	Continuing
Subtotal Support and Management				401	1,366	-214	280	290	Continuing	Continuing
Subtotal Test and Evaluation							4,994	8,418	Continuing	Continuing
Total Project				11,778	10,992	15,233	16,834	14,545	Continuing	Continuing

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603851F ICBM Dem/Val

PROJECT: 1021

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1021 ICBM Propulsion Applications	195	183	192	189	189	186	1,771	1,760	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**

(U) This applications project explores alternatives and improvements to the current ICBM propulsion systems capability. Program objectives focus on studies to assess future ICBM missile propulsion requirements. Fired Propulsion System Rocket Engine (PSRE) component reuse studies will also be accomplished.

(U) FY 1996 ($ in Thousands):

- (U) $90 Assessment of PSRE and study of options to meet Minuteman post boost vehicle requirements.
- (U) $50 Fired PSRE reuse study on components such as low thrust bipropellent valves.
- (U) $55 Ordnance component reuse studies.
- (U) $195 Total

(U) FY 1997 ($ in Thousands):

- (U) $183 Continue fired PSRE reuse study on components such as relief valves.
- (U) $183 Total

(U) FY 1998 ($ in Thousands):

- (U) $192 Conduct studies for improved ICBM booster propellant and materials.
- (U) $192 Total

(U) FY 1999 ($ in Thousands):

- (U) $189 Continue studies for improved ICBM booster propellant and materials.
- (U) $189 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
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	PROJECT 1021

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	195	191	194	191	Continuing
(U) Appropriated Value	200	191			
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions	-4	-4			
b. SBIR		-4			
c. Omnibus or Other Above Threshold Reprogram	-1				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			-2	-2	
(U) Current Budget Submit/President's Budget	195	183	192	189	Continuing

(U) Change Summary Explanation:

Funding: FY02-03 includes baseline extension and reductions to fund other AF and DoD priorities.

Schedule: No significant impact.

Technical: No significant impact.

(U) C. Other Program Funding Summary ($ in Thousands):

Related RDT&E: None.

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) PSRE: Conduct Assessment Studies	X*	-----	-----	X*												
(U) PSRE: Conduct Reuse Studies	X*	-----	-----	-----	-----	-----	X									
(U) Ordnance: Conduct Reuse Studies		X*	-----	X*												
(U) Improved Propellant/Materials Studies									X	-----	-----	-----	-----	-----	-----	--->

* Started and/or Completed

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603851F ICBM Dem/Val

PROJECT: 1021

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Contract Engineering Support	181	170	177	174
(U) Program Management Support	14	13	15	15
(U) Total	195	183	192	189

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Various	Various	Ongoing	n/a	n/a	186	181	170	177	174	Continuing	Continuing
Support and Management Organizations											
Various	Various	Ongoing	n/a	n/a	15	14	13	15	15	Continuing	Continuing
Test and Evaluation Organizations											
None											

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val	PROJECT 1021

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Property										
None										
Support and Management Property										
None										
Test and Evaluation Property										
None										
Subtotal Product Development				186	181	170	177	174	Continuing	Continuing
Subtotal Support and Management				15	14	13	15	15	Continuing	Continuing
Subtotal Test and Evaluation										
Total Project				201	195	183	192	189	Continuing	Continuing

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603851F ICBM Dem/Val

PROJECT: 1022

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1022 ICBM Reentry Vehicle Applications	5,531	9,639	13,123	14,651	16,569	23,215	22,199	24,565	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**

(U) ICBM Reentry Vehicle (RV) Applications efforts are required to support a Minuteman force of 500 missiles, arms control treaties/initiatives directing the Minuteman force be downloaded to a single RV configuration, the need to ensure Minuteman force contains the safest, most reliable RV, and CINCSTRATCOM guidance that we should continue to ensure the continuing readiness for our strategic deterrent. ICBM RV Applications efforts will support RVs beyond their original design life through addressing problems with operational reentry systems, meeting real on-going needs, and ensuring the availability of long-lead components/materials. This project will develop methods to better predict aging phenomena, and identify life cycle cost reduction methods. Additionally, these efforts will maintain a minimum level of technical engineers and capability to respond to aging phenomena and future requirements including transition to force applications to comply with evolving Air Force global engagement strategy/vision. RV work conducted under this program will leverage the Science & Technology community and coordinate with Navy RV efforts to eliminate duplication and realize synergistic cost savings.

(U) FY 1996 ($ in Thousands):

- (U) $2,016 Existing RV material subsystems and identify potential material replacements evaluations.
- (U) $915 Options for improved aging prediction testing/measurement techniques evaluations.
- (U) $676 Options for improved sensors/instrumentation to better analyze operational RVs and materials evaluations.
- (U) $589 Options for improved fuze assessment/measurement methodologies evaluations.
- (U) $472 Supportability for critical RV components evaluations.
- (U) $622 SERV acquisition documentation.
- (U) $241 Options to better measure/analyze accuracy contributors identification.
- (U) $5,531 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val
	PROJECT 1022

(U) FY 1997 ($ in Thousands):

- (U) $2,579 Continue to evaluate existing RV material subsystems and potential material replacements by performing applicable ground and flight tests.
- (U) $1,385 Design, develop, and conduct prototype testing of selected aging prediction techniques and tools.
- (U) $1,781 Design, develop, and conduct prototype testing of selected fuze assessment/measurement methodologies.
- (U) $1,583 Design, develop, and conduct prototype testing of selected sensors/instruments.
- (U) $480 Identify and ground test potential replacement options for critical RV components.
- (U) $1,286 Conduct initial evaluation of improved accuracy assessment measurement methodology.
- (U) $500 Develop necessary SERV acquisition documentation and conduct Phase I activities.
- (U) $45 Other
- (U) $9,639 Total

(U) FY 1998 ($ in Thousands):

- (U) $3,678 Continue to evaluate existing RV material subsystems and potential material replacements by performing applicable ground and flight tests.
- (U) $1,720 Continue to design, develop, and conduct prototype testing of selected aging prediction techniques and tools.
- (U) $2,662 Continue to design, develop, and conduct prototype testing of selected fuze assessment/measurement methodologies.
- (U) $2,497 Continue to design, develop, and conduct prototype testing of selected sensors/instruments.
- (U) $529 Identify and ground test potential replacement options for critical RV components.
- (U) $1,537 Continue evaluation of improved accuracy assessment measurement methodology.
- (U) $500 Conduct SERV Phase I activities.
- (U) $13,123 Total

(U) FY 1999 ($ in Thousands):

- (U) $4,224 Continue to evaluate existing RV material subsystems and potential material replacements by performing applicable ground and flight tests.
- (U) $1,923 Continue to design, develop, and conduct prototype testing of selected aging prediction techniques and tools.
- (U) $3,234 Continue to design, develop, and conduct prototype testing of selected fuze assessment/measurement methodologies.
- (U) $2,958 Continue to design, develop, and conduct prototype testing of selected sensors/instruments.
- (U) $592 Identify and ground test potential replacement options for critical RV components.
- (U) $1,720 Continue evaluation of improved accuracy assessment measurement methodology.
- (U) $14,651 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603851F ICBM Dem/Val

PROJECT: 1022

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	5,531	10,123	15,299	18,910	Continuing
(U) Appropriated Value	5,673	10,123			
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions	-111	-228			
b. SBIR		-256			
c. Omnibus or Other Above Threshold Reprogram	-31				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			-2,176	-4,259	
(U) Current Budget Submit/President's Budget	5,531	9,639	13,123	14,651	Continuing

(U) Change Summary Explanation:

Funding: FY98-03 funding includes baseline extension and offset reductions to fund other AF and DoD priorities. FY97 spend plan revised based on FY96 accomplishments. FY96 funding adjusted by internal funding/reductions realignments.

Schedule: No significant impact.

Technical: No significant impact.

(U) **C. Other Program Funding Summary ($ in Thousands):**

Related RDT&E: None.

(U) **D. Schedule Profile**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Develop SERV Acquisition Documentation	X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	X				
(U) Evaluate Materials, Identify Replacements	X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--->
(U) Plan/Perform Ground/Flight Tests		X*	-----	-----	-----	-----	-----	X								

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PE NUMBER AND TITLE: 0603851F ICBM Dem/Val

PROJECT: 1022

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Aging Prediction Methodologies																
(U) Identify Improved Prediction Techniques	X*	-----	-----	X*												
(U) Design/Develop/Test Selected Techniques					X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--->
(U) Sensor/Instrumentation Integration																
(U) Identify Options for Improved Sensors/Instrumentation	X*	-----	-----	X*												
(U) Design/Develop/Test Selected Sensors/Instruments					X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--->
(U) Assessment Methodology																
(U) Identify Options to Measure Accuracy Contributors	X*	-----	-----	X*												
(U) Conduct Evaluation of Accuracy Measurement Techniques					X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--->
(U) Fuze Assessment																
(U) Identify Options for Improved Measurement Tools	X*	-----	-----	X*												
(U) Design/Develop/Test Selected Measurement Tools					X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--->
(U) Critical Components																
(U) Identify Supportability	X*	-----	-----	X*												
(U) Identify, Design, & Test Potential Replacement Options					X*	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--->

* Started and/or Completed

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603851F ICBM Dem/Val

PROJECT: 1022

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Contract Engineering Support	5,531	9,594	13,123	14,651
(U) Other		45		
(U) Total	5,531	9,639	13,123	14,651

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Various	Various	Ongoing	n/a	n/a	1,688	4,890	7,249	9,979	11,651	Continuing	Continuing
Support and Management Organizations											
Various	Various	Ongoing	n/a	n/a	500	431	620	920	980	Continuing	Continuing
Other							45				45
Test and Evaluation Organizations											
Various	Various	Ongoing	n/a	n/a	0	210	1,725	2,224	2,020	Continuing	Continuing

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val PROJECT 1022

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Property										
None										
Support and Management Property										
None										
Test and Evaluation Property										
None										
Subtotal Product Development				1,688	4,890	7,249	9,979	11,651	Continuing	Continuing
Subtotal Support and Management				500	431	665	920	980	Continuing	Continuing
Subtotal Test and Evaluation					210	1,725	2,224	2,020	Continuing	Continuing
Total Project				2,188	5,531	9,639	13,123	14,651	Continuing	Continuing

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603851F ICBM Dem/Val

PROJECT: 1023

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1023 Rocket System Launch Program (RSLP) Applications	28	17,838	31	32	34	36	34	35	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**

(U) This task supports studies/analysis on hardware for cost effective use on excess missile assets.

(U) FY 1996 ($ in Thousands):

- (U) $28 Adoption of MSLS or similar low cost front-end systems for use on deactivated missile assets studies/analyses.
- (U) $28 Total

(U) FY 1997 ($ in Thousands):

- (U) $31 Continue studies/analyses for the adoption of low cost front-end systems for use on deactivated missile assets.
- (U) $458 Initiate studies/analyses to support storage of excess Peacekeeper-unique handling equipment.
- (U) $2,000 Develop GPS range safety modifications
- (U) $14,754 Develop improved accuracy capabilities for conventional ICBM precision strike
- (U) $542 Payment of FY97 offset ($500) and nonpay inflation adjustment ($42) assessed against Guidance Applications Program (BPAC 1020, this PE) but paid by this project.
- (U) $53 Other
- (U) $17,838 Total

(U) FY 1998 ($ in Thousands):

- (U) $31 Continue studies/analyses for the adoption of low cost front-end systems for use on deactivated missile assets.
- (U) $31 Total

(U) FY 1999 ($ in Thousands):

- (U) $32 Continue studies/analyses for the adoption of low cost front-end systems for use on deactivated missile assets.
- (U) $32 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val
	PROJECT 1023

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	28	1,031	31	32	Continuing
(U) Appropriated Value	11,530	18,731			
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions	-227	-394			
b. SBIR		-499			
c. Omnibus or Other Above Threshold Reprogram	-11,275				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB					
(U) Current Budget Submit/President's Budget	28	17,838	31	32	Continuing

(U) Change Summary Explanation:

Funding: FY98 -03 reduced to fund other AF and DoD priorities.

Schedule: No significant impact.

Technical: No significant impact.

(U) **C. Other Program Funding Summary ($ in Thousands):** See PE 0605860F, Rocket System Launch Program (RSLP)

Related RDT&E: PE 0605860F, Rocket System Launch Program (RSLP) (Space).

(U) **D. Schedule Profile**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Multiservice Launch System Applications Studies/Analysis	X*	-----	-----	X*	X*	-----	-----	X	X	-----	-----	X	X	-----	-----	X
(U) Handling Equipment Analysis					X*	-----	-----	X								

* Started and/or Completed

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603851F ICBM Dem/Val

PROJECT: 1023

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Studies/Analysis	28	489	31	32
(U) GPS Range Safety/Improved Accuracy		16,754		
(U) Other		595		
(U) Total	28	17,838	31	32

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Textron	CPFF	20 Mar 97	n/a	n/a	0	0	4,200				4,200
Textron	CPFF	15 May 97	n/a	n/a	0	0	4,000				4,000
Phillips Lab	MIPR	30 Mar 97	n/a	n/a	0	0	2,704				2,704
Wright Lab	MIPR	30 Mar 97	n/a	n/a	0	0	1,100				1,100
Various	Various	Various	n/a	n/a	0	0	700				700
Support and Management Organizations											
TRW/SETA	T&M	15 Mar 97	n/a	n/a	0	0	1,550				1,550
Various	Various	Ongoing	n/a	n/a	0	28	489	31	32	Continuing	Continuing
Other							595				595
Test and Evaluation Organizations											
TBD	TBD	30 May 97	n/a	n/a	0	0	2,500				2,500

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Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Property										
None										
Support and Management Property										
None										
Test and Evaluation Property										
None										
Subtotal Product Development						12,704				12,704
Subtotal Support and Management					28	2,634	31	32	Continuing	Continuing
Subtotal Test and Evaluation						2,500				2,500
Total Project					28	17,838	31	32	Continuing	Continuing

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603851F ICBM Dem/Val

PROJECT: 1024

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1024 ICBM Command & Control (C2) Applications	195	1,051	192	189	189	186	466	463	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**

(U) The deMIRVing of ICBMs and overall cutbacks in the number of nuclear weapons reduces the incentive to attack individual ICBM silos. Therefore, the incentive to attack Minuteman launch control centers will increase unless steps are taken to lessen an aggressor's confidence in being able to prevent missile launch by simultaneously destroying all launch control centers. This program funds efforts to identify existing technologies (Ground Launch Cruise Missile, Small ICBM, Airborne Launch Control Centers, etc.) to increase the uncertainty of destroying Minuteman launch control center capabilities. The identification and use of existing military hardware, software, and system designs/documentation are principle concerns. Additionally, it is critical to explore ways of continuing assured connectivity to strategic forces. Study efforts will be conducted to ensure reliable and standardized communication links are maintained between the ICBM forces and higher authorities. Testing existing low cost technology (fiber optic cable, telescoping antennas, etc.) under a generation scenario will be stressed. Methods to further disengagement strategies and cost savings will also be pursued.

(U) FY 1996 ($ in Thousands):

- (U) $195 Technical and cost options for providing a Milstar extremely high frequency (EHF) capability to Minuteman launch control centers identification.
- (U) $195 Total

(U) FY 1997 ($ in Thousands):

- (U) $170 Complete EHF studies to include identifying a single terminal option and a cost analysis.
- (U) $878 Identify technical and cost options for providing future command, control, communications, and computer (C4) elements and alternatives [e.g., Defense IEMATS (Improved Emergency Message Automated Transmission System) Replacement Command and Control Terminal (DIRECT) Program].
- (U) $3 Other
- (U) $1,051 Total

(U) FY 1998 ($ in Thousands):

- (U) $192 Examine alternate concepts for replacing Strategic Automated Command and Control System (SACCS) and other command, control, and communication (C3) systems with a secure, high data rate communications network.
- (U) $192 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val
	PROJECT 1024

(U) FY 1999 ($ in Thousands):

- (U) $189 Accomplish an in-depth analysis for the Fiber Optic Link/Hardened Intersite Cable System (HICS) upgrade.
- (U) $189 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	195	1,103	194	191	Continuing
(U) Appropriated Value	200	1,103			
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions	-4	-23			
b. SBIR		-29			
c. Omnibus or Other Above Threshold Reprogram	-1				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1996 PB			-2	-2	
(U) Current Budget Submit/President's Budget	195	1,051	192	189	Continuing

(U) Change Summary Explanation:

Funding: FY98-03 includes baseline extension and reductions to fund other AF and DoD priorities. FY97 spend plan revised based on FY96 accomplishments. FY96 funding adjusted by internal funding/reductions realignment.

Schedule: No significant impact.

Technical: No significant impact.

(U) C. Other Program Funding Summary ($ in Thousands):

Related RDT&E: None.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val PROJECT 1024

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Milstar EHF		X*	-----	-----	-----	X										
(U) Fiber optic link/HICS upgrade													X	-----	-----	X
(U) Future C4 studies/analyses					X*	-----	-----	X								
(U) SACCS replacement study									X	-----	-----	X				

* Started and/or Completed

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val
	PROJECT 1024

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Contract Engineering Support	191	1,039	185	185
(U) Program Management	4	9	7	4
(U) Other		3		
(U) Total	195	1,051	192	189

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Organizations											
None											
Support and Management Organizations											
Various	Various	Ongoing	n/a	n/a	301	195	1,048	192	189	Continuing	Continuing
Other							3				3
Test and Evaluation Organizations											
None											

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val	PROJECT 1024

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Property										
None										
Support and Management Property										
None										
Test and Evaluation Property										
None										
Subtotal Product Development										
Subtotal Support and Management				301	195	1,051	192	189	Continuing	Continuing
Subtotal Test and Evaluation										
Total Project				301	195	1,051	192	189	Continuing	Continuing

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 4 - Demonstration and Validation	PE NUMBER AND TITLE: 0603851F ICBM Dem/Val — PROJECT: 4209

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4209 Long Range Planning (LRP)	2,749	2,093	2,465	2,345	2,285	2,385	2,518	2,501	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**

(U) The Long Range Planning (LRP) task analyzes ICBM systems to identify potential modifications required to meet user objectives relative to long term sustainment, technology insertion, employment, and force structure. The primary focus of the studies centers on system supportability, operability, reliability, and maintainability. Options/concepts generated by these studies are evaluated for feasibility, system impacts, and cost.

(U) FY 1996 ($ in Thousands):

- (U) $634 Long Range Planning tasks, develop the Systems Options Report, and update the Logistics Program Management Plan and the ICBM Master Plan.
- (U) $1,358 Feasibility and life extension studies
- (U) $757 Technology insertion studies in support of changing ICBM environments
- (U) $2,749 Total

(U) FY 1997 ($ in Thousands):

- (U) $536 Support Long Range Planning tasks, develop the Systems Options Report, and update the Logistics Program Management Plan and the ICBM Master Plan.
- (U) $641 Perform feasibility studies in direct support of Minuteman life extension
- (U) $910 Perform technology insertion studies in support of changing ICBM environments
- (U) $6 Other
- (U) $2,093 Total

(U) FY 1998 ($ in Thousands):

- (U) $640 Support Long Range Planning tasks, develop the Systems Options Report, and update the Logistics Program Management Plan and the ICBM Master Plan.
- (U) $1,012 Perform feasibility and life extension studies.
- (U) $813 Perform technology insertion studies in support of changing ICBM environments.
- (U) $2,465 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val
	PROJECT 4209

(U) FY 1999 ($ in Thousands):

- (U) $645 Support Long Range Planning tasks, develop the Systems Options Report, and update the Logistics Program Management Plan and the ICBM Master Plan.
- (U) $942 Perform feasibility and life extension studies.
- (U) $758 Perform technology insertion studies in support of changing ICBM environments.
- (U) $2,345 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	2,552	2,198	2,486	2,367	Continuing
(U) Appropriated Value	2,618	2,198			
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions	-52	-50			
b. SBIR		-55			
c. Omnibus or Other Above Threshold Reprogram	-14				
d. Below Threshold Reprogramming	197				
(U) Adjustments to Budget Years Since FY 1997 PB			-21	-22	
(U) Current Budget Submit/President's Budget	2,749	2,093	2,465	2,345	Continuing

(U) Change Summary Explanation:

Funding: FY98-03 includes baseline extension and reductions to fund other AF and DoD priorities. FY97 spend plan revised based on FY96 accomplishments. FY96 funding adjusted by internal funding/reductions realignment.

Schedule: No significant impact.

Technical: No significant impact.

(U) C. Other Program Funding Summary ($ in Thousands):

Related RDT&E: None.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val
	PROJECT 4209

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Contract Award		X*			X*				X				X			
(U) Program Reviews		X*	X*			X	X			X	X			X	X	
(U) Deliverable Reports				X*				X				X				X

* Started and/or Completed

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val
	PROJECT 4209

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Contractor Engineering Support	2,079	1,945	2,320	2,197
(U) Program Management Support	670	142	145	148
(U) Other		6		
(U) Total	2,749	2,093	2,465	2,345

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Various	Various	Ongoing	n/a	n/a	1,992	2,079	1,945	2,320	2,197	Continuing	Continuing
Support and Management Organizations											
Various	Various	Ongoing	n/a	n/a	602	670	142	145	148	Continuing	Continuing
Other							6				6
Test and Evaluation Organizations											
None											

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603851F ICBM Dem/Val	PROJECT 4209

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Property										
None										
Support and Management Property										
None										
Test and Evaluation Property										
None										
Subtotal Product Development				1,992	2,079	1,945	2,320	2,197	Continuing	Continuing
Subtotal Support and Management				602	670	148	145	148	Continuing	Continuing
Subtotal Test and Evaluation										
Total Project				2,594	2,749	2,093	2,465	2,345	Continuing	Continuing

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603853F Evolved Expendable Launch Veh (EELV) (Space)

PROJECT: 0006

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
0006 EELV Dem/Val	36,894	42,333	63,260	0	0	0	0	0	0	172,533
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification:

The Evolved Expendable Launch Vehicle (EELV) program is a space launch system development program. The purpose of this program is to replace the current fleet of medium to heavy-lift class expendable launch vehicles (Titan II, Delta II, Atlas II, and Titan IV) with a more affordable family of space launch vehicles. With a nonrecurring development cost of $2 billion, EELV is projected to save 25-50 percent over the current fleet of expendable launch vehicles during a 20 year period. Program content includes the development of the system design, demonstrations of key technologies, modifications to industrial capability and launch facilities, and demonstration launches of both medium- and heavy-lift EELV variants. The EELV family of vehicles must be capable of meeting the Government's spacelift needs (DoD, intelligence, and other government missions) through at least 2020, as defined in the National Mission Model. The first operational launch for the Medium-Lift Variant (MLV) is required by FY02 to support satellite block changes and transitions. The first operational capability for the Heavy-Lift Variant (HLV) is required by FY05 to maintain assured access to space following the Titan IV phaseout. This program is in Budget Activity 4, Demonstration and Validation, because it supports risk reduction, demonstration and validation of technologies, and concept verifications leading to lower cost expendable launch vehicles.

(U) Acquisition Strategy:

The EELV concept of a family of launch vehicles emphasizes commonality of hardware and infrastructure and economies of scale to enhance production, operations, and support efficiencies. Cost improvements will be achieved through commonality, consolidation, reduction of supporting infrastructure (launch pads, manufacturing facilities, workforce), and optimization of production and launch operations, processes, and rates. Development contracts will be competitively awarded. Downselect to a single EELV contract/concept is planned at the EMD decision point (third quarter FY98). Production contracts will be sole source to the EELV EMD contractor.

(U) FY 1996

- (U) $32,000 Completed four Low Cost Concept Validation (LCCV) contracts culminating in the Dec 96 downselect to two Pre-EMD contracts to continue concept development.
- (U) $4,894 Program management and other support costs.
- (U) $36,894 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603853F Evolved Expendable Launch Veh (EELV) (Space)
	PROJECT 0006

(U) FY 1997

- (U) $38,854 Awarded two $60M, FFP, Pre-EMD contracts in Dec 96. Pre-EMD contracts will span 17 months.
- (U) $3,479 Program management and other support costs.
- (U) $42,333 Total

(U) FY 1998

- (U) $56,900 Complete two $60 million, firm fixed price, Pre-EMD contracts in May 98.
- (U) $6,360 Program management and other support costs.
- (U) $0 Downselect to single EMD contractor. EMD begins in June 98 funded under PE 0604853F.
- (U) $63,260 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget	37,147	44,457		
(U) Appropriated Value	39,226	44,457		
(U) Adjustments to Appropriated Value				
a. Congressional General Reductions	-916	-1,003		
b. Small Business Innovative Research	-605	-1,121		
c. Omnibus or other above threshold reprogramming	-799			
d. Below Threshold Reprogramming	-12			
(U) Adjustments to Budget Years Since FY97 PB			+63,260	
(U) Current Budget Submit/President's Budget	36,894	42,333	63,260	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603853F Evolved Expendable Launch Veh (EELV) (Space)

PROJECT: 0006

(U) Change Summary Explanation:

- Funding: The FY96 reductions were for general Congressional reductions and an additional $0.811M reduction to support higher military requirements. FY97 reductions were the result of general Congressional Reductions. FY98 funds were transferred from PE 0604853F (EELV EMD) to reflect the approved schedule for the pre-EMD phase. The pre-EMD phase will run from December 1996 to May 1998. The change is required to implement the approved acquisition strategy as documented in the Single Acquisition Management Plan (SAMP).
- Schedule: Not Applicable.
- Technical: Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Comp	Total
(U) National User (non-AF budget)	72,300	18,600	7,100						0	98,000
(U) Missile Procurement, AF (PE 030593F)					245,428	285,471	171,951	303,782	Cont.	Cont.
Related RDT&E										
(U) EELV EMD (PE 0604853F)			28,376	293,950	324,891	232,991	256,797	419,280	162,200	1,718,485
(U) EELV (PE 0305953F)				3,383	3,480	3,577	2,398	795	Cont.	Cont.
(U) Medium Launch Vehicles (PE 0305119F)										
(U) Titan Space Launch Vehicles (PE 0305144F)										

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
LCCV Module																
(U) Tailored Preliminary Design Review				X												
(U) DAB					X											
(U) Downselect to two contracts					X											
Pre-EMD Module																
(U) Pre-EMD contract awards					X											
(U) Downselect Design Review										X						
(U) EMD DAB											X					
(U) Downselect to single EMD contract/concept											X					

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603853F Evolved Expendable Launch Veh (EELV) (Space)

PROJECT: 0006

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Concept Development Contracts	32,000	38,854	56,900	0
(U) Program management and other support costs	4,894	3,479	6,360	0
(U) Total	36,894	42,333	63,260	0

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)***

* Does not include ARPA FY94 funding of $9,800 and National User funds: FY96 - $72,300, FY97 - $18,600, FY98 - $7,100. Information represents Air Force funding

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Alliant Tech	C/FFP (LCCV)	Aug 95	13,000	13,000	5,000	8,000	0	0	0	0	13,000
Boeing	C/FFP (LCCV)	Aug 95	13,000	13,000	5,000	8,000	0	0	0	0	13,000
Lockheed Martin	C/FFP (LCCV)	Aug 95	13,000	13,000	5,000	8,000	0	0	0	0	13,000
McDonnell Douglas	C/FFP (LCCV)	Aug 95	13,000	13,000	5,000	8,000	0	0	0	0	13,000
Lockheed Martin	C/FFP (Pre-EMD)	Dec 96	47,877	47,877	0	0	19,427	28,450	0	0	47,877
McDonnell Douglas	C/FFP (Pre-EMD)	Dec 96	47,877	47,877	0	0	19,427	28,450	0	0	47,877
Support and Management Organizations											
SPO Mission Spt	Various	Various	N/A	N/A	852	2,069	2,127	1,676	0	0	6,724
FFRDC	CPAF	FY95	N/A	N/A	1,329	1,803	255	3,833	0	0	7,220
Ranges	Various	Various	N/A	N/A	7,255	211	226	110	0	0	7,802

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY **4 - Demonstration and Validation**	PE NUMBER AND TITLE **0603853F Evolved Expendable Launch Veh (EELV) (Space)** — PROJECT **0006**

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Other Cntr Spt	Various	Various	N/A	N/A	610	811	871	741	0	0	3,033
Test and Evaluation Organizations											
Not Applicable					0	0	0	0	0	0	0

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: Not Applicable

Subtotal Product Development	20,000	32,000	38,854	56,900	0	0	147,754
Subtotal Support and Management	10,046	4,894	3,479	6,360	0	0	24,779
Subtotal Test and Evaluation	0	0	0	0	0	0	0
Total Project	30,046	36,894	42,333	63,260	0	0	172,533

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603854F Global Broadcast Service (GBS) (Space)

PROJECT: 2679

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2679 Global Broadcast Service (GBS)	14,000	43,565	56,977	62,678	76,565	152,990	253,451	367,022	2,113,752	3,141,000
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification**

Acquire a three-phased Global Broadcast Service (GBS) program which will provide a worldwide, satellite-based, high data rate communications broadcast capability in accordance with the Mission Need Statement approved by the Joint Requirements Oversight Council (JROC) in Aug 95. Acquire an advanced [wideband] satellite system to host GBS phase 3 and continue appropriate services now provided by the DSCS system in accordance with Joint Space Management Board direction based on the Aug 96 MILSATCOM Architecture.

GBS will provide efficient high data rate connectivity between many distributed information sources and warfighters who receive the broadcast directly on small, inexpensive user terminals. Examples of data to be broadcast include digitized imagery, logistics data, weather data, maps, operational orders (e.g., Air Tasking Order), and video. Phase One, starting in 1996, will use commercial satellite leases to provide a CONUS-based testbed for requirements definition and operational concept refinement. Phase Two, with first launch in 1998, will provide an interim, near worldwide GBS capability at military frequencies hosted on the last three UHF Follow-On (UFO) satellites (numbers 8, 9, and 10). Phase Three, with first launch in 2005, will provide a fully capable, global capability at military frequencies hosted on a conceptual satellite the DoD Space Architect calls the Advanced Wideband System. The Air Force was designated executive agent for the GBS Program by USD(A&T) on 27 Mar 96.

The Advanced Wideband Satellite System is in the planning stage to merge the future GBS Phase 3 and Defense Communications System (DSCS) follow-on packages on a common satellite bus IAW OSD direction following review of the DoD MILSATCOM Architecture developed by the DoD Space Architect. It will be procured making maximum use of commercial technology and practices with initial launch in the 2006 time frame. DSCS-like services will use the same X-band frequency as DSCS, and the GBS phase 3 broadcast will use the same Ka-band frequency as GBS phase 2.

Funding is in Budget Activity 4, Demonstration and Validation, since it supports the demonstration and validation of a Global Broadcast Service technology.

(U) FY 1996 ($ in Thousands)

- (U)$ 4,900 Testbed Transition (Relocation, Sustainment, Connectivity)
- (U)$ 1,200 Engineering Support
- (U)$ 500 Ground Receive Terminals
- (U)$ 2,000 System Integration
- (U)$ 3,600 Funds to Navy (Acquisition of Phase 2 UFO Satellite Antenna for Theater Injection)
- (U)$ 1,800 SPO Support
- (U)$ 14,000 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603854F Global Broadcast Service (GBS) (Space)
	PROJECT 2679

(U) FY 1997 ($ in Thousands)

- (U)$ 5,025 Testbed Transition (Sustainment, Connectivity)
- (U)$ 733 Engineering Support
- (U)$ 17,817 Primary Injection Point
- (U)$ 4,185 Ground Receive Terminals
- (U)$ 4,425 System Integration and Planning
- (U)$ 128 System Test Support
- (U)$ 3,900 Funds to Navy (Acquisition of Phase 2 UFO Satellite Antenna for Theater Injection)
- (U)$ 7,352 SPO Support
- (U)$ 43,565 Total

(U) FY 1998 ($ in Thousands):

- (U)$ 4,900 Testbed Transition (Sustainment, Connectivity)
- (U)$ 200 Engineering Support
- (U)$ 13,862 Primary Injection Point
- (U)$ 1,064 Ground Receive Terminals
- (U)$ 22,424 System Integration and Planning
- (U)$ 1,169 System Test Support
- (U)$ 7,158 SPO Support
- (U)$ 6,000 Funds to Navy (Terminals)
- (U)$ 200 Joint Spectrum Center (Frequency Reservations)
- (U)$ 56,977 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603854F Global Broadcast Service (GBS) (Space)
PROJECT 2679	

PROJECT NO. AND NAME

2679 Global Broadcast Service (GBS)

(U) FY 1999 ($ in Thousands):

- (U)$ 4,900 Testbed Transition (Sustainment, Connectivity)
- (U)$ 200 Engineering Support
- (U)$ 7,646 Primary Injection Point
- (U)$ 378 Ground Receive Terminals
- (U)$ 34,324 System Integration and Planning
- (U)$ 1,136 System Test Support
- (U)$ 7,928 SPO Support
- (U)$ 6,000 Funds to Navy (Terminals)
- (U)$ 166 Joint Spectrum Center (Frequency Reservations)
- (U)$ 62,678 Total

(U) B. Program Change Summary ($ in Thousands)	FY 1996	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY97)	14,000	45,000	98,000	43,000
(U) Appropriated Value	0	45,000		
(U) Adjustments to Appropriated Value				
a. Congressional General Reductions		-1024		
b. SBIR		-411		
c. Omnibus and Other Above Threshold Reprogram				
d. Below Threshold Reprogram				
(U) Adjustments to Budget Years Since FY97 PB			-41,023	+19,678
(U) Current Budget Submit/President's Budget	14,000	43,565	56,977	62,678

(U) Change Summary Explanation:

Funding/Schedule: Funding shifts from FY98 to FY99 delay provision of integrated communications security (COMSEC) equipment one year (to FY01) and slip Broadcast Management subsystem upgrades. This affects availability of some attributes of GBS service, not the availability of the basic GBS service itself.
Technical: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603854F Global Broadcast Service (GBS) (Space)
	PROJECT 2679

(U) C. Other Program Funding Summary ($ in Thousands)

Related RDT&E

(U) ARPA-DISA Bosnia Operational Communications Augmentation (BOCA) and Joint Broadcast Service (JBS)
(U) ARPA Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technical Demonstration (ACTD)
(U) Navy UFO Program
(U) Navy SATCOM Ship Terminal Programs
(U) Army Ground Terminal Programs

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Phase I (96-01)																
(U) Joint Warfighter Interoperability Demos (JWID)				x				x				x				x
(U Lease Commercial Transponder						x	x	x	x	x	x	x	x	x	x	x
(U) Phase II (98-00+)																
(U) Acquisition Program Reviews - TBD																
(U) Launch UFO #8 (Feb 98)										x						
(U) Launch UFO #9 (Aug 98)												x				
(U) Launch UFO #10 (Feb 99)														x		
(U) Phase 3 (05+)																
(U) MILSATCOM Architecture (Define Phase 3)				x												
(U) Acquisition Milestone Reviews - TBD																

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603854F Global Broadcast Service (GBS) (Space)
	PROJECT 2679

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Testbed Transition (Relocation, Sustainment, Connectivity)	4,900	5,025	4,900	4,900
(U) Engineering Support	1,200	733	200	200
(U) Primary Injection Point	0	17,817	13,862	7,646
(U) Ground Receive Terminals	500	4,185	1,064	378
(U) System Integration and Planning	2,000	4,425	22,424	34,324
(U) System Test Support	0	128	1,169	1,136
(U) Funds to Navy (Acquisition of Phase 2 UFO Satellite Antenna for Theater Injection)	3,600	3,900	0	0
(U) SPO Support	1,800	7,352	7,158	7,928
(U) Funds to Navy (Terminals)	0	0	6,000	6,000
(U) Joint Spectrum Center (Frequency Reservations)	0	0	200	166
(U) Total	14,000	43,565	56,977	62,678

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
DISA	MIPR	-	-	-	0	4,900					4,900
NAVY-UFO PROG	MIPR	-	-	-	0	3,600	3,900				7,500
NSA	MIPR	-	-	-	0	2,000					2,000
Multiple	Multiple	Multiple	Multiple	Multiple	0	1,700					1,700
TBD	TBD	TBD	TBD	TBD	0		32,185	48,650	53,614	2,888,326	3,022,775
Support and Management Organizations											
FFRDC Support						1,800	4,000	3,700	4,300	37,316	51,138
SPO Support							3,352	3,458	3,628	28,122	38,538
Test and Evaluation Organizations											
Support for Development & Operational Testing (Army TE, and Air Force SMC/TEV)							128	1,169	1,136	10,016	12,449

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603854F Global Broadcast Service (GBS) (Space)

PROJECT: 2679

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Government Furnished Property:											
Product Development Property - TBD											
Support and Management Property - TBD											
Test and Evaluation Property - TBD											
Subtotal Product Development					0	12,200	36,085	48,650	53,614	2,888,326	3,038,875
Subtotal Support and Management					0	1,800	7,352	7,158	7,928	65,438	89,676
Subtotal Test and Evaluation							128	1,169	1,136	10,016	12,449
Total Project					0	14,000	43,565	56,977	62,678	2,963,780	3,141,000

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603855F DoD Space Architect (Space)

PROJECT: 2678

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2678 Space Architect	5,499	10,957	0	0	0	0	0	0	0	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification** - The Under Secretary of Defense (USD) for Acquisition and Technology (A&T) established the DoD Office of the Space Architect (OSA) to consolidate responsibilities for DoD space missions and system architecture development into a single organization in response to Congressional concerns regarding DoD space management. The DoD OSA integrates space architectures and systems, eliminates unnecessary vertical stovepiping of programs, and achieves efficiencies in acquisition and future operations through program integration, thus improving space support to military operations. The OSA obtains direct support from various space planning and development organizations across the federal government and industry for DoD space architecture planning and development.

Note: All funding was transferred to PE 0305917F for FY 1998 - 2003 to consolidate R&D and O&M appropriations into one Program Element.

(U) **Acquisition Strategy:** RDT&E funds will be used to obtain infrastructure support and direct support from various space planning and development organizations across the DoD and industry. This includes FFRDCs and contracted System Engineering and Technical Assistance (SETA) in direct support of DoD space architecture planning and development. Funds will be applied to existing contract vehicles.

- As primary support, the DoD Space Architect proposes to use two existing SMC contracts for technical support:
  - -- Engineering, Analysis, Design and Development (EADD) Contract; Nichols Research Corporation
  - -- Engineering, Analysis and Design (EAD) Contract; Nichols Research Corporation
- These contracts currently provide support to the Air Force Space and Missile Systems Center long-range planning, conceptual development, and engineering analysis and assessment efforts.

(U) FY 1996 ($ in Thousands):
- (U) $5,499 Staff and equipment for new Space Architect organization to initiate first architecture studies
- (U) $5,499 Total

(U) FY 1997 ($ in Thousands):
- (U) $ 140 MILSATCOM
- (U) $1,249 Space Control
- (U) $4,459 Satellite Operations
- (U) $ 273 Position Navigation
- (U) $2,226 Environmental Sensing

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603855F DoD Space Architect (Space)
	PROJECT 2678

- (U) $ 150 Communications Study
- (U) $2,000 Support to DUSD (Space)
- (U) $ 571 In-House Support
- (U) $10,957 Total

(U) FY 1998 ($ in Thousands):
- (U) $0
- (U) $0

(U) FY 1999 ($ in Thousands):
- (U) $0
- (U) $0

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	0	15,000	15,000	15,000	Cont
(U) Appropriated Value					
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions		-345			
b. SBIR		-299			
c. Omnibus or Other Above Threshold Reprogram	5,499				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			-15,000	-15,000	
(U) Current Budget Submit/President's Budget	5,499	10,957	0	0	Cont

(U) Change Summary Explanation:

Funding: FY 1996 reprogramming initiated OSA. FY 1998 and FY 1999 decreases reflect decision to establish new consolidated PE for all OSA funding.
Schedule: None
Technical: None

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) N/A										

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603855F DoD Space Architect (Space)
	PROJECT 2678

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

(U) N/A

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0603855F DoD Space Architect (Space)
	PROJECT 2678

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
Staff and equipment for Space Architect office	5,499			
MILSATCOM		140		
Space Control		1,249		
Satellite Operations		4,459		
Position Navigation		273		
Environmental Sensing		2,116		
Communications Study		150		
In-House Support		571		
Support to DUSD (Space)		2,000		
Total	5,499	10,957	0	0

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Support and Management Organizations											
Aerospace	CPAF	1993	1,977	1,977			1,977				
TASC	CPAF	Sept 1994	700	700			700				
ANSER	CPFF	1993	389	389			389				
Mitre	CPAF	1993	632	632			632				
EAD	CPAF	Feb 1997	6,742	6,742		3,149	3,593				
EADD	CPAF	Feb 1997	6,016	6,016		2,350	3,666	0	0	Cont	Cont

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0603855F DoD Space Architect (Space)

PROJECT: 2678

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Test and Evaluation Organizations											
					0	0	0	0	0	Cont	Cont
Government Furnished Property: None											
Subtotal Product Development					0	0	0	0	0	Cont	Cont
Subtotal Support and Management					0	5,499	10,957	0	0	Cont	Cont
Subtotal Test and Evaluation					0	0	0	0	0	Cont	Cont
Total Project					0	5,499	10,957	0	0	Cont	Cont

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0604237F Variable Stability In-Flight Simulation Test Aircraft

PROJECT: 3308

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3308 Variable Stability In-Flight Simulation Test Aircraft	0	1,338	0	0	0	0	0	0	1,338	59,510
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This program modified an F-16D to create a versatile high-performance flying simulator to replace the NT-33A aircraft, which is scheduled to retire in May 1997. For the past 39 years, the research and development flight test community has extensively employed the variable-stability NT-33A for flight evaluation of fielded aircraft upgrades and new aircraft developments. Its success has been directly attributable to its relatively low-cost of operation, rapid response to customer needs, and high degree of credibility in the flight test community. VISTA was developed to replace the NT-33A because the NT-33A's performance is not representative of future aircraft (it is the oldest aircraft in the Air Force still actively flying). VISTA has the capability to simulate a wide range of air vehicles to verify crucial flight control and human factor designs, establish flying qualities specification criteria, and operate as a flying laboratory for flight control and cockpit display research. In addition, the Air Force Test Pilot School uses VISTA, as they have the NT-33A, to safely train test pilots to evaluate aircraft handling quality, avionics, and human factors designs in a realistic high-performance environment. Future costs to operate VISTA will be funded by PE 0603245F, Flight Vehicle Integration, and other users' aircraft development and training programs. There are no plans to request future funding in this PE to continue operating the VISTA aircraft.

(U) FY 1996: Not Applicable.

(U) FY 1997 ($ in Thousands):

- (U) $1,338 Upgrade VISTA to permit continued investigation of the flight control laws and performance characteristics of fielded aircraft upgrades, new aircraft developments, and test pilot training.
  - (U) Upgrade mechanical and electrical aircraft subsystems, reassemble the aircraft, and checkout modifications to ensure safety of flight on subsequent flight testing and training.
- (U) $1,338 Total

(U) FY 1998: Not Applicable.

(U) FY 1999: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0604237F Variable Stability In-Flight Simulation Test Aircraft PROJECT 3308

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	0	0	0	0	0
(U) Appropriated Value	0	1,400			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions		-28			
b. SBIR		-33			
c. Omnibus/Other Above Threshold Reprogrammings		-1			
d. Below Threshold Reprogrammings					
(U) Current Budget Submit/FY 1998 PB	0	1,338	0	0	59,510

(U) Change Summary Explanation:

Funding: In FY 1996, the VISTA upgrade program was funded under PE 0603245F, Flight Vehicle Technology Integration, and by other reimbursable customers. In FY 1997, Congress added funds to PE 0604237F to continue the VISTA upgrade program. VISTA will continue flight testing in FY 1998 and beyond, but will be funded from PE 0603245F and other aircraft test and training programs. There are no plans to request future funding in this PE to continue the VISTA program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 4 - Demonstration and Validation

PE NUMBER AND TITLE: 0604327F Hardened Target Munitions

PROJECT: 4641

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4641 (U) Hard and Deeply Buried Target Defeat System	0	0	4,981	0	0	0	0	0	0	4,981
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification

The Hard and Deeply Buried Target Defeat Capability (HDBTDC) program is an effort designed to hold at risk those highest priority assets essential to the enemy's war fighting ability, which are heavily defended and protectively hardened. Hardening techniques include construction of facilities, of which many are deep underground, with multiple layers of reinforced concrete, rock rubble, and/or earth overburden. Other hardened targets include operations within caves, tunnels, and mountains, built using rapidly improving construction equipment, exported by allies and adversaries on a large scale. (Examples include enemy command and control facilities, air defense facilities, facilities for the production, storage, and deployment of weapons including weapons of mass destruction, surface to surface missile launch sites, aircraft storage, artillery sites, etc.) HDBTDC is currently in the Concept Exploration phase, potential solutions include (but are not limited to) Special Forces, conventional short or long range ballistic missiles (land or sea launched), cruise missiles, direct attack munitions, standoff weapons, etc. FY98 funds will complete the Phase 0 Analysis of Alternatives (AOA) study effort, augment ongoing sensitivity and trade studies activity, prepare for System Program Office standup (if required), and initiate Phase I of Program Definition and Risk Reduction (PDRR). This program is in budget activity 4 - Demonstration and Validation, Research Category 6.3B, because the prototyping, demonstration, and early operational assessment (risk reduction strategies) associated with technology, manufacturing, and support of several conceptual systems under consideration will occur in FY 98. FY 96 and FY 97 Phase 0 (Concept Exploration) Analysis of Alternatives (AOA) expenditures were/will be accomplished in PE 0603311F (Ballistic Missile Technology).

(U) FY 1996 ($ in Thousands):
- (U) $0
- (U) $0 Total

(U) FY 1997 ($ in Thousands):
- (U) $0
- (U) $0 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY: 4 - Demonstration and Validation	PE NUMBER AND TITLE: 0604327F Hardened Target Munitions / PROJECT: 4641

(U) FY 1998 ($ in Thousands):
- (U) $2,000 Complete Analysis of Alternatives (AOA) study effort.
- (U) $1,000 Commence System Program Office (SPO) Standup
- (U) $1,981 Commence Program Definition and Risk Reduction (PDRR) Activities (Phase I)
- (U) $4,981 Total

(U) FY 1999 ($ in Thousands):
- (U) $0 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	0	0	0	0	0
(U) Appropriated Value	0	0	0	0	0
(U) Adjustments to Appropriated Value					
a. Cong Reductions					
b. SBIR					
c. Omnibus or Other Above Threshold Reprogram					
d. Below Threshold Reprogramming	0	0			
(U) Adjustments to Budget Years Since FY 1997 PB			4,981		
(U) Current Budget Submit/98 President's Budget	0	0	4,981	0	4,981

(U) Change Summary Explanation:

Funding: FY 98 funding is required to transition the program from Concept Exploration (Phase 0) to Program Definition and Risk Reduction (Phase I).
Schedule: None
Technical: None

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0604327F Hardened Target Munitions PROJECT 4641

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) PE 0603311 Ballistic Missile Technology	$500	$2,100*							0	500
(U) Total	$500	$2,100*							0	2,100*

NOTE: * FY97 reprogramming action is in progress at this time.

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Complete Preliminary Analysis				X*												
(U) Commence Formal AOA					X*											
(U) Complete AOA										X						
(U) Commence System Program Office (SPO) Standup										X						
(U) Milestone I, Commence PDRR Activities											X					

NOTE: * Accomplished in PE 0603311F (Ballistic Missile Technology)

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 4 - Demonstration and Validation	PE NUMBER AND TITLE 0604327F Hardened Target Munitions
	PROJECT 4641

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Analysis of Alternatives (AOA)	0	0	2,000	0
(U) SPO Standup			1,000	0
(U) PDRR			1,981	0
(U) Total	0	0	4,981	0

* NOTE: FY 96 and FY 97 Phase 0 (Concept Exploration) Analysis of Alternatives (AOA) expenditures were/will be accomplished in PE 0603311F (Ballistic Missile Technology).

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
TRW											
Colorado Spgs	CPAF	Oct 96	3,471	4,600	0	0	0	2,000	0	0	2,000
PDRR											
Contractor (TBD)	CPIF	May 98	1,981	1,981	0	0	0	1,981	0	0	1,981
Support and Management Organizations											
ASC (Eglin) or OO-ALC (Hill)	PO	Jan 98						1,000	0	0	1,000

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)			DATE: February 1997
BUDGET ACTIVITY: 4 - Demonstration and Validation	PE NUMBER AND TITLE: 0604327F Hardened Target Munitions		PROJECT: 4641

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

(U) Subtotal Product Development	0	0	3,981	0	0	3,981
(U) Subtotal Support and Management			1,000	0	0	1,000
(U) Subtotal Test and Evaluation				0	0	0
(U) Total Project	0	0	4,981	0	0	4,981

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0207325F Joint Air-to-Surface Standoff Missile

PROJECT: 4515

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4515 Joint Air-to-Surface Standoff Missile (JASSM)	27,600	160,958	203,321	135,542	86,990	29,041	5,076	0	0	648,528
Quantity of RDT&E Articles	0	0	0	9	35	0	0	0	0	44

(U) A. **Mission Description and Budget Item Justification**

The Joint Air-to-Surface Standoff Missile (JASSM) is a joint Air Force/Navy program with the Air Force as the lead service. This is an ACAT ID program to provide an affordable long range, conventional air-to-surface, autonomous precision guided, standoff cruise missile compatible with fighter and bomber aircraft and able to attack a variety of fixed or relocatable targets. Initial integration efforts are for the B-52H, F-16 Block 50 and F/A-18. Objective aircraft include the B-1, B-2, F-15E, F-117, P-3 and S-3. JASSM is a flagship program for the Cost as an Independent Variable concept allowing the competing contractors maximum trade space to develop an affordable missile that meets all key performance parameters. This descriptive summary reflects Air Force only funding. The Navy is funding Navy unique JASSM requirements.

(U) FY 1996 ($ in Thousands):
- (U) $18,637 Program Definition & Risk Reduction (PDRR) contractors(s) for JASSM weapon system development and hardware.
- (U) $1,004 Initiate flight and ground test support/planning.
- (U) $2,259 Initiate aircraft integration.
- (U) $4,047 Establish program office support.
- (U) $1,653 Establish mission support.
- (U) $27,600 Total

(U) FY 1997 ($ in Thousands):
- (U) $122,624 Continues two selected PDRR contractors for JASSM weapons system development and hardware.
- (U) $8,261 Continues flight test support for threshold aircraft, aircraft modifications, live fire test support & target construction.
- (U) $18,160 Continue aircraft integration.
- (U) $9,202 Continue program office support contracts.
- (U) $2,711 Continue mission support.
- (U) $160,958 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0207325F Joint Air-to-Surface Standoff Missile

(U) FY 1998 ($ in Thousands):
- (U) $107,054 Continues PDRR contractor(s) for JASSM through downselect.
- (U) $11,155 Initial funding for downselected single EMD contractor.
- (U) $49,407 Continue flight test support, aircraft modifications, live fire test support & target construction/rehab.
- (U) $17,807 Continue aircraft integration.
- (U) $10,656 continue program support contracts.
- (U) $2,242 Continue mission support.
- (U) $5,000 Initiate advanced studies.
- (U) $203,321 Total

(U) FY 1999 ($ in Thousands):
- (U) $56,354 Continue EMD.
- (U) $55,749 Continue flight test support, aircraft modifications, live fire test support & target construction/rehab.
- (U) $8,762 Continue aircraft integration.
- (U) $8,331 Continue program support contracts.
- (U) $2,346 Continue mission support.
- (U) $4,000 Continue advanced studies.
- (U) $135,542 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	0	198,632	143,033	95,968	734,115
(U) Appropriated Value	0	168,632			
(U) Adjustments to Appropriated Value					
a. Cong Reductions	0	-3,551			
b. SBIR	0	-4,123			
c. Omnibus or Other Above Threshold Reprogram	23,762				
d. Below Threshold Reprogramming	3,991				
e. Rescissions	-153				
(U) Adjustments to Budget Years Since FY 1997 PB			+60,288	+39,574	-85,579
(U) Current Budget Submit/FY98 PB	27,600	160,958	203,321	135,542	648,528

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0207325F Joint Air-to-Surface Standoff Missile
	PROJECT 4515

(U) Change Summary Explanation:

Funding: Congress added $25M in the FY96 Appropriation Bill to start the program. The funding was initially in PE 0207610F and was later transferred to the new JASSM PE. The FY97 Defense Appropriations Bill reflected a $30M reduction based on projected contract savings. FY98-99 funding reflects adjustments for inflation and adjustments to match the PDRR contract profiles and EMD projections.

Schedule: The approved acquisition strategy was based on a 24 month PDRR with two contracts awarded in Jun 96. The $30M congressional reduction in FY97 slipped the schedule to a 25½ month PDRR. Competitive rolling downselect to one contractor for an EMD phase (length to be proposed by contractors but estimated at 32 months) will follow.

Technical: Industry has maximum flexibility in determining weapon design. There are three key performance parameters (range, missile mission effectiveness and carrier operability). All other requirements are considered tradable.

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Missile Procurement					93,957	92,201	189,456	213,909	1,203.8	1,793.3
(U) Seek Eagle					8,206	2,358	10,575	0	0	21,079
(U) Quantity		0	0	0	95	100	205	250	1,750	2,400

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Milestone I Approval			X													
(U) Dual Contract Award/PDRR Phase			X													
(U) PDRR Phase Complete												X				
(U) Milestone II Approval												X				
(U) EMD												X				
(U) LRIP Begins 2QFY00																

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0207325F Joint Air-to-Surface Standoff Missile

PROJECT: 4515

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Major Contracts	18,637	122,624	118,209	56,354
(U) Associated Contracts	2,259	18,160	17,807	8,762
(U) Support Contracts	4,047	9,202	10,656	8,331
(U) In-House	1,653	2,711	2,242	2,346
(U) Test Support	1,004	8,261	49,407	55,749
(U) Advanced Studies			5,000	4,000
(U) Total	27,600	160,958	203,321	135,542

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
JASSM Development Contractors	CPFF/CPIF	Jun 96	368,095	368,095	0	18,637	122,624	118,209	56,354	52,271	368,095
Support and Management Organizations											
F-16 SPO	Misc	Apr 96	34,901	34,901	0	210	5,530	5,328	2,931	20,902	34,901
B-52 SPO	Misc	Sep 96	29,089	29,089	0	1,500	11,029	10,729	5,831	2,588	29,089
Other Acft SPOs	Misc	Various	3,900	3,900	0	549	1,601	1,750	0	0	3,900

Note: Contract cost information is source selection sensitive because of the competivite nature of the contract effort. This information is provided to AF PEO/WP and will be available on request. Cost data will be releasable after the EMD contract award and Milestone II approval.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)											DATE: February 1997
BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development					PE NUMBER AND TITLE: 0207325F Joint Air-to-Surface Standoff Missile						PROJECT: 4515
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Sverdrup Tech Inc.	Task Order	Jan 96	6,298	6,298	0	1,097	1,883	3,318	0	0	6,298
Navy	MIPR	Jan 96	3,650	3,650	0	800	2,850	0	0	0	3,650
JASSM SPO/Other	Misc	Various	56,258	56,258	0	3,803	7,180	14,580	14,677	16,018	52,258
Test and Evaluation Organizations											
46TW	REO	Jan 96	146,337	146,337	0	1,004	8,261	49,407	55,749	31,916	146,337

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: Not Applicable.

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development				0	18,637	122,624	118,209	56,354	52,271	368,095
Subtotal Support and Management				0	7,959	30,073	35,705	23,439	36,920	134,096
Subtotal Test and Evaluation				0	1,004	8,261	49,407	55,749	31,916	146,337
Total Project				0	27,600	160,958	203,321	135,542	121,107	648,528

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0207414F Combat Intelligence System

PROJECT: 2758

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2758 Combat Intelligence System (CIS)	0	0	12,267	10,499	10,421	9,266	7,773	6,875	Cont.	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) Note: This funding request was previously programmed across PEs 0604321F, 0207431F, and 0305158F. They have been consolidated here in PE 0207414F for program clarity and reporting efficiency.

(U) A. Mission Description and Budget Item Justification

(U) Combat Intelligence System (CIS) is the Air Force's single, standard automated intelligence system optimizing both component and unit-level intelligence functions to provide warfighters with the most accurate and timely intelligence data available. CIS is the core capability for automating the receipt, correlation, and dissemination of intelligence information to a variety of intelligence and operational systems which support combat planning and execution. As the intelligence segment to Theater Battle Management Core Systems (TBMCS), it provides an automated capability at the component and unit levels to rapidly receive and process all-source intelligence data to support Contingency Theater Automated Planning System (CTAPS). CIS builds and maintains in-theater situational awareness during deployment to the theater and provides indications and warning support after arrival. CIS is electronically interoperable and compatible with other intelligence systems, providing an integrated network capable of intelligence support to decision makers, battle planners, mission planners, and warfighters. The category of research being performed in this program is Engineering and Manufacturing Development, because it develops new capabilities to upgrade current systems.

(U) Acquisition Strategy: Full and open competition has led to a cost plus award fee contract with Lockheed Martin Command and Control Systems (Colorado Springs, CO) to develop capabilities and integrate this system and software.

(U) FY 1996 and FY 1997: Execution year funding remains programmed across PEs 0604321F, 0207431F, and 0305158F.

(U) FY 1998

- (U) $10,167 Complete software development for TBMCS Version 1.0 release, and initiate TBMCS software Version 2.0 development.
- (U) $ 900 Implement results of studies for CIS Intelligence Interoperability
- (U) $ 1,200 System engineering and support.
- **(U) $12,267 Total**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0207414F Combat Intelligence System
	PROJECT 2758

(U) FY 1999
- (U) $ 9,414 Continue software development for TBMCS V2.0 release and intiate TBMCS software version 3.0 planning and design.
- (U) $ 1,085 Continue studies for CIS Intelligence Interoperability
- **(U) $10,499 Total**

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY97 President's Budget	0	0	0**	0**	TBD
(U) Appropriated Value	0				
(U) Adjustments to Appropriated Value					
a. Cong Reductions					
b. Small Business Innovative Research					
c. Omnibus/Other Above Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			12,315	10,480	
(U) FY 1998/1999 Biennial Budget	0*	0*	12,267	10,421	TBD

(U) Change Summary Explanation:

Funding: * FY96 and FY97: Funding is programmed in PEs 0604321F, 0207431F, and 0305158F.
** FY98 and FY99: Funds were previously programmed in PEs 0604321F, 0207431F, and 0305158. They have been consolidated for clarity and reporting efficiency.

Schedule: Not Applicable

Technical: Not Applicable

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0207414F Combat Intelligence System	PROJECT 2758

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
(U) RDT&E, PE 0207431F, CAIS	0	7,385	0	0	0	0	0	0	0	7,385
(U) RDT&E, PE 0305158F, Const Source	1,989	1,954	0	0	0	0	0	0	Cont	TBD
(U) RDT&E, PE 0604321F, CIS-EMD	3,619	2,791	0	0	0	0	0	0	0	TBD
(U) Other Procurement, PE 0207414F	9,114	9,705	15,252	13,173	18,730	14,631	12,077	12,125	Cont	TBD
(U) Other Procurement, PE 0207431F	3,597	4,293	5,487	4,886	6,666	5,189	4,813	4,829	Cont	TBD
(U) Other Procurement, PE 0305158F	968	1,951	0	0	0	0	0	0	0	2,919
(U) O&M, PE 0207431, CAIS	10,826	3,479	3,330	3,353	4,326	5,371	5,488	5,615	Cont	TBD

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) CIS 1.2 Release				X												
(U) TBMCS Contract Awarded	X															
(U) TBMCS V1.0 Preliminary Design Review (PDR)					X											
(U) TBMCS V1.0 In Plant Test											X					
(U) TBMCS V1.0 Release												X				
(U) TBMCS V2.0 PDR														X		

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0207414F Combat Intelligence System PROJECT 2758

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Software Development			11,067	9,414
(U) Engineering Support			1,200	1,085
(U) Total			**12,267**	**10,499**

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Total Program
Product Development Organizations										
Lockheed Martin Cmd & Ctrl Systems and various others F19628-95-C0143	SS/CPAF	Oct 95	TBD	TBD	0	0	0	11,067	9,414	TBD
Support and Management Organizations										
TEMS	Ongoing	Various						374	374	TBD
MITRE	Ongoing							632	541	TBD
Test and Evaluation Organizations										
Test Support	Ongoing							194	170	TBD

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0207414F Combat Intelligence System PROJECT 2758

Government Furnished Property: Not Applicable

Subtotal Product Development	11,067	9,414	TBD
Subtotal Support and Management	1,006	915	TBD
Subtotal Test and Evaluation	194	170	TBD
Total Project	**12,267**	**10,499**	**TBD**

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0305176F Combat Survivor Evader Locator (CSEL)

PROJECT: 4522

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4522 Combat Survivor/Evader Locator (CSEL)	0	9218	4315	0	0	0	0	0	0	27,227
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Notes: 1) Congressionally approved reprogramming of $13.5M in FY95 funds used in FY96 RDT&E efforts for new start.

(U) A. Mission Description and Budget Item Justification

(U) The Combat Survivor/Evader Locator is a joint program, with the Air Force as lead Service, that will provide enhanced Combat Search and Rescue (CSAR) capability by replacing antiquated survivor radios (PRC-90/112) with current and emerging technologies in a new hand-held radio. This radio will be used by all the Services and DoD, and potentially non-DoD government agencies. CSEL features include two-way, secure, over-the-horizon (OTH) messaging and line-of-sight (LOS) voice, near real-time geopositioning, verification of evader identity and condition, low probability of intercept/detection (LPI/LPD), anti-jam, and the integration of commercial satellite systems capabilities. This program is in Budget Activity (BA) 5, Engineering and Manufacturing Development (EMD). Previously this program was in BA 3, Advanced Technology Development.

(U) FY 1996 **(Congressionally approved reprogramming of $13.5M in FY95 funds used in FY96 RDT&E efforts as a new start for CSEL.)**

– (U)		CSEL Engineering and Manufacturing Development	($10,963)
– (U)		COBRA Base Station Development	($2,000)
– (U)		Other Government Support	($537)
– (U)	$0	Total	($13,500)

(U) FY 1997

– (U)	$5,410	CSEL Engineering and Manufacturing Development
– (U)	$2,000	COBRA Base Station Development
– (U)	$1,808	Other Government Support
– (U)	$9,218	Total

(U) FY 1998

– (U)	$2,332	CSEL Engineering and Manufacturing Development
– (U)	$1,983	Other Government Support
– (U)	$4,315	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0305176F Combat Survivor Evader Locator (CSEL)
	PROJECT 4522

(U) FY 1999

– (U) $0 Not Applicable

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	0	9,596	4,865	0	Continuing
(U) Appropriated Value		9,596			
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions		-192			
b. SBIR		-177			
c. Omnibus and Other Above Threshold Reprogram	*0				
d. Below Threshold Reprogramming					
e. Rescission		-9			
(U) Adjustments to Budget Years since FY97 PB			**-550		
(U) Current Budget Submit/President's Budget	0	9,218	4,315	0	Continuing

(U) Change Summary Explanation:

Funding: * Congressionally approved reprogramming actions for FY96 from FY95 RDT&E funds for new start. ($13,500)
**Adjustment required to pay higher AF bills

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Other Procurement, Air Force (PE 0305176F)	0	2,858	5,731	14,137	14,977	14,859	6,114	6,289	Continue	Continue

(U) D. Schedule Profile

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0305176F Combat Survivor Evader Locator (CSEL)

PROJECT: 4522

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) RFP Release	X															
(U) Contract Award (RDT&E)		X														
(U) Initial Design Review			X													
(U) Final Design Review					X											
(U) Government DT/OA								X								
(U) Production Options Proposal								X								
(U) Production Option 1 Award (OPAF)								X								
(U) Option 1 (First Unit) Delivery										X						
(U) IOT&E (RDT&E)										X						
(U) Production Option 2 Award (OPAF)												X				
(U) Option 2 Delivery													X			
(U) Production Option 3 Award (OPAF)													X			
(U) Option 3 Delivery														X		

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0305176F Combat Survivor Evader Locator (CSEL)

PROJECT: 4522

(U) A. Project Cost Breakdown ($0 in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) CSEL Engineering and Manufacturing Development	10,963	5,410	2,332	0
(U) COBRA Base Station Development	2,000	2,000	0	0
(U) Other Government Support	537	1,808	1,983	0
(U) FY95 RDT&E Reprogrammed Funding for New Start	*-13,500*			
(U) Total		9,218	4,315	

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Total Program
Product Development Organizations										
Boeing (formerly Rockwell-Autonetics)	CPAF	23 Feb 96	TBD	TBD	0	10,963	5,410	2,332	0	Cont
SMC (COBRA)	Multiple	Multiple	TBD	TBD	0	2,000	2,000	0	0	Cont
Support and Management Organizations										
Program Support					0	483	1,558	1,483	0	Cont
Test and Evaluation Organizations										
AFOTEC					0	54	250	500	0	Cont
Government Furnished Property: Not Applicable.										
Subtotal Product Development					0	12,963	7,410	2,332	0	Cont
Subtotal Support and Management					0	483	1,558	1,483	0	Cont
Subtotal Test and Evaluation					0	54	250	500	0	Cont
FY95 RDT&E Reprogrammed Funding for New Start						*-13,500*				
Total Project					0	0	9,218	4,315	0	Cont

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY
5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE
0604201F Integrated Avionics Planning and Development

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	14,745	17,726	16,494	7,884	4,252	2,540	3,111	3,152	TBD	TBD
2257 Standard Avionics & JSRC Initiatives	4,722	964	1,594	1,135	1,154	1,152	0	0	TBD	TBD
2258 Standard Inertial Navigation Unit	623	435	299	0	0	0	0	0	TBD	TBD
2050 Joint Helmet-Mounted Cueing System (JHMCS)	9,400	16,327	14,601	6,749	3,098	1,388	3,111	3,152	TBD	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification

This program element explores and develops integrated avionics architectures and components which will reduce acquisition and support costs, increase weapon system performance and availability, and foster weapons system interoperability with standard interfaces. This program element is devoted to the demonstration and Engineering and Manufacturing Development (EMD) of integrated avionics architectures and open systems. The scope is both domestic and international. Reliability and Maintainability (R&M) play a major role in the identification of specific development efforts within this element as evidenced by the evolution of the Standard Inertial Navigation Unit (INU). Joint avionics development efforts are pursued through participation in and support of the Joint Service Review Committee (JSRC). Current initiatives include the Embedded Global Positioning System/Inertial Navigation System and the Joint Helmet-Mounted Cueing System. This is budget activity 5 due to the development nature of the effort.

(U) Acquisition Strategy:

Acquisition strategy is incorporated at the project level.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY97 PB)	15,833	18,620	19,353	8,462	TBD
(U) Appropriated Value	16,892	18,620			
(U) Adjustments to Appropriated Value					
a. Congressional General Reductions	-331	-410			
b. Below Threshold Reprogramming (BTR)	-103	0			
c. Above Threshold Reprogramming (ATR)	-1,278	0			
d. Small Business Innovative Research (SBIR)	-435	-484			
(U) Adjustment to Budget Year since FY97PB			-2,859	-578	
(U) Current Budget Submit/FY 98 PB	14,745	17,726	16,494	7,884	TBD

(U) Change Summary Explanation:

In FY 96 the ATR of $1,278,000 includes $174,000 for the Bosnia bill, $90,000 for reprogramming for Bosnia II and F-16s to Jordan, $1,000,000 for reprogramming action and $14,000 for an administrative and personnel rescission.
In FY 98 and FY 99 the reductions are for higher AF priorities.

Schedule: No changes

Technical: No changes

(U) **C. Other Program Funding Summary ($ in Thousands)** Not Applicable

(U) **D. Schedule Profile** See individual projects

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604201F Integrated Avionics Planning and Development

PROJECT: 2257

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2257 Standard Avionics & JSRC Initiatives	4,722	964	1,594	1,135	1,154	1,152	0	0	TBD	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification

This project identifies, demonstrates and/or develops candidate architecture standards and open system modular components for the Air Force and other services through the JSRC. Maintains/updates the common avionics database as a widely used avionics interoperability/standardization planning tool. Supports international avionics initiatives and standardization activities. Develops an opportunity matrix for tactical and airlift programs to identify opportunities to leverage investments. JSRC is a phase 0 concept studies project that explores candidate avionics systems and designs for potential developmental efforts and aircraft interoperability initiatives.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development PROJECT 2257

(U) FY 1996

–	(U) $1,400	Continued tri-service standardization opportunities via the Joint Service Review Committee (JSRC) processes
–	(U) $2,109	Open Avionics & Technology Transition Efforts
–	(U) $ 491	B-52 Steerable TV
–	(U) $ 210	Continued Avionics Planning Baseline and Database
–	(U) $ 90	Logistics Planning & Support
–	(U) $ 422	Program Management Support
–	(U) $ 4,722	Total

(U) FY 1997

–	(U) $ 80	Continue tri-service standardization opportunities via the JSRC processes
–	(U) $ 160	Open Avionics System Architecture Efforts
–	(U) $ 154	Continue Avionics Planning Baseline
–	(U) $ 90	Logistics Planning & Support
–	(U) $ 480	Program Management Support
–	(U) $ 964	Total

(U) FY 1998

–	(U) $ 100	Continue Avionics Planning Baseline
–	(U) $ 447	Avionics Roadmap & Technology Insertion
–	(U) $ 525	B-52 Steerable Television (Improved Targeting Capability)
–	(U) $ 100	Logistics Planning & Support
–	(U) $ 422	Program Management Support
–	(U) $1,594	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development
	PROJECT 2257

(U) FY 1999
- (U) $ 133 Continue Avionics Planning Baseline
- (U) $ 391 Avionics Roadmap & Technology Insertion
- (U) $ 296 Integrated Modular Avionics (IMA)
- (U) $ 105 Logistics Planning & Support
- (U) $ 210 Program Management Support
- (U) $1,135 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	4,722	1,013	4,630	1,448	TBD
(U) Appropriated Value	4,722	1,013			
(U) Adjustments to Appropriated Value					
a. General Congressional Reduction	0	-23			
b. Below Threshold Reprogramming	0	0			
c. Small Business Innovative Research	0	-26			
(U) Adjustment to Budget since FY97PB			-3,036	-313	
(U) Current Budget Submit/FY 98 PB	4,722	964	1,594	1,135	TBD

U) Change Summary Explanation:

Funding: Adjustment in FY 96 for Congressional reductions.
Adjustment in FY 97 covers general Congressional and inflation reductions.
In FY 98 and FY 99 the reductions are for higher AF priorities.

Schedule: No changes

Technical: No changes

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development PROJECT 2257

(U) C. Other Program Funding Summary ($ in Thousands) Not Applicable

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Publish Avionics Planning Baseline	O				O				X				X			
(U) Avionics Tech Map Update				O			X				X				X	
(U) B-52 TV				O				X			X					
(U) Demonstrate IMA														X		

X - Planned Effort
O - Completed Effort

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development PROJECT 2257

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Joint Service Review Committee	1,400	80	0	0
(U) Open Avionics & Tech Insertion Efforts	2,109	160	447	687
(U) B-52 TV	491	0	525	0
(U) Avionics Database	210	154	100	133
(U) Logistics Planning & Support	90	90	100	105
(U) Program Management Support	422	480	422	210
(U) Total	4,722	964	1,594	1,135

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations: None											
Support and Management Organizations											
Support Contracts	FFP	Annual 1 Jan	12 Mo.	12 Mo.		4,300	484	1,172	925	TBD	TBD
Prgm Mgmt Support	Various	Annual 1 Jan	12 Mo.	12 Mo.		422	480	422	210	TBD	TBD
Test and Evaluation Organizations: None											

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604201F Integrated Avionics Planning and Development

PROJECT: 2258

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2258 Standard Inertial Navigation Unit	623	435	299	0	0	0	0	0	TBD	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification

Develop DoD standard Embedded Global Positioning System (GPS)/ Inertial Navigation System (INS) (EGI) Precise Positioning System (PPS), (0.8 nm/h free inertial) Navigation System for Army's OH-58 Kiowa Warrior, Special Operations, Apache AH-64A+ and AH-64 C/D Apache Longbow helicopters, Navy's AH-1W Super Cobra helicopter, F-14, F-18, EA-6B, A-10, F-15, F-16 and KC-135 aircraft. Directly tied to the Congressionally mandated Minimum Avionics Requirement (MAR) capability for DoD aircraft and the Joint Chiefs of Staff (JCS) Radio Navigation Master Plan. Develop enhanced accuracy (0.3 nm/hr) Inertial Navigation Unit (INU) for the F-117A aircraft. Continue development of INU depot Support Equipment (SE) for the Standard Ring Laser Gyro (RLG) program. Embedded GPS/INS efforts resulted from a Tri-service acquisition plan. Program currently is in phase III (Production). Contracts were awarded on a full and open basis to Honeywell and Litton Industries.

(U) FY 1996
- (U) $NSP Continue Embedded Global Positioning Satellite (GPS) Inertial Navigation System (INS) (EGI) integration
- (U) $170 Engineering Tasks
- (U) $453 Program Management Support.
- (U) $623 Total

(U) FY 1997
- (U) $145 Engineering Tasks
- (U) $290 Program Management Support
- (U) $435 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development PROJECT 2258

(U) FY 1998
- (U) $99 Engineering Tasks
- (U) $200 Program Management Support
- (U) $299 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	623	459	0	0	TBD
(U) Appropriated Value	623	459			
(U) Adjustments to Appropriated Value					
a. Below Threshold Reprogramming	0	0			
b. Congressional General Reductions	0	-12			
c. Small Business Innovative Research	0	-12			
(U) Adjustment to Budget Years since FY97PB			299	0	
(U) Current Budget Submit/FY 98 PB	623	435	299	0	TBD

(U) Change Summary Explanation:
Adjustment in FY 97 covers general Congressional and inflation reductions.

Schedule: No changes

Technical: No changes

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development PROJECT 2258

(U) C. **Other Program Funding Summary ($ in Thousands)** Not applicable

(U) D. **Schedule Profile** (specific FY96-97 activities being planned)

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Complete F-117 Testing	X															
(U) Integrate GPS/INU on New Aircraft				X				X				X				
(U) Complete Qualification, Testing, and Evaluation (QT&E)				X												

X - Planned Effort

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development PROJECT 2258

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Engineering Tasks	170	145	99	0
(U) Program Management Support	453	290	200	
(U) Total	623	435	299	0

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Honeywell	FFP/LOE	Sept 96	110	110			110			TBD	TBD
Litton	FFP/LOE	Jan 97	10	10			10			TBD	TBD
Support and Management Organizations											
Mission Support	LOE					623	315	299	1,357	TBD	TBD

Test and Evaluation Organizations: None

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604201F Integrated Avionics Planning and Development

PROJECT: 2050

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2050 Joint Helmet-Mounted Cueing System (JHMCS)	9,400	16,327	14,601	6,749	3,098	1,388	3,111	3,152	TBD	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification

This Joint program with the USN will develop a helmet display system, capable of depicting aircraft heading data, pilots viewing perspective, target indication graphics and digital information. Consolidating this information on the pilot's visor allows the pilot to quickly align sensors and weapons on targets and engage threats using high off-boresight angle weapons such as the AIM-9X. The JHMCS includes a helmet with a mounted visor display capability, a helmet-vehicle interface cable, and several other components. JHMCS is currently in Phase II (EMD).

(U) FY 1996

- (U) $ 3,995 Risk Reduction & Source Selection -- McDonnell Douglas
- (U) $ 1,341 Risk Reduction -- Lockheed Martin
- (U) $ 1,593 Risk Reduction -- Lab Technology & Mission Analysis
- (U) $ 16 Test Support (AFFTC)
- (U) $ 1,527 Contract Management--ECO and reprogramming
- (U) $ 928 Program Management Support.
- (U) $ 9,400 Total

(U) FY 1997

- (U) $13,244 Conduct Joint Helmet Mounted Cueing System (JHMCS) EMD contract.
- (U) $ 2,335 Risk Reduction (MDA, LMTAS, & Lab Technology)
- (U) NSP Determine maintenance concepts.
- (U) $ 407 Test Support (AFFTC)
- (U) $ 341 Program management support
- (U) $16,327 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development PROJECT 2050

(U) FY 1998
- (U) $11,442 Conduct Joint Helmet Mounted Cueing System (JHMCS) EMD contract.
- (U) $ 2,817 Test Support (AFFTC)
- (U) $ 342 Program management support
- (U) $14,601 Total

(U) FY 1999
- (U) $ 3,527 Conduct Joint Helmet Mounted Cueing System (JHMCS) EMD contract.
- (U) $ 2,887 Test Support (AFFTC)
- (U) $ 335 Program management support
- (U) $ 6,749 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY97PB)	10,488	17,148	14,723	7,014	TBD
(U) Appropriated Value	10,404	17,148			
(U) Adjustments to Appropriated Value					
a. Congressional General Reductions	0	-375			
b. Below Threshold Reprogramming (ATR)	-1,004	0			
c. Above Threshold Reprogramming (ATR)	0	0			
d. SBIR	0	-446			
(U) Adjustments to Budget Years since FY97PB			-122	-265	
(U) Current Budget Submit/FY 98 PB	9,400	16,327	14,601	6,749	TBD

(U) Change Summary Explanation: JHMCS is an FY 96 new start.
Funding: FY 96 budget reduced by $1.038 million for Congressional, ATR (Bosnia & F-16s to Jordan) and SBIR actions.
FY97 budget reduced by $1.855 million for Congressional ($1.125M) reductions.
In FY 98 and FY 99 the reductions are for higher AF priorities.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development PROJECT 2050

Schedule: No Changes

Technical: No Changes

(U) C. Other Program Funding Summary ($ in Thousands) Not Applicable

(U)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Milestone I	O															
(U) Request for Proposal (RFP) release			O													
(U) Joint Operational Requirements Document (JORD) Development				O												
(U) Milestone II (EMD Contract Award)						O										
(U) Critical Design Review									X							
(U) System Integration Testing												X				
(U) Flight Test															X	
(U) Functional Configuration Audit																X

X - Planned Effort
O - Completed Effort

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development PROJECT 2050

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Risk Reduction Tasks	6,929	2,335	0	0
(U) EMD Effort	0	13,244	11,442	3,527
(U) Test Support	16	407	2,817	2,887
(U) Contract Management	527	0	0	0
(U) Program Management Support	928	341	342	335
(U) AF Reprogramming	1,000	0	0	0
(U) Total	9,400	16,327	14,601	6,749

(U) B. Budget Acquisition History and Planning Information ($ in Thousands):

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
TBD	CPAF	2/97	31,257	35,245	9,400*	9,400	16,327	14,601	6,749	17,498	57,826
Support and Management Organizations											
TBD	TBD	2/97	2,455	2,455							

Test and Evaluation Organizations: None

* Prior year dollars were used to fund Risk reduction activity which is another contract.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604201F Integrated Avionics Planning and Development PROJECT 2050

(U) C. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: TBD

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	FY 1999 Exp	Total Program
Subtotal Product Development					9,400	16,327	14,601	6,749	TBD
Total Project					9,400	16,327	14,601	6,749	TBD

(U) C. Funding Profile ($ in Thousands) Not Applicable

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604218F Engine Model Derivative Prog

PROJECT: 2634

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2634 Engine Model Derivative Program (EMDP)	714	675	741	767	789	800	813	832	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification**

EMDP is an engineering development level of effort program that provides the latest engine technology advances to current weapon systems and provides a framework for engine development for future systems. EMDP contributes to system life extension, reduced life cycle cost, and enhanced performance. Enhanced performance is required to counter increases in system weight and increased threat capability. EMDP demonstrates derivative engine concepts incorporating advanced technology and components from government and contractor funded programs. EMDP demonstrates advances in performance, durability, operability, supportability, reliability, maintainability, and unique capabilities, such as thrust reversing and vectoring nozzles. These demonstrations are in prototype derivatives of existing engines prior to full scale development. Early demonstration of improved engine characteristics significantly reduces risk and shortens engine development and qualification, allowing quick, cost-effective response to weapon system needs. EMDP also evaluates candidate engines (commercial or military) to provide competitive engine opportunities. EMDP ensures the Air Force has propulsion alternatives to meet near- and far-term needs. EMDP plans for and sustains the engineering development necessary to provide increased performance, reduced life cycle cost and system life extension for air breathing engines for current and future systems. This program is in budget activity 5 - Engineering and Manufacturing Development because it applies advanced technology to existing engines to demonstrate possible performance improvements.

(U) FY 1996 ($ in Thousands):

- (U) $ 80 Optimization Model Integration. This software tool supports all ongoing and future roadmapping studies.
- (U) $ 64 T-38 Roadmapping Study. This effort supports an Air Education and Training Command (AETC) and T-38 SPD (System Program Director) request to provide and evaluate propulsion options for the T-38 aircraft fleet. Goals will be to address deficiencies identified by AETC and to reduce life cycle costs of the T-38 aircraft.
- (U) $ 431 C-130E/H Roadmapping. This effort supports an Air Combat Command (ACC) and SPD request to provide and evaluate propulsion investment options for the C-130G/H aircraft fleet. The goal is to address deficiencies identified in Mission Area Plans and to reduce life cycle costs of the C-130E/H weapon system.
- (U) $ 8 Establish contract vehicles with P&W, GE, Williams International, Allison, Teledyne, Sundstrand, Microturbo and Rolls-Royce.
- (U) $ 131 Mission Support
- (U) $ 714 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604218F Engine Model Derivative Prog
	PROJECT 2634

(U) FY 1997 ($ in Thousands):

- (U) $ 100 Accomplish AGM-130 Flight Demonstration. This effort will support the gas turbine engine replacement for the weapon's current solid rocket motor. The gas turbine engine will extend the range of the AGM-130 beyond its present capability, and allow launch beyond the range of selected surface-to-air threats.
- (U) $ 220 Continuation of the T-38 Roadmapping study.
- (U) $ 104 A-10 Roadmapping study. This effort will support an ACC and SPD request to provide and evaluate propulsion options for the A-10 aircraft. Goals will be to address deficiencies identified in Mission Area Plans and to reduce life cycle costs of the A-10 aircraft.
- (U) $ 130 Other studies for Global Hawk Unmanned Aerial Vehicle (UAV) and other gas turbine and hypersonic rocket systems.
- (U) $ 121 Mission Support
- (U) $ 675 Total

(U) FY 1998 ($ in Thousands):

- (U) $ 280 Roadmapping studies. These efforts assist the aircraft SPDs, engine System Support Managers (SSMs) and the using commands in developing a long term propulsion plan of enhancements, modifications and upgrades to meet the unique requirements of each system. The C-130E/H and T-38 studies are examples of this type of effort. The roadmapping studies could consume the entire EMDP budget (as currently funded) in future years. Examples of candidate systems for evaluation include B-1, B-2, C-5, F-117, KC-10, HH53, HH60, JSTARS, and AWACS.
- (U) $ 41 Continuation of Hypersonic/Rocket studies and Small Gas Turbine Engine studies.
- (U) $ 300 Continuation of Global Hawk flight test program. Flight test effort to improve the performance of the AE3007H engine for Phase III and Phase IV of the Global Hawk Program. These performance improvements will be realized by incorporating turbine component technology now in development.
- (U) $ 120 Mission Support
- (U) $ 741 Total

(U) FY 1999 ($ in Thousands):

- (U) $ 280 Roadmapping studies.
- (U) $ 40 Continuation of Hypersonic/Rocket studies and Small Gas Turbine Engine studies.
- (U) $ 327 Continuation of Global Hawk flight test program.
- (U) $ 120 Mission Support
- (U) $ 767 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604218F Engine Model Derivative Prog
	PROJECT 2634

(U) B. **Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget FY97PB	756	705	747	774	Continuing
(U) Appropriated Value	756	705			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-15	-14			
b. SBIR	-13	-15			
c. Omnibus or Other Above Threshold Reprogram	-7				
d. Below Threshold Reprogramming					
e. Recissions	-7	-1			
(U) Adjustments to Budget Years Since FY 1997 PB			-6	-7	
(U) Current Budget Submit/FY1998 PB	714	675	741	767	Continuing

(U) Change Summary Explanation:

Funding: Reductions occurred to meet higher priority Air Force needs.

Schedule: N/A

Technical: Level of effort for planned studies will be reduced in scope.

(U) C. **Other Program Funding Summary ($ in Thousands)** Not Applicable

(U) D. **Schedule Profile**: Not Applicable

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604218F Engine Model Derivative Prog PROJECT 2634

(U) A. Project Cost Breakdown ($ in Thousands)

Major tasks will be roadmapping studies by General Electric, Williams and Allison Engine Comp.

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
P & W	FFP/CPFF	08 Mar 96	N/A	N/A	$ 1,298	$ 81	$ 0	$ 0	$ TBD	CONT	CONT
GE	FFP/CPFF	22 Apr 96	N/A	N/A	$ 1,138	$ 65	$ 324	$ 277	$ TBD	CONT	CONT
Williams Int'l	FFP/CPFF	28 Feb 96	N/A	N/A	$ 335	$ 1	$ 100	$ 44	$ 47	CONT	CONT
Allison	FFP/CPFF	28 Feb 96	N/A	N/A	$ 1,146	$ 432	$ 95	$ 0	$ 0	CONT	CONT
Teledyne CAE	FFP/CPFF	05 Feb 96	N/A	N/A	$ 2,882	$ 1	$ 35	N/A	$ TBD	CONT	CONT
Allied Signal	FFP/CPFF	N/A	N/A	N/A	$ 186	N/A	N/A	N/A	$ TBD	CONT	CONT
Sundstrand	CPFF	08 Mar 96	N/A	N/A	N/A	$ 1	$ 0	$ 0	$ TBD	CONT	CONT
Microturbo	CPFF	26 Nov 96	N/A	N/A	N/A	$ 1	$ 0	$ 0	$ TBD	CONT	CONT
Rolls Royce	CPFF	14 Aug 96	N/A	N/A	N/A	$ 1	$ 0	$ 0	$ TBD	CONT	CONT
Total					$ 6,985	$ 583	$ 554	$ 321	$ 320	CONT	CONT
Support and Management Organizations											
In-House Support						$ 131	$ 121	$ 120	$ 120	CONT	CONT
Test and Evaluation Organizations											
AEDC								$ 300	$ 327		

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604218F Engine Model Derivative Prog
	PROJECT 2634

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: None

	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development	$ 583	$ 554	$ 321	$ 320	CONT	CONT
Subtotal Support and Management	131	121	120	120	CONT	CONT
Subtotal Test and Evaluation (Global Hawk)			$ 300	$ 327	CONT	CONT
Total Project	$ 714	$ 675	$ 741	$ 767	CONT	CONT

Related RDT&E:

(U) - PE # 0603202F, Aircraft Propulsion Subsystem Integration, provides fan and low pressure turbine technology.

(U) - PE # 0603216F, Advanced Turbine Engine Gas Generator, provides compressor, combustor, and high pressure turbine technology.

(U) - PE # 0602203F, Aerospace Propulsion, provides additional component and engine test data.

(U) - PE # 0708011F, Industrial Preparedness Program, provides materials processing and component fabrication demonstration.

(U) - Activities conducted by the Army, Navy, National Aeronautics and Space Administration, and propulsion industry Independent Research and Development (IR&D).

(U) - PE # 0604268F, Aircraft Engine Component Improvement Program, complements EMDP by addressing engine safety problems, service-revealed deficiencies, and improved reliability. This PE will change to #0207268F with submission of the FY97 President's Budget.

(U) - The Air Force and Navy have a broad memorandum of understanding for joint cooperative propulsion programs in areas of common interest.

(U) - There is no unnecessary duplication of effort within the Air Force or the Department of Defense.

(U) D. Schedule Profile: The FY96 C-130 Study began in May 1996 and will continue for eight months. T-38 study will conclude in FY97. A-10 study concludes in 1998.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604222F Nuclear Weapons Support

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	4,516	5,655	4,782	5,005	5,407	5,606	6,824	7,077	Continuing	Continuing
4236 Engineering Analysis	709	1,689	715	706	748	732	0	0	Continuing	Continuing
5708 Nuclear Weapons Support	3,807	3,966	4,067	4,299	4,659	4,874	6,824	7,077	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification**

Provides funds for maintaining core USAF nuclear weapon system expertise. Includes in-house technical capabilities, contractual efforts, supplies and equipment, travel and salaries of the San Antonio Air Logistics Center, Nuclear Weapons Directorate, Nuclear Weapons Integration Division's civilian and military nuclear weapon specialists at Kirtland Air Force Base. Provides technical guidance for continued and improved weapons capability, interoperability, safety, surety, security, development, stockpile management and retirement. Customers are: DoD (Air Force, Navy and Defense Special Weapons Agency [DSWA]), DOE and NATO. Supports US Strategic Command and Air Combat Command Required Operational Capability 16-71 (Peacekeeper), 12-76 (Air Launched Cruise Missile), 6-76 (B61 Strategic Bomb), 6-69 (B83 Modern Strategic Bomb), and SAC System Operational Requirements Document 13-82-III (Advanced Cruise Missile). Air Force representative for development and implementation of the Joint DoD-DOE Surety Plan, DOE Stockpile Stewardship Plan, and the DoD/DOE Annual Certification. These plans document nuclear weapon issues which benefit from the application of risk assessment, data collection, and model development. The Nuclear Weapons Integration Division is responsible for all USAF nuclear weapons development, systems engineering, nuclear surety engineering, engineering analyses and weapons support procedure changes. These efforts place this project in RDT&E research category/budget activity 5, Engineering and Manufacturing Development. This work is tied to the DOE nuclear weapons development process independent of the DoD acquisition system. Weapons are always undergoing some form of RDT&E to continually assure safety and reliability as the DoD restructures the nation's nuclear stockpile. Therefore, USAF platforms require continuing engineering development and analysis to ensure compatibility and safety of nuclear systems. Funding this element is essential to maintaining current safety and reliability levels in the US nuclear stockpile.

(U) **Acquisition Strategy**: Not Applicable

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604222F Nuclear Weapons Support

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	4,822	4,788	4,781	4,726	Cont
(U) Appropriated Value	4,822	5,788			
(U) Adjustments to Appropriated Value					
(U) a. Congressional and Undistributed Reductions	-94	-133			
(U) b. SBIR	-113				
(U) c. Omnibus or Above Threshold Reprogramming	-94				
(U) d. Below Threshold Reprogramming (BTR)	-4				
(U) Adjustments to Budget Years Since FY97 PB	-1		1	279	
(U) Current Budget Submit/FY 98 President's Budget	4,516	5,655	4,782	5,005	Cont

(U) Change Summary Explanation:

Funding: Increase in FY97 due to Congressional add for backlog in nuclear requirements studies. Increase in funding for FY98 due to military/civilian pay inflation increase partially offset by non-pay inflation decrease. Changes in FY99 due to personnel end strength adjustments.

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Not Applicable										

Related RDT&E:

(U) PE0603851F, ICBM Modernization Dem/Val; PE0604851F, ICBM Modernization EMD.
(U) PE0101122F, Air Launched Cruise Missile; PE 0101120F, Advanced Cruise Missile (ACM).
(U) PE0101113F, B-52 Squadrons.
(U) PE0101126F, B-1B Squadrons; PE0604240F, B-2 Advance Technology Bomber, PE0101127F, B-2 Squadrons.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) PE0207130F/0207134F, F-15 A-D Squadrons, F-15E Squadrons.										
(U) PE0207590F SEEK EAGLE.										

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support

(U) D. Schedule Profile

Technical Capabilities Maintained For:	FY 1996[2]				FY 1997[2]				FY 1998[2]				FY 1999[2]			
Active Stockpile Weapons	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) - B53 Strategic Bomb																
(U) - W80-1 (ALCM, ACM)																
(U) - B61-7, 11, B83 (Strategic Bombs)																
(U) - B61-3, 4, 10 (Tactical Bombs)																
(U) - W62,W78, W87 (Minuteman III & Peacekeeper)																
Weapons only in Inactive Stockpile (In Storage)																
(U) - W84 (GLCM)																
Weapons in Retirement[1]																
(U) - W69 (SRAM A)																
(U) - W56 (Minuteman II)																
(U) - B61-0,2,5 (Strategic Bombs)																

Note1: Weapons remain in USAF custody pending DOE scheduling for shipment and dismantlement.
Note2: Stockpile Data, i.e., IOC, retirement dates, etc. are classified

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support	PROJECT 4236

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4236 Engineering Analysis	709	1,689	715	706	748	732	0	0	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification

Funds the engineering analysis performed on contract for all new and fielded nuclear weapon systems. Contractors provide technical expertise unavailable through organic resources in critical areas of nuclear weapons safety and security.

(U) FY 1996

- (U) $205 Nuclear Aircraft System Support. Revised and verified nuclear weapons loading, delivery, warhead mate and demate technical orders; provided support on the nuclear hardness database; provided Aircraft Monitor and Control (AMAC) software analysis and technical expertise for continued nuclear weapons integration on US and non-US aircraft systems; continued to support development of USAF-DOE interconnectivity to Joint Nuclear Weapons Publications System (JNWPS).
- (U) $299 Nuclear Weapons Program Support. Provided technical expertise to support development programs including the B61-11 modification, B83-1 reradiation system, W87 life extension and B83 spin rocket motor; fielded and updated nuclear weapon stockpile-to-target sequences for 7 weapons systems and developed new documents for the B61-11 program; documented and supported B61-11 Technical Surety Analysis Report; documented and supported weapon program actions, agreements, and program status including over 30 Project Officer Group reports and Annual Certification Reports; developed inactive stockpile plans for all systems, completed staging for W69, B61-0,2,5 and W56 dismantlement and close-out of W80 bottle seating issue.
- (U) $205 Nuclear Weapons/Systems Assessments. Provided technical assessments and support on the Agent Defeat Weapon (ADW) Concept study.
- (U) $709 Total

(U) FY 1997

- (U) $210 Nuclear Aircraft System Support. Revise and verify nuclear weapons loading, delivery, warhead mate and demate technical orders; provide support on the nuclear hardness database; perform aircraft software analysis, and provide technical expertise for continued nuclear weapons integration on US and non-US aircraft systems.
- (U) $1019 Nuclear Weapons Program Support. Provide technical expertise to support development, fielding and updates of nuclear weapon stockpile-to-target sequences; document and support all weapons safety analyses; document and support all weapon program actions, agreements, and program status; conduct special studies on stockpile related matters and warhead life extension studies, provide technical support on inactive stockpile issues, weapon system safety evaluations use control, long term storage, life extension and dismantlement issues to weapon Lead Project Officers;

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support PROJECT 4236

–	(U) $460	Nuclear Weapons/System Assessments. Provide technical assessments and support on nuclear safety analyses, weapons storage complex assessment and the ADW Concept study.
–	(U) $1,689	Total
	(U) FY 1998	
–	(U) $205	Nuclear Aircraft System Support. Revise and verify nuclear weapons loading, delivery, warhead mate and demate technical orders; provide support on the nuclear hardness database, perform aircraft software analysis; and provide technical expertise for continued nuclear weapons integration on US and non-US aircraft systems.
–	(U) $300	Nuclear Weapons Program Support. Provide technical expertise to support development, fielding and updates of nuclear weapon stockpile-to-target sequences; document and support all weapons safety analyses; document and support all weapon program actions, agreements, and program status; conduct special studies on stockpile related matters, provide technical support on inactive stockpile issues, use control, long term storage, life extension and dismantlement issues to weapon Lead Project Officers.
–	(U) $210	Nuclear Weapons/System Assessments. Provide technical assessments and support on nuclear safety analyses, the ADW Concept study and limited special studies.
–	(U) $715	Total
	(U) FY 1999	
–	(U) $202	Nuclear Aircraft System Support. Revise and verify nuclear weapons loading, delivery, warhead mate and demate technical orders; provide support on the nuclear hardness database, perform aircraft software analysis; and provide technical expertise for continued nuclear weapons integration on US and non-US aircraft systems.
–	(U) $304	Nuclear Weapons Program Support. Provide technical expertise to support development, fielding and updates of nuclear weapon stockpile-to-target sequences; document and support all weapons safety analyses; document and support all weapon program actions, agreements, and program status; conduct special studies on stockpile related matters, provide technical support on inactive stockpile issues, use control, long term storage, life extension and dismantlement issues to weapon Lead Project Officers.
–	(U) $200	Nuclear Weapons/System Assessments. Provide technical assessments and support on nuclear safety analyses and limited special studies.
–	(U) $706	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	710	726	721	712	Cont
(U) Appropriated Value	710	1726			
(U) Adjustments to Appropriated Value					
(U) a. Congressional and Undistributed Reductions	-13	-37			
(U) b. Omnibus or Above Threshold Reprogramming	-9				
(U) Adjustments to Budget Years Since FY97 PB	21		-6	-6	
(U) Current Budget Submit/FY 98 President's Budget	709	1689	715	706	Cont

(U) Change Summary Explanation:

Funding: Increase in FY97 due to Congressional add for backlog in nuclear requirements studies. Decrease in funding for FY98 and beyond due to non-pay inflation rate changes.

Schedule: N/A

Technical: N/A

(U) **C. Other Program Funding Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Not Applicable										

(U) **D. Schedule Profile**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Not Applicable																

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604222F Nuclear Weapons Support

PROJECT: 4236

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Contractor Engineering Support	709	1689	715	706
(U) Total	709	1689	715	706

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Miscellaneous	MIPR/FFP	1Q FY98	NA	NA	Cont	709	1689	715	706	Cont	Cont
DOE/ALO, Albuquerque, NM											
TECH REPS, Inc., Albuquerque, NM											
Orion International, Albuquerque, NM											
Naval Air Warfare Center, Indianapolis, IN											
Silicon Graphics, Albuquerque, NM											
Kaman Sciences Corp, Boston MA											
Albuquerque Logistics, Albuquerque, NM											
Support and Management Organizations											
None											
Test and Evaluation Organizations											
None											

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support PROJECT 4236

(U) B. **Budget Acquisition History and Planning Information Continued ($ in Thousands)**

Government Furnished Property: Not Applicable

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Property										
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development					709	1689	715	706	Cont	Cont
Subtotal Support and Management										
Subtotal Test and Evaluation										
Total Project					709	1689	715	706	Cont	Cont

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604222F Nuclear Weapons Support

PROJECT: 5708

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
5708 Nuclear Weapons Support	3,807	3,966	4,067	4,299	4,659	4,874	6,824	7,077	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification**

Funds San Antonio Air Logistics Center, Nuclear Weapons Integration Division's civilians at Kirtland AFB, New Mexico providing technical and engineering support for all new and fielded USAF nuclear weapon systems.

(U) FY 1996

– (U) $1,035 Nuclear Aircraft System Support. Supported the Prime Nuclear Airlift Force (PNAF) and PA-200 USAF Nuclear Weapon System Safety Group (NWSSG) Operational Safety Reviews (OSRs); supported the USAF NWSSG Special Safety Studies of the B61-11 and B53 and the NWSSG B-2A Preoperational Safety Study; supported the US Strategic Command's (USSTRATCOM) nuclear safe escape effort initiating upgrade of Nuclear Hardness Database Center software to accommodate B-2A during modeling/simulation of safe escape data; conducted independent nuclear surety evaluations and made nuclear safety design certification recommendations on nuclear aircraft system modifications; continued management of the F-15E and B-52H Nuclear Project Officers Groups; coordinated development tests for the B61-11; completed the draft nuclear safety design certification evaluation of the C-17A; performed engineering analyses and completed statements of nuclear weapon compatibility for the F-16A/B and F-16C/D software updates; provided technical support for efforts to upgrade the use control devices on the strategic weapon systems, for upgrading the F-15E Programmable Armament Control Set (PACS) and for B-1B Block E design for nuclear capability roll-in; initiated the F-16A/B and PA-200 Tornado aircraft mid-life weapons system hardware/software update and upgrade; conducted nuclear weapon Aircraft Monitor and Control (AMAC) tests on the B-2A for the Block 10 software and on the F-16A/B for the Mid-Life-Update; conducted evaluations of nuclear weapon system incidents; provided support/members for the B-2A & C-17A Nuclear Certification Working Groups, and the F-16A/B/C/D & B-1B Project Officers Groups.

– (U) $674 Nuclear Ground-Launched Missile (ICBM) Support. Supported START I and START II treaties in efforts related to Minuteman II deactivation and Single Reentry Vehicle, provided the ICBM program office/contractors nuclear surety design guidance on the Minuteman III Guidance Replacement Program (GRP), the Airborne Launch Control System (ALCS) transition to the Navy E6B Aircraft Program, the Rockwell Guidance Repair Center (RGRC) Privatization in Place (PIP) Program, the Code Processing System and other upgrade programs; provided technical support required by NWSSG action items, performed safety analyses and independent evaluations for nuclear safety design certification of weapon system modifications and approval of the Minuteman Integrated Life Extension Program, supported and provided a member for the Minuteman III System-Wide Unauthorized Launch Study Working Group and the Senior Steering Group, and provided a member for the HQ Air Force Space Command ICBM Nuclear Security Process Action Team (PAT).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support PROJECT 5708

– (U) $1,148 Nuclear Weapons Program Support. Accomplished nuclear weapon safety and compatibility studies including the Annual Certification Reports; supported USAF nuclear weapon stockpile activities (W62 Arming, Fuzing and Firing study, W80 desiccant ring replacement, and W78 bottle replacement), weapon use control analyses for the B61 and ICBM warheads, the Agent Defeat Weapon study, and W80 and W84 storage assessments; continued the B61-11 modification program; approved revisions to W80, B53, B61-3,4,7,10 and B83 STS and new B61-11 STS document; continued support to USAF, DoD and other agencies in all facets of nuclear arsenal; continued to manage the B53, B61, W80, B83, W84, and the ICBM warheads Nuclear Project Officers Groups; initiated the Nuclear Weapons Capability Protection Assessment (NWCPA) to examine current status, anticipated age-related degradation problems, estimated replacement need dates and likely problems due to sunset technology and changes to the DOE production complex..

– (U) $950 Nuclear Weapons/Systems Assessments. Continued to develop joint DoD/DOE nuclear surety assessment methodology; conducted fault tree analyses of nuclear weapons systems; completed the W80 abnormal environment assessment and continuing Agent Defeat Weapon (ADW) Concept study; downscaled Kirtland Underground Munitions Storage Complex (KUMSC) study.

– (U) $3,807 Total

(U) FY 1997

– (U) $1,050 Nuclear Aircraft System Support. Continue FY 1996 level of effort: support USSTRATCOM's nuclear safe escape effort; update/expand nuclear hardness database, conduct nuclear aircraft weapon system surveillance test programs; provide technical support required by NWSSG action items, Special Safety Studies, and Operational Safety Reviews; support design, development, standardization and procurement of stores management systems for nuclear weapon command and control; provide nuclear surety design criteria, standards, specifications, and related requirements documents for all USAF nuclear capable aircraft weapon systems; complete C-17A nuclear safety design certification evaluation and recommendations; manage the B-52H, F-15E, and Nuclear Airlift Project Officers Groups; perform an independent analysis of the B-2A Block 20 software; direct AMAC testing on the B-2A Block 20 and F-16A/B Mid-Life-Update & Block 40; support testing for a mixed stores capability on the B-2A; conduct independent engineering evaluation of F-15E PACS Upgrade and Combined Armament Test Set; perform nuclear safety analyses, independent engineering evaluations for nuclear safety design certification of nuclear weapon system modifications, and engineering evaluations and support testing required for nuclear weapon compatibility certification.

– (U) $782 Nuclear Ground-Launched Missile (ICBM) Support. Continue FY 1996 level of effort: support START I and START II treaties during Minuteman III base transfers; provide nuclear surety design criteria, standards, specifications, and related requirements documents for all USAF ground-launched missile systems; provide nuclear surety design guidance to the ICBM program office/contractors for weapon system modifications; perform independent nuclear surety analyses for nuclear safety design certification of weapon system modifications and approval of the Minuteman Integrated Life Extension Program; support and provide a member for the Minuteman III System-Wide Unauthorized Launch Study Working Group and the Senior Steering Group; conduct the Independent Technical Nuclear Safety Analysis (TNSA) for the Airborne Launch Control System (ALCS) transition to the Navy E6B Aircraft Program and brief recommendations during the NWSSG Special Safety Study of the ALCS; support the Minuteman III NWSSG Operational Safety Review; and support NWSSG action items and Special Safety Studies as required.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support PROJECT 5708

–	(U) $1,142	Nuclear Weapons Program Support. Continue FY 1996 level of effort: accomplish nuclear weapon safety and compatibility studies, support USAF nuclear weapon stockpile activities and weapon use control analysis techniques; support environmental and intrinsic radiation studies; continue the Nuclear Weapons Capability Protection Assessment (NWCPA) to develop, plan, schedule and execute nuclear weapon life extension programs for safety, security reliability and operability actions for B61, B83, W80 and ICBM warheads; complete B61-11 modification program; continue support to USAF, DoD and other agencies in all facets of nuclear arsenal.
–	(U) $992	Nuclear Weapons/Systems Assessments. Continue FY 1996 level of effort: continue Agent Defeat Weapon (ADW) phase 0 study; complete KUMSC study; continue to develop joint DoD/DOE nuclear surety assessment methodology; conduct fault tree analyses of nuclear weapons and weapon systems; provide other special assessments as capable.
–	(U) $3,966	Total

(U) FY 1998

–	(U) $1,117	Nuclear Aircraft System Support. Continue FY 1997 level of effort: support the US Strategic Command's nuclear safe escape effort; update/expand nuclear hardness database; conduct nuclear aircraft weapon system surveillance test programs; provide technical support required by NWSSG action items, Special Safety Studies, and Operational Safety Reviews; perform independent engineering nuclear safety evaluations; support design, development, standardization and procurement of stores management systems for nuclear weapons command and control; provide nuclear surety design criteria, standards, specifications, and related requirements documents for all USAF nuclear capable aircraft weapon systems; manage the B-52H, F-15E, and Nuclear Airlift Project Officers Groups; perform an independent analysis of the B-2A Block 20 software; direct aircraft compatibility testing; perform independent engineering evaluations for nuclear safety design certification of nuclear weapon system modifications; perform engineering evaluations and support testing required for nuclear weapon compatibility certification.
–	(U) $710	Nuclear Ground-Launched Missile (ICBM) Support. Continue FY 1997 level of effort: provide nuclear surety design criteria, standards, specifications, and related requirements documents for all USAF ground-launched missile systems; provide nuclear surety design guidance to ICBM program office/contractors for weapon system modifications and upgrade programs; provide nuclear certification support; perform independent nuclear surety analyses for nuclear safety design certification of weapon system modifications and approval of integrated life extension programs; and support NWSSG action items and Special Safety Studies as required.
–	(U) $1,220	Nuclear Weapons Program Support. Continue FY 1997 level of effort: accomplish nuclear weapon safety and compatibility studies, support USAF nuclear weapon stockpile activities and weapon use control analysis techniques; support environmental and intrinsic radiation studies; continue the NWCPA to develop, plan, schedule and execute nuclear weapon life extension programs for safety, security reliability and operability actions for B61, B83, W80 and ICBM warheads; continue support to USAF, DoD and other agencies in all facets of nuclear arsenal.
–	(U) $1,020	Nuclear Weapons/Systems Assessments. Continue FY 1997 level of effort: complete Agent Defeat Weapon (ADW) phase 0 study; continue KUMSC study; begin to apply joint DoD/DOE nuclear surety assessment methodology on abnormal nuclear environments analyses ; conduct fault tree analyses of nuclear weapons and weapon systems; provide other special assessments as capable.
–	(U) $4,067	Total

(U) FY 1999

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support PROJECT 5708

–	(U) $1,151	Nuclear Aircraft System Support. Continue FY 1998 level of effort: support the US Strategic Command's nuclear safe escape effort; update/expand nuclear hardness database; conduct nuclear aircraft weapon system surveillance test programs; provide technical support required by NWSSG action items, Special Safety Studies, and Operational Safety Reviews; perform independent nuclear safety analyses; support design, development, standardization and procurement of stores management system for nuclear weapons command and control; provide nuclear surety design criteria, standards, specifications, and related requirements documents for all USAF nuclear capable aircraft weapon systems; manage the B-52H, F-15E, and Nuclear Airlift Project Officers Groups; direct nuclear weapon aircraft interface testing on delivery aircraft as required; perform independent engineering evaluations for nuclear safety design certification of nuclear weapon system modifications; perform engineering evaluations and support testing required for nuclear weapon compatibility certification.
–	(U) $770	Nuclear Ground-Launched Missile (ICBM) Support. Continue FY 1998 level of effort: provide nuclear surety design criteria, standards, specifications, and related requirements documents for all USAF ground-launched missile systems; provide nuclear surety design guidance to ICBM program office/contractors for weapon system modifications and upgrade programs, perform independent nuclear surety analyses for nuclear safety design certification of weapon system modifications; provide nuclear certification support; complete nuclear safety analysis for nuclear safety design certification of the Minuteman III GRP Program; and support NWSSG action items and Special Safety Studies as required.
–	(U) $1,290	Nuclear Weapons Program Support. Continue FY 1998 level of effort: accomplish nuclear weapon safety and compatibility studies, support USAF nuclear weapon stockpile activities and weapon use control analysis techniques; support environmental and intrinsic radiation studies; continue the NWCPA to develop, plan, schedule and execute nuclear weapon life extension programs for safety, security reliability and operability actions for B61, B83, W80 and ICBM warheads; continue support to USAF, DoD and other agencies in all facets of nuclear arsenal.
–	(U) $1,088	Nuclear Weapons/Systems Assessments. Continue FY 1998 level of effort: continue application of joint DoD/DOE nuclear surety assessment methodology to abnormal nuclear environment analyses; conduct fault tree analyses of nuclear weapons and weapon systems; provide other special assessments as capable.
–	(U) $4,299	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support
	PROJECT 5708

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	4,112	4,062	4,060	4,014	Cont
(U) Appropriated Value	4,112				
(U) Adjustments to Appropriated Value					
a. Congressional and Undistributed Reductions	-81	-96			
b. SBIR	-113				
c. Omnibus or Above Threshold Reprogramming	-85				
d. Below Threshold Reprogramming (BTR)	-4				
(U) Adjustments to Budget Years Since FY97 PB	-22		7	285	
(U) Current Budget Submit/FY 98 President's Budget	3,807	3,966	4,067	4,299	Cont

(U) Change Summary Explanation:

Funding: Increase in funding for FY98 and beyond due to inflation rate changes (military/civilian pay and military/civilian inflation). Changes in FY99 due to personnel end strength adjustments.

Schedule: N/A

Technical: N/A

(U) **C. Other Program Funding Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Not Applicable										

(U) **D. Schedule Profile**

	FY 1996				FY 1997				FY 1998				FY 1999		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Not Applicable																

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support
	PROJECT 5708

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Program Management Personnel	234	234	239	244
(U) Research Personnel	2,720	2,870	2927	2985
(U) Travel	300	275	300	325
(U) Training Development	100	150	150	175
(U) Research Support Equipment Acquisition	145	125	125	150
(U) Miscellaneous	308	312	326	420
(U) Total	3,807	3,966	4,067	4,299

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Organizations											
SA-ALC/NWI	N/A	N/A	N/A	N/A	Cont	3,807	3,966	4,067	4,299	Cont	Cont
Support and Management Organizations											
None											
Test and Evaluation Organizations											
None											

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604222F Nuclear Weapons Support	PROJECT 5708

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: Not Applicable

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Property										
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development					3,807	3,966	4,067	4,299	Cont	Cont
Subtotal Support and Management										
Subtotal Test and Evaluation										
Total Project					3,807	3,966	4,067	4,299	Cont	Cont

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604226F B-1B

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	186,940	207,930	216,886	199,718	214,409	143,158	33,497	5,377	16,915	1,427,906
1019 ECM Improvements*	13,691	39,537	0	0	0	0	0	0	0	70,175
1020 AFMSS*	9,154	10,369	0	0	0	0	0	0	0	20,630
1021 B-1 Simulator*	4,350	7,714	0	0	0	0	0	0	0	11,434
4143 Conventional Weapons Upgrade*	159,745	150,310	0	0	0	0	0	0	0	495,788
4596 Conventional Mission Upgrade*	0	0	216,886	199,718	214,409	143,158	33,497	5,377	16,915	829,960
Quantity of RDT&E Articles	0	3(4,562)	17(23,896)	0	3(3,388)	0	0	0	0	23

* BPACs 1019, 1020, 1021, and 4143 were consolidated into BPAC 4596 beginning in FY98.

(U) A. **Mission Description and Budget Item Justification**

(U) With the drawdown of forward-based US ground, naval, and tactical air forces, current defense strategy calls for long range, conventionally armed strategic bombers to play a major role in the initial stages of a regional contingency. The 95 B-1B Lancers in the Air Force inventory will constitute over one-half of all US strategic bombers -- making them the centerpiece of the conventional bomber force well into the next century. To maximize the B-1's contribution in this role, the Air Force must enhance the B-1's capability to perform precision attacks against moderately defended targets deep in enemy airspace. The needed enhancements fall primarily into two categories: improved lethality through integration of advanced conventional weapons, and improved survivability through upgrades to the electronic countermeasures (ECM) system. The Air Force established the Conventional Mission Upgrade Program (CMUP) to fulfill these requirements.

(U) This Program Element provides RDT&E funding for CMUP. The program achieved Required Assets Available of Cluster Bomb Units (CBUs) in September 1996. Funding in the FYDP covers integration of the Joint Direct Attack Munition (JDAM), Wind Corrected Munitions Dispenser (WCMD), Joint Stand-Off Weapon (JSOW), Joint Air to Surface Stand-Off Missile (JASSM), and upgrades to the existing ECM suite. Parallel and complimentary enhancements include an upgrade to the avionics computers to enable simultaneous carriage of multiple weapon types, provide growth capability, and reduce support costs; development of an interface to the Air Force Mission Support System (AFMSS) for more effective employment of the B-1 in a theater scenario; and upgrades to the air crew and maintenance training

systems to keep them consistent with the aircraft's configuration. The FY98 program includes work in Research Category/Budget Activity Engineering and Manufacturing Development, and is structured as follows:

(U) **Defensive System Upgrade Program (DSUP):** The existing ALQ-161 defensive system, designed and optimized for the strategic nuclear mission (i.e., low altitude penetration against specific air defense threats) has limited effectiveness in the B-1B's new conventional mission. DSUP will remove most of the ALQ-161 system and replace it with an AN/ALR-56M radar warning receiver and the RF Countermeasures (RFCM) portion of the Navy's IDECM program, which includes a techniques generator and a fiber optic towed decoy. A new low band on board jammer will be installed to provide the requisite threat coverage. These new systems will significantly improve situational awareness and the survivability of the B-1B in the medium and high altitude regimes where most conventional missions will be conducted. These enhancements are required to maximize the effectiveness of the new weapons capability provided under CMUP. Additionally, these modifications will eventually reduce annual O&S costs approximately $50M per year after full fleet modification. (Formerly Project 1019, ECM Improvements)

(U) **B-1B Mission Planning System:** Consists of improved B-1 mission planning capabilities by adding an aircraft specific software module to the ongoing AFMSS program. Automated mission planning systems traditionally have been developed and deployed by individual Air Force operating commands to support their assigned aircraft and weapons systems. The Air Force is now transitioning to a standard system, AFMSS. While AFMSS provides common mission planning capabilities for all aircraft, the aircraft, weapons, and electronics (A/W/E) hardware and software on each type aircraft provide unique interfaces and functionality not provided by the AFMSS "core" system. This project provides those aircraft unique interfaces. The B-1 A/W/E module will supplement the AFMSS core capabilities to achieve enhanced route planning, penetration, and weapons delivery capabilities. AFMSS replaces an aging mission planning system which is no longer fully supportable and does not meet current mission requirements. This A/W/E module will be developed concurrently with the AFMSS core software and the B-1 operational flight programs. (Formerly Project 1020, AFMSS)

(U) **Training Systems:** Provides updates to the existing training system necessary to match changes made to the aircraft described in the other sections. The total B-1 Training System consists of the Simulator System to train air crew members and Maintenance Training Equipment (MTE) to train maintenance personnel. The SS is actually a suite of systems which provides the necessary visual, motion, and aural cues for complete ground training of B-1 air crew members -- there are five Weapon System Trainers, five Cockpit Procedure Trainers, two Mission Trainers and one Training System Support Center (TSSC). The TSSC includes the computational system resources required to support software, hardware, and firmware changes. The MTE provides maintenance training for simulation of fault isolation and removal/replacement of all B-1 aircraft systems. The MTE, also a suite of systems, includes eight Avionics/Armament Maintenance Training Systems, 10 Simulator Maintenance Training Systems, one Primary/Secondary Flight Control System Maintenance Trainer and one TSSC to support software, hardware, and firmware changes. (Formerly Project 1021, B-1 Simulators)

(U) **Conventional Weapons Upgrades**: Improves the B-1's effectiveness in conventional operations by integrating advanced conventional weapons. Specific enhancements include integration of CBUs (EMD completed in FY95), Wind Corrected Munitions Dispenser (WCMD), JDAM, JSOW, JASSM, and aircraft enhancements necessary to carry these weapons. Aircraft enhancements included under the JDAM integration effort are an anti-jam secure-voice radio

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(communications upgrade) for improved interoperability with other theater forces, a Mil-Std-1760 electrical interconnection system which provides a common interface between aircraft and precision weapons, and a Global Positioning System (GPS) receiver for providing position updates to precision weapons The Air Force accelerated the DSUP RAA date in the FY98 POM. SECAF accelerated procurement of JDAM modification kits for six aircraft. ALE-50 (Towed Decoy System) was accelerated in conjunction with JDAM to yield enhanced operational capability in FY99. An upgraded avionics computer suite will handle the advanced weapons requirements and significantly improve computer reliability and maintainability. Also included are preliminary engineering and planning studies for potential future weapon system enhancements and for weapon system operational support improvements as well as the Live Fire Test and Evaluation. (Formerly Project 4143, Conventional Weapons Upgrade)

(U) **Acquisition Strategy:**

(U) These major upgrades will be accomplished during three phases and integrated in conjunction with ongoing sustainment block upgrades. RDT&E work on Phase I, "Enhanced Capability," contains the Block C CBU upgrade (EMD completed in FY95). Phase II, "Near Precision Capability," contains Block D (GPS/Comm Navigation Management System, JDAM, and Mil-Std-1760 integration), Block E (Computer and WCMD upgrades) and the Block F DSUP integration upgrade. Phase III, "Standoff Capability," contains the Block G JSOW & JASSM integration upgrades. Boeing North American Aviation (formerly Rockwell International, North American Aircraft Division) is the integrating contractor for all major aircraft upgrades. AFMSS and training system upgrades will be released periodically during Phases I, II, and III.

(U) Key elements of the overall CMUP acquisition strategy include: use of sole source contract with a prime/integrating contractor; assignment of Total System Installed Performance Responsibility (TSIPR) to the integrating contractor; use of cost plus award fee (CPAF) development contracts; and combining developmental upgrades with software sustainment blocks to minimize number of software releases, aircraft downtime and differences in fielded configurations. The Phase I CBU capability is being fielded in Block C. Block D will include JDAM/Mil-Std-1760 and GPS/Comm modifications (as well as the ALE-50 Towed Decoy). The computer and WCMD upgrades will be fielded as part of Block E. DSUP will be fielded as Block F. JSOW and JASSM capability will be fielded in Block G.

(U) The three test articles being purchased in FY97 ($4,562) are computer set kits to be installed in labs to support Block E EMD. The seventeen test articles to be purchased in FY98 consist of twelve computer set kits ($18,249) (eight to be installed in labs, two in aircraft, two as test spares) and five DSUP kits ($5,647) to support Block F EMD (three in labs and two in aircraft).

(U) **B. Program Change Summary ($ in Thousands)** See Project R-3 Exhibit

(U) **C. Other Program Funding Summary ($ in Thousands)** See Project R-3 Exhibit

(U) **D. Schedule Profile** See Project R-3 Exhibit

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COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4596 Conventional Mission Upgrade*	0	0	216,886	199,718	214,409	143,158	33,497	5,377	16,915	829,960

(U) A. **Mission Description and Budget Item Justification**

(U) The B-1 will deliver most of the heavy bomber fleet's conventional weapons in future conflicts. Current B-1 conventional combat capability is optimized for delivery of MK-82 non-precision 500 pound gravity bombs. The increase in the B-1's conventional weapons employment capability will involve upgrading the following systems:

- (U) CBUs: Modify 50 of the 101 existing B-1 conventional bomb modules (now used only for MK-82 bombs) for integration of cluster bomb units (CBUs). The modified modules will complete delivery in Mar 1997.
- (U) GPS/Communications Navigation Management System: Incorporate Global Positioning System (GPS) capability for more precise long range navigation, TACAN emulation, and weapons delivery. Integrate the ARC-210 "HAVE QUICK" secure/anti-jam communications system for improved capability to operate within force packages. Includes Voice Demand Assigned Multiple Access/Advanced Narrowband Digital Voice Terminal (DAMA/ANDVT), a SATCOM required communications upgrade.
- (U) JDAM/Mil-Std-1760: Modify the B-1 rotary launcher and develop interfaces for JDAM and other advanced conventional weapons. Incorporate Mil-Std-1760 weapons interface required for use with JDAM and other precision weapons.
- (U) Computers: Upgrade the current avionics computer complex to provide for weapons flexibility and reduce operation and support costs. Existing avionics computers will be replaced with modern, 32-bit hardware, and current software will be converted to Ada.
- (U) Wind Corrected Munitions Dispenser: Add Mil-Std-1760 weapon interface to modified conventional bomb modules (see "CBUs" above) to allow B-1 to employ WCMD. Increases accuracy of CBUs when released at high altitudes, reducing target passes.
- (U) Advanced Munitions: Develop necessary modifications to integrate JSOW and JASSM.
- (U) DSUP: provides defensive system enhancements in: situational awareness, countermeasures effectiveness and reliability and maintainability

(U) **Acquisition Strategy:**

(U) **DSUP:** At Air Combat Command's (ACC) request, the Air Force formed a Tiger Team to examine an incremental approach to correct the B-1B's defensive system deficiencies. In FY95, the Air Force began a 13 month integrated acquisition strategy process (IASP) that culminated in a successful ASP briefing to SAF/AQ on 23 Apr 96. A key element of that strategy was examining the use of the Navy's RF Countermeasures (RFCM) System being developed under the Integrated Defensive Electronic Countermeasures (IDECM) program. The Air Force placed Boeing North American (BNA - formerly Rockwell NAAD) on contract to examine the feasibility of using the RFCM portion of the Navy's IDECM system to meet ACC's requirements. Boeing completed the architecture study and recommended the

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use of the IDECM RFCM system. Following a comprehensive Cost As Independent Variable (CAIV) study during the summer of FY96, the Air Force concurred with the use of the IDECM RFCM system. In Jun 96, the Air Force awarded a DSUP pre-EMD contract to Boeing that will accomplish a System Requirements Review (SRR), Systems Functional Review (SFR), and preparation of an EMD proposal. EMD contract award is planned for Jun 97 following a 3QFY97 Milestone II DAB decision. During EMD, the Critical Design Review (CDR) will be completed in 4QFY98 and flight test will start in 2QFY00. A Milestone III DAB is planned for 3QFY02.

(U) **MPS:** ESC/YV manages the B-1B Mission Planning development effort of the B-1 A/W/E, with ASC/YD retaining program management and funding authority for the program. Together, the organizations report to AFPEO/FB, the Program Executive Officer for Fighters and Bombers. The Government awarded a cost-plus-award-fee (CPAF) contract to Logicon for development of this A/W/E, using full-and-open competition and streamlined source selection. The Air Force plans a "single, combined release" of the B-1B Block C/D A/W/E software. This will provide the full functionality required for both the CBU (Block C) and JDAM/1760/GPS/Comm (Block D) upgrades. The single Block C/Block D combined release procurement goes through 1QFY98 with planned follow-on software development related to OFP changes for Blocks E, F and G and any evolving B-1 mission planning requirements through FY01.

(U) Training Systems: The Simulator upgrade is funded through a 5-year contract awarded 21 Jun 94 to Lockheed-Martin Training & Technical Services. This contract encompasses development, production and Contractor Logistic Support (CLS) through FY99. The development portion is a cost-plus-award-fee (CPAF) type contract and production is firm-fixed-price (FFP). The CLS is fixed-price-award-fee (FPAF) for the simulator system and FFP for the maintenance training equipment. Time and Materials will be used for over and above work on both the simulator system and MTE.

(U) **Conventional Weapons Upgrades**

(U) Conventional Weapons Upgrades are contracted in three phases. In each phase, cost type contracts are used for EMD and fixed price contracts for production/mod kits:

- (U) Phase I: Enhanced capability (but unguided) weapons (CBU) integration (Completed development in FY95)
- (U) Phase II: Near precision weapons integration (JDAM/1760/GPS/Comm, computer upgrade, and WCMD), studies and design definition for data link implementation, and congressionally-directed demonstration of the feasibility of adding the Relative Targeting System (RTS)). These are divided into three sub-phases:
  - (U) Phase IIA: Pre-EMD (design analyses, trade studies, engineering work leading up to the hardware preliminary design review)
  - (U) Phase IIB: EMD (continued development effort through flight test, kit proof, and physical configuration audit)
  - (U) Phase IIC: Production (aircraft installation and modification kit)
- (U) Preliminary engineering and planning studies necessary to determine the feasibility and cost/schedule of potential future weapon system enhancements.
- (U) Phase III: Precision weapons with standoff capability (JSOW & JASSM)

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(U) Government organizations responsible for various development efforts include: the B-1B System Program Office (SPO) and Simulator Systems SPO at ASC, Wright-Patterson AFB, OH; Oklahoma City Air Logistics Center (OC-ALC), Tinker AFB, OK; Warner Robins Air Logistics Center (WR-ALC), Robins AFB, GA; JDAM/JSOW/JASSM/WCMD SPO, Eglin AFB, FL; GPS Joint SPO (JPO), Los Angeles AFB, CA; Mission Planning SPO at ESC, Hanscom AFB, MA; Rome Laboratories, Griffiss AFB, NY; Air Force Flight Test Center (AFFTC), Edwards AFB, CA; Air Force Developmental Test Center (AFDTC), Eglin AFB, FL; and Air Force Operational Test and Evaluation Center (AFOTEC), Kirtland AFB, NM.

(U) FY 1996 ($ in Thousands):

- (U) $8,307 (DSUP) Start systems engineering process to translate top-level system requirements into lower-level requirements, reduce program schedule risk, and accelerate entry into EMD
- (U) $1,992 (DSUP) Acquisition strategy planning for DSUP EMD
- (U) $792 (DSUP) IDECM Support and FOTD Risk Reduction Planning
- (U) $7,325 (MPS) Continue Logicon contract development activities
- (U) $275 (MPS) Contract support (Lockheed-Martin)
- (U) $1,898 (Training Systems) WST Block B/C/IVACC
- (U) $1,511 (Training Systems) MTE computer rehost
- (U) $104,831 (Weapons) Continue Phase IIB contract activities for JDAM, 1760, GPS and Communications Navigation Management System
- (U) $15,000 (Weapons) PGM Acceleration (to be reprogrammed to BP1100)
- (U) $13,340 (Weapons) Engineering Change Proposal to Phase IIB contract for computer upgrade and continue development activities
- (U) $2,389 (Weapons) Engineering Change Proposal to Phase IIB contract for Wind Corrected Munition Dispenser (WCMD) kit integration and begin development
- (U) $233 (Weapons) Task order contract for ICD work on JSOW development
- (U) $16,400 Government flight test and planning
- (U) $141 ECO
- (U) $284 GFE
- (U) $1,757 Modeling & Simulation / Studies & Analyses
- (U) $5,646 CAAS
- (U) $4,819 Mission Support
- (U) $186,940 Total

(U) FY 1997 ($ in Thousands):

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- (U) $19,023 (DSUP) Continue pre-EMD contractor systems engineering process, culminating in System Functional Review (SFR)
- (U) $13,656 (DSUP) Begin EMD
- (U) $8,564 (MPS) Continue Logicon contract
- (U) $450 (MPS) Contract support (Lockheed-Martin)
- (U) $62 (Training Systems) ACA with Logicon
- (U) $3,117 (Training Systems) MTE computer rehost
- (U) $521 (Training Systems) A/W/E effort
- (U) $517 (Training Systems) begin Block D development
- (U) $740 (Training Systems) IVACC
- (U) $500 (Weapons) Continue ICD work on JSOW development
- (U) $5,239 (Weapons) Studies and design definition for data link implementation
- (U) $77,095 (Weapons) Continue Phase IIB contract activities for JDAM, 1760, GPS and Communications Navigation Management System
- (U) $29,845 (Weapons) Continue computer upgrade
- (U) $8,006 (Weapons) Continue EMD for WCMD integration
- (U) $15,113 Government flight test and planning
- (U) $4,848 GFE
- (U) $6,859 ECO
- (U) $5,026 CAAS
- (U) $1,775 Modeling & Simulation / Studies & Analyses
- (U) $6,974 Mission Support
- (U) $207,930 Total

(U) FY 1998 ($ in Thousands):

- (U) $48,274 (DSUP) Continue DSUP EMD activities
- (U) $9,426 (MPS) Continue Logicon contract
- (U) $150 (MPS) Continue Lockheed Martin contract
- (U) $1,825 (Training Systems) Continue Block D development
- (U) $41 (Training Systems) ACA with Logicon
- (U) $1,817 (Training Systems) A/W/E Effort
- (U) $708 (Training Systems) Continue MTE computer rehost
- (U) $49,069 (Weapons) Continue computer upgrade
- (U) $1,150 (Weapons) Conduct acquisition planning to support FY99 EMD start for JSOW & JASSM integration

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- (U) $10,295 (Weapons) Continue EMD for WCMD integration
- (U) $49,638 (Weapons) Continue Phase IIB contract activities for JDAM, 1760, GPS and Communications Navigation Management System
- (U) $1,634 GFE
- (U) $19,530 Government flight test
- (U) $8,988 ECO
- (U) $5,413 CAAS
- (U) $2,500 Modeling & Simulation / Studies & Analyses
- (U) $6,428 Mission Support
- (U) $216,886 Total

(U) FY 1999 ($ in Thousands):

- (U) $51,155 (DSUP) Continue DSUP EMD activities
- (U) $9,723 (MPS) Continue Logicon contract
- (U) $150 (MPS) Continue Lockheed-Martin support
- (U) $9,478 (Training Systems) Continue Block D development
- (U) $19 (Training Systems) ACA with Logicon
- (U) $49,294 (Weapons) Continue computer upgrade
- (U) $19,918 (Weapons) Begin EMD for JSOW & JASSM integration
- (U) $9,022 (Weapons) Continue EMD for WCMD integration
- (U) $20 (Weapons) Complete Phase IIB contract activities for JDAM, 1760, GPS and Communications Navigation Management System
- (U) $1,402 GFE
- (U) $23,396 Government flight test
- (U) $11,836 ECO
- (U) $5,428 CAAS
- (U) $2,500 Modeling & Simulation / Studies & Analyses
- (U) $6,377 Mission Support
- (U) $199,718 Total

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(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	189,527	220,932	202,133	202,580	1,466,493
(U) Appropriated Value	202,438	217,732			1,484,946
(U) Adjustments to Appropriated Value					
a. Cong Reductions	-3,963	-4,644			-14,121
b. SBIR	-4,761	-5,158			-12,960
c. Omnibus or Other Above Threshold Reprogram	-4,181				-4,181
d. Below Threshold Reprogramming	-2,593				420
e. Rescissions					
(U) Adjustments to Budget Years Since FY 1997 PB			14,753	-2,862	-22,917
(U) Current Budget Submit/FY1998 PB	186,940	207,930	216,886	199,718	1,427,987

(U) Change Summary Explanation:

Funding:

(U) FY96 (-15,498): Undistributed Reductions (-3,963), SBIR (-4,761), ATR {(Bosnia) (-2,066), F-16s to Jordan (-2,115)},BTR to B-2 (-2,593), BTR to Mod & Sim Branch (-75)

(U) FY97 (-9,802): Undistributed Reductions (-4,644), SBIR (-5,158)

(U) FY98 to FY04 (-22,917): Funding was aligned with the current estimates for CMUP (-14,621), (DSUP acceleration initiative, JASSM initiative), excess funds (-600), Inflation (-4,123), Misc adjustments (-191) and AFMC Intracommand Support ZBT (-3,382).

Schedule: The upgrade to the visual systems in the Weapon System Trainers and Mission Trainers has been delayed and will be delivered three months after delivery of the Block C simulator upgrade. The Air Force accelerated the DSUP RAA date in the FY98 POM. SECAF accelerated procurement of JDAM modification kits for six aircraft. ALE-50 (Towed Decoy System) was accelerated in conjunction with JDAM to yield enhanced operational capability in FY99.

Technical: The AF has selected the RFCM portion of the Navy's IDECM system for DSUP.

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(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) PE 0101126F, Aircraft Procurement (B-1); BP11, Modifications (CMUP-related only)	16,800	86,785	63,494	71,752	63,984	47,761	135,296	114,692	214,063	824,927
(U) PE 0101126F, Other Procurement (B-1)							276			276
(U) PE 0207325F, RDT&E (JASSM)	250	460								710
(U) PE 0604600F, RDT&E (WCMD)	412									412
(U) PE 0604754F, RDT&E (JTIDS)	147									147
(U) PE 0208006F, Operations and Maintenance (MPS)		30								30
(U) PE 0604270F, EW Development (TDS)	16,154	24,090	3,200							43,444
(U) PE 0207442F, EW Production (TDS/IDECM)		673	20,425	33,124	39,054	45,317	40,916	13,406		192,915

Related RDT&E:

(U) Program Element #0205164F, Global Positioning System (GPS)
(U) Program Element #0604618F/N, Joint Direct Attack Munition (JDAM)
(U) Program Element #0604727F/N, Joint Stand-Off Weapon (JSOW)
(U) Program Element #0604600F, Wind Corrected Munitions Dispenser (WCMD)
(U) Program Element #0208006F, Air Force Mission Support System (AFMSS)
(U) Program Element #604270F, Electronic Warfare (EW) Development
(U) Program Element #305164F, Global Positioning System (GPS)

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(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
DSUP																
(U) Acquisition Milestones																
(U) - Acq Strat Panel/O-IPT			X*													
(U) - Milestone II						X										
(U) Engineering Milestones																
(U) - SRR				X*												
(U) - SFR						X										
(U) - SSR								X								
(U) - PDR										X						
(U) - CDR												X				
(U) T&E Milestones																
(U) - Start subsystem qual test														X		
(U) - Complete subsystem qual test															X	
(U) Contract Milestones																
(U) - CCP for Pre-EMD			X*													
(U) - Award EMD Contract							X									
Mission Planning System																
(U) **Engineering Milestones**																
(U) - Preliminary Design Review		X*	X*[1]													
(U) - Critical Design Review				X*												
(U) **T&E Milestones**																
(U) - CMUP JDAM DT&E/IOT&E										X						
(U) - Test Readiness Review/FQT								X								
(U) - SVT									X							
(U) **Contract Milestones**																
(U) - Software Delivery									X							

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Training Systems	FY 1996 1	2	3	4	FY 1997 1	2	3	4	FY 1998 1	2	3	4	FY 1999 1	2	3	4
(U) **Acquisition Milestones**																
(U) - Start Production Block - B/C - WST				X*												
(U) - First Delivery - WST/MT				X*												
(U) - Start EMD - MTE rehost				X*												
(U) - Start Production - MTE rehost												X				
(U) - MTE rehost delivery												X				
(U) - Start EMD - CPT rehost							X									
(U) - Start Production - CPT rehost										X						
(U) - CPT rehost delivery											X					
(U) - Start Production - Block D														X		
(U) **Engineering Milestones**																
(U) - CDR Block B/C - WST	X*															
(U) Block D																
(U) - SRR									X							
(U) - PDR														X		
(U) - CDR										X						
(U) **T&E Milestones**																
(U) - System T&E - Block B/C WST			X*													
(U) **Contract Milestones**																
(U) - Block B/C WST Delivery				X*												
(U) - MTE rehost award				X*												
(U) - MTE rehost delivery												X				
(U) - CPT rehost award							X									
(U) - CPT rehost delivery											X					
(U) - Start EMD WST Rehost															X	

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Weapons	FY 1996 1	2	3	4	FY 1997 1	2	3	4	FY 1998 1	2	3	4	FY 1999 1	2	3	4
(U) **Acquisition Milestones**																
(U) - Phase I RAA (CBU)				X*												
(U) - Phase I FOC							X									
(U) - Block D Comm/Nav MSIII								X								
(U) - Block D JDAM/1760 LRIP											X					
(U) - Block D JDAM/1760 MS III													X			
(U) - Phase II RAA (GPS/Comm)													X			
(U) - Phase II RAA (JDAM/1760)													X			
Weapons																
(U) **Engineering Milestones**																
(U) - Phase II SRR				X*												
(U) - Phase II SFR					X*											
(U) - Phase II PDR									X							
(U) - Phase II SSR										X						
(U) - Phase II CDR (GPS/Comm/JDAM/1760)			X*													
(U) - Phase II CDR (Computer/WCMD)										X						
(U) **T&E Milestones**																
(U) - Start Phase II GPS/Comm/ JDAM/1760 Flight Test								X								
(U) - Complete GPS/Comm/ JDAM/1760 Flight Test											X					
(U) **Contract Milestones**																
(U) - Step I EMD (Computer / WCMD)			X*													
(U) - Step II EMD (Computer/WCMD)						X*										
(U) - Phase II Production (GPS/Comm - Group A/B) [Lot 1]								X								

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604226F B-1B

PROJECT: 4596

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) - Phase II Production (GPS/Comm GFE Long Lead) [Lot 1/ LRIP # 1]						X*										
(U) - Phase II Production (JDAM/1760/ GPS/Comm) [Lot 1/ LRIP # 1]							X									
(U) - Phase II Production (GPS/Comm) (Lot 2)										X						
(U) - Phase II LRIP #2 (JDAM/1760)											X					
(U) - Phase II Production (JDAM/1760) [Lot 1]													X			
(U) - Phase III EMD (JSOW/JASSM)													X			

1 NOTE: Incremental PDR held to support Block C and Block D, respectively.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604226F B-1B
	PROJECT 4596

(U) Milestones Beyond FY 1999

DSUP

(U) Acquisition Milestones
(U) - Milestone III 3QFY02
(U) - Required Assets Available 1QFY02
(U) - Full Operational Capability 2QFY08
(U) T&E Milestones
(U) - Flight Test Start 2QFY00
(U) - Complete Flight Test 1QFY02
(U) Contract Milestones
(U) - LRIP 4QFY00
(U) - Full Rate Production 3QFY02

Training Systems

(U) Acquisition Milestones
(U) - Block D End H/W Development 2QFY00
(U) - Block D End S/W Development 2QFY00
(U) - Block D End H/W & S/W Integration 3QFY00
(U) - Block D End T&E 4QFY00
(U) - Block D Site Activation 4QFY00
(U) - Start Production WST Rehost 4QFY00
(U) - Start Block E EMD 1QFY01
(U) - Start Block F EMD 1QFY01
(U) - WST Rehost Delivery 1QFY01
(U) - Block D Delivery 2QFY01
(U) - Block D Production Units Installed 2QFY01
(U) - Block E Delivery 3QFY03

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	PROJECT 4596

Weapons

(U)	Acquisition Milestones	
(U)	- Full Operational Capability (GPS/Comm)	1QFY01
(U)	- Full Operational Capability (JDAM/1760)	4QFY01
(U)	- Required Assets Available (Computer)	1QFY02
(U)	- Required Assets Available (WCMD)	1QFY02
(U)	- Required Assets Available (JSOW/JASSM)	2QFY02
(U)	- Full Operational Capability (WCMD)	1QFY04
(U)	- Full Operational Capability (Computer)	4QFY06
(U)	- Full Operational Capability (JSOW/JASSM)	4QFY06
(U)	T&E Milestones	
(U)	- Begin Flight Test (Computer)	1QFY00
(U)	- Begin Flight Test (WCMD)	1QFY00
(U)	- Complete EMD/Flight Test (WCMD)	1QFY01
(U)	- Complete Flight Test (Computer)	1QFY01
(U)	- Begin Flight Test (JSOW/JASSM)	3QFY01
(U)	- Complete Flight Test (JSOW/JASSM)	1QFY02
(U)	Contract Milestones	
(U)	- Phase II Production (JDAM/1760) [Lot 2]	2QFY00
(U)	- Phase II Production (WCMD)	3QFY01
(U)	- Phase II Production (Computer)	3QFY01
(U)	- Phase III Production (JSOW/JASSM)	2QFY02

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604226F B-1B	PROJECT 4596

(U) A. Project Cost Breakdown ($ in Thousands)

(U) DSUP	FY 1996	FY 1997	FY 1998	FY 1999
(U) Risk Reduction/Evaluation	11,091	19,023		
(U) Contractor EMD		13,656	48,274	51,155
(U) **Mission Planning System**				
(U) Contract Funding	7,600	9,014	9,576	9,873
(U) **Training Systems**				
(U) IVACC		740		
(U) ACA with Logicon		62	41	19
(U) A/W/E		521	1,817	
(U) WST	1,898			
(U) MTE computer rehost	1,511	3,117	708	
(U) Block D		517	1,825	9,478
(U) **Weapons**				
(U) Block D (JDAM/GPS/Comm/1760)	104,831	77,095	49,638	20
(U) PGM Acceleration	15,000			
(U) Computer	13,340	29,845	49,069	49,294
(U) WCMD	2,389	8,006	10,295	9,022
(U) JSOW / JASSM	233	500	1,150	19,918
(U) Data Link Studies		5,239		
(U) Government flight test	16,400	15,113	19,530	23,396
(U) GFE	284	4,848	1,634	1,402
(U) ECO	141	6,859	8,988	11,836
(U) CAAS	5,646	5,026	5,413	5,428
(U) Modeling & Simulation / Studies & Analyses	1,757	1,775	2,500	2,500
(U) OGC/Mission Support	4,817	6,974	6,428	6,377
(U) Total	186,940	207,930	216,886	199,718

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604226F B-1B

PROJECT: 4596

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
(U) **DSUP**											
(U) BNA	SS/CPFF	Aug 93	39,415	39,415	9,301	11,091	19,023	0	0	0	39,415
(U) BNA	SS/CPAF	May 97	200,496	200,496	0	0	13,656	48,274	51,155	87,411	200,496
(U) **Mission Planning System**											
(U) Logicon[1]	CPAF	Aug 94	46,418	46,418	0	7,325	8,564	9,426	9,723	11,380	46,418
(U) Lockheed-Martin	CPAF	Dec 95	1,325	1,325	0	275	450	150	150	300	1,325
(U) **Training Systems**											
(U) Lockheed-Martin	C/CPAF	Jun 94	76,209	76,209	0	3,409	4,957	4,391	9,497	53,955	76,209
(U) **Weapons**											
(U) BNA - CBUs	SS/CPFF	93	4,960		4,960						4,960
(U) BNA - CBUs	SS/CPFF	Jan 94	16,307		16,307						16,307
(U) BNA-Link 16	TBD	TBD	5,239	5,239			5,239				5,239
(U) BNA- PH IIA	SS/CPFF	Aug 93	84,049		84,049						84,049
(U) BNA- PH IIB	SS/CPAF	Mar 95	277,685	277,685	46,101	104,831	77,095	49,638	20	0	277,685
(U) TBD[2]	TBD	TBD	15,000	15,000	0	15,000	0	0	0	0	15,000
(U) BNA-PH IIB[3]	SS/CPAF	Feb 97	201,380	201,380	793	13,340	29,845	49,069	49,294	59,039	201,380
(U) BNA-PH IIB[3]	SS/CPAF	Feb 97	39,103	39,103	0	2,389	8,006	10,295	9,022	9,391	39,103
(U) LORAL/QT	C/CPAF	Jun 94	3,631	3,631	3,631	0	0	0	0	0	3,631

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604226F B-1B

PROJECT: 4596

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
(U) TBD-PH III	TBD	TBD	79,950	79,950	0	233	500	1,150	19,918	58,149	79,950
Contractor or Government Performing Activity	**Contract Method/Type or Funding Vehicle**	**Award or Obligation Date**	**Performing Activity EAC**	**Project Office EAC**	**Total Prior to FY 1996**	**Budget FY 1996**	**Budget FY 1997**	**Budget FY 1998**	**Budget FY 1999**	**Budget to Complete**	**Total Program**
Support and Management Organizations											
(U) CAAS	Various	Annual	41,754	41,754	6,409	5,646	5,026	5,413	5,428	13,832	41,754
(U) CAAS	Various	Annual	41,754	41,754	6,409	5,646	5,026	5,413	5,428	13,832	
(U) Studies & Analyses / Modeling & Sim	Various	Various	21,672	21,672	8,340	1,757	1,775	2,500	2,500	4,800	21,672
(U) Mission Support	Various	Various	48,551	48,551	11,700	4,819	6,974	6,428	6,377	12,334	48,551
(U) ECO	Various	Various	47,660	47,660	144	141	6,859	8,988	11,836	19,692	47,660
Test and Evaluation Organizations											
(U) **DSUP**											
(U) AFFTC	P.O.	Various	66,068	66,068	108	400	1,000	2,730	16,220	45,610	66,068
(U) **Weapons**											
(U) AFFTC	P.O.	Various	99,760	99,760	10,788	16,000	14,113	16,800	7,176	34,883	99,760

[1]NOTE: Funded under the AFMSS Program, Program Element #0208006F in FY94 and FY95. Funded under the JDAM program, Program Element #0604618F in FY95.
[2]NOTE: PGM Accleration funds will be reprogrammed to BP1100.
[3]NOTE: ECP to Phase IIB contract for computer upgrade and WCMD integration EMD.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604226F B-1B
	PROJECT 4596

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
(U) **DSUP**										
(U) Various	Various	Various	Various	0	0	3,500	710	720	1,888	6,818
(U) **Weapons**										
(U) Various	Various	Various	Various	526	284	1,348	924	682	692	4,456
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development				165,668	158,177	172,183	174,027	150,181	282,205	1,102,441
Subtotal Support and Management				26,593	12,282	20,634	23,329	26,141	50,658	159,637
Subtotal Test and Evaluation				10,896	16,481	15,113	19,530	23,396	80,493	165,909
Total Project				203,157	186,940	207,930	216,886	199,718	413,356	1,427,987

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604227F Flight Simulator Development

	COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	7,961	4,247	4,305	4,422	4,590	4,691	4,779	4,889	Continuing	Continuing
2325	Simulator Development Activities	1,645	1,393	1,515	1,357	1,429	1,481	1,508	1,544	Continuing	Continuing
2769	Simulator Update Development	3,153	2,854	2,790	3,065	3,161	3,210	3,271	3,345	Continuing	Continuing
3000	KC-135 Aircrew Training System	131	0	0	0	0	0	0	0	0	2,420
4022	Simulator for Electronic Combat Training (SECT)	3,032	0	0	0	0	0	0	0	0	27,350
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification** This is a continuing program element for development of aircrew and maintenance training techniques and devices. Devoted to the engineering and manufacturing development (EMD) of aircrew and maintenance training systems, this program element is included in Budget Activity 5 - EMD. Objectives are to adapt simulation technology and standards developed by the laboratories and industry to satisfy MAJCOM training requirements and to develop prototype training devices.

(U) **Acquisition Strategy:** Maximize the use of free and open competitive awards. Mission support efforts use a variety of contract vehicles. Specific programs use contract types appropriate to the work to be performed. The Simulator for Electronic Combat Training (SECT) contract, for example, has been restructured from a Cost Plus Award Fee to a Fixed Price Incentive Firm contract.

(U) B. **Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	8,349	4,439	4,694	4,650	Continuing
(U) Appropriated Value	8,786	4,439			
(U) Adjustments to Appropriated Value					
a. Cong/Gen Reductions	-170	-118			

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604227F Flight Simulator Development

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
b. SBIR	-132	-74			
c. Omnibus or Other Above Threshold Reprogram	-188				
d. Below Threshold Reprogramming	-335				
(U) Adjustments to Budget Years Since FY 1997 PB			-389	-228	
(U) Current Budget Submit/President's Budget	7,961	4,247	4,305	4,422	Continuing

(U) Change Summary Explanation:
Funding: Total FY97 changes of $192 thousand include Congressional/general reductions and SBIR. Changes in FY98 and beyond reflect a reduction in Project 2769, an FY98 through FY03 reduction due to a one-time adjustment for Aeronautical Systems Center computer mission support, and an FY98 through FY03 inflation rate adjustment.

Schedule: Not Applicable

Technical: Not Applicable

(U) C. Other Program Funding Summary ($ in Thousands) Not Applicable

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Reference individual project data																

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE: February 1997
BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE: 0604227F Flight Simulator Development	PROJECT: 2325

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2325 Simulator Development Activities	1,645	1,393	1,515	1,357	1,429	1,481	1,508	1,544	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification ($ in Thousands)**

This project supports engineering development of new aircrew and maintenance training technologies and standards. Funds the pre-production of first article training devices to satisfy the customer's training requirements. Efforts currently planned or underway include using artificial intelligence techniques in the development of a generic Intelligent Training Management System (TIMS). SMART 2000, an evaluation of cutting-edge technology for training, will also be developed.

(U) FY 1996 ($ in Thousands):

- (U) $ 300 Initiate development of subjective techniques for the transfer of training from the simulator to the aircraft
- (U) $ 225 Technical support for Vis/Eval effort
- (U) $ 150 Evaluate technologies for Area of Interest (AOI) visual system
- (U) $ 144 Develop a Universal Threat Simulation System (UTSS) to use for joint service applications
- (U) $ 96 Continue Dynamic Peripheral Acuity evaluations
- (U) $ 200 Continue development of structural modeling
- (U) $ 300 Network evaluation training and simulation
- (U) $ 130 Continue development of Technology Roadmap (Training Systems Product Group (TSPG) infrastructure)
- (U) $ 100 Mission support
- (U) $1,645 Total

(U) FY 1997 ($ in Thousands):

- (U) $ 100 Develop visual and radar databases and standards
- (U) $ 300 Continue evaluation support for SMART 2000 and visual systems
- (U) $ 330 Complete evaluation of improved G-suit/G-seat/sensory simulation capability
- (U) $ 304 Continue development of technology Roadmap (TSPG infrastructure)
- (U) $ 300 Complete subjective transfer training
- (U) $ 59 Mission support
- (U) $1,393 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development
	PROJECT 2325

(U) FY 1998 ($ in Thousands):

- (U) $ 100 Continue development of visual and radar database and standards
- (U) $ 600 Continue evaluation of visual systems
- (U) $ 240 Define user training tasks for multi-ship training environments
- (U) $ 320 Perform long-haul networking studies and analysis
- (U) $ 100 Identify and define training device data models and software
- (U) $ 100 Continue development of Training Systems Product Group (TSPG) infrastructure
- (U) $ 55 Mission support
- (U) $1,515 Total

(U) FY 1999 ($ in Thousands):

- (U) $ 80 Continue development of visual and radar database and standards
- (U) $ 670 Continue evaluation of visual systems
- (U) $ 175 Define user training tasks for multi-ship training environments
- (U) $ 240 Perform long-haul networking studies and analysis
- (U) $ 110 Identify and define training device data models and software
- (U) $ 30 Continue development of TSPG infrastructure
- (U) $ 52 Mission support
- (U) $1,357 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development
	PROJECT 2325

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	1,645	1,461	1,527	1,369	Continuing
(U) Appropriated Value	1,677	1,461			
(U) Adjustments to Appropriated Value					
a. Cong/Gen Reductions	-32	-44			
b. SBIR		-24			
c. Omnibus or Other Above Threshold Reprogram					
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			-12	-12	
(U) Current Budget Submit/President's Budget	1,645	1,393	1,515	1,357	Continuing

(U) Change Summary Explanation:

Funding: FY97 includes $68 thousand for Congressional/general reductions and SBIR; FY98 through FY03 are reduced due to a one-time adjustment for Aeronautical Systems Center computer mission support and an inflation rate change.

Schedule: Not Applicable

Technical: Not Applicable

(U) **C. Other Program Funding Summary ($ in Thousands) Not Applicable**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development PROJECT 2325

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Peripheral Vision Testing				X*												
(U) Intelligent Training Management System Complete	X*															
(U) Simulator Training Transfer Complete				X*												
(U) SMART 2000 Integration and Documentation								X								
(U) Prototype Training System SMART 2000 and Visual Systems				X*				X				X				X
(U) Universal Threat Simulator System Architecture Development				X*												
(U) Technology Roadmap (Training Systems Product Group Infrastructure)				X*				X				X				X
(U) Area of Interest (AOI)				X*												
(U) G-Suit/G-Seat Sensory Simulation								X								
(U) Visual and Radar Database Standards								X				X				X
(U) Multi-ship Training Environment												X				X
(U) Long-Haul Studies and Analysis												X				X
(U) Training Device Models and Software												X				X

* Denotes completed milestone

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development
	PROJECT 2325

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
Structural Modeling	200	0	0	0
Long-Haul Studies	0	0	320	240
Peripheral Vision Testing	96	0	0	0
Visual and Radar Data Standard	0	100	100	80
Training Device Models and Software	0	0	100	110
Simulator Training Transfer	300	300	0	0
SMART 2000 and Visual Systems	0	300	600	670
Universal Threat Simulator	144	0	0	0
Technical Support	225	0	0	0
Technology Roadmap	130	304	100	30
G-suit/G-seat/Sensory Simulation	0	330	0	0
Multi-Ship Training	0	0	240	175
Low Cost Helmet-Mounted Display	150	0	0	0
Network Evaluation	300	0	0	0
Mission Support	100	59	55	52
(U) Total	1,645	1,393	1,515	1,357

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development PROJECT 2325

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Numerous	Various	Various	None	None	39,523	1,545	1,334	1,460	1,305	TBD	TBD
Support and Management Organizations											
Training Systems Program Office, ASC, WPAFB	Various	Various	0	0	87	100	59	55	52	TBD	TBD
Test and Evaluation Organizations Not Applicable											

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development PROJECT 2325

(U) B. **Budget Acquisition History and Planning Information Continued ($ in Thousands)**

Government Furnished Property: Not Applicable

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development				39,523	1,545	1,334	1,460	1,305	TBD	TBD
Subtotal Support and Management				87	100	59	55	52	TBD	TBD
Subtotal Test and Evaluation				0	0	0	0	0	0	0
Total Project				39,610	1,645	1,393	1,515	1,357	TBD	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604227F Flight Simulator Development

PROJECT: 2769

COST *($ In Thousands)*	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2769 Simulator Update Development	3,153	2,854	2,790	3,065	3,161	3,210	3,271	3,345	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification This project provides critical Training System Product Group (TSPG) support for multiple user command's products to include F-16 Weapon System Trainer, B-1B conventional upgrade, Simulator for Electronic Combat Training (SECT), C-17 training suite, Universal Training Device, and C-141 Aircrew Training System. These support systems include a computer center, communications, Advisory and Assistance Services (A&AS) contracting, travel, supplies, specialized training, and equipment.

(U) FY 1996 ($ in Thousands):
- (U) $ 457 Travel
- (U) $ 44 Communications
- (U) $ 135 Training
- (U) $ 779 A&AS
- (U) $ 839 Management
- (U) $ 385 Computer center
- (U) $ 180 Supplies
- (U) $ 117 Equipment
- (U) $ 217 Miscellaneous
- (U) $3,153 Total

(U) FY 1997 ($ in Thousands):
- (U) $ 491 Travel
- (U) $ 40 Communications
- (U) $ 86 Training
- (U) $ 645 A&AS
- (U) $ 765 Management
- (U) $ 383 Computer center
- (U) $ 148 Supplies

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development PROJECT 2769

- (U) $ 102 Equipment
- (U) $ 194 Miscellaneous
- (U) $2,854 Total

(U) FY 1998 ($ in Thousands):
- (U) $ 526 Travel
- (U) $ 55 Communications
- (U) $ 140 Training
- (U) $ 700 A&AS
- (U) $ 793 Management
- (U) $ 195 Supplies
- (U) $ 147 Equipment
- (U) $ 234 Miscellaneous
- (U) $2,790 Total

(U) FY 1999 ($ in Thousands):
- (U) $ 580 Travel
- (U) $ 61 Communications
- (U) $ 153 Training
- (U) $ 768 A&AS
- (U) $ 870 Management
- (U) $ 214 Supplies
- (U) $ 162 Equipment
- (U) $ 257 Miscellaneous
- (U) $3,065 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development PROJECT 2769

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	3,153	2,978	3,167	3,281	Continuing
(U) Appropriated Value	3,487	2,978			
(U) Adjustments to Appropriated Value					
a. Cong/Gen Reductions	-68	-74			
b. SBIR	-132	-50			
c. Omnibus or Other Above Threshold Reprogram	-134				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			-377	-216	
(U) Current Budget Submit/President's Budget	3,153	2,854	2,790	3,065	Continuing

(U) Change Summary Explanation:

Funding: Changes of $124 thousand for FY97 include Congressional/general reductions and SBIR. Changes in FY98 and beyond reflect a reduction in Faster than Real-Time Training efforts and FY98 through FY03 reductions due to a one-time adjustment for Aeronautical Systems Center computer mission support and inflation rate changes.

Schedule: Not Applicable

Technical: Not Applicable

(U) **C. Other Program Funding Summary ($ in Thousands) Not Applicable**

(U) **D. Schedule Profile Not Applicable**

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development PROJECT 2769

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
Travel	457	491	526	580
Communications	44	40	55	61
Training	135	86	140	153
A&AS	779	645	700	768
Management	839	765	793	870
Computer Center	385	383	0	0
Supplies	180	148	195	214
Equipment	117	102	147	162
Miscellaneous	217	194	234	257
(U) Total	3,153	2,854	2,790	3,065

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations Not Applicable											
Support and Management Organizations											
Training System Program Office (SPO) ASC, WPAFB, OH	Various	Various	None	None	39,651	3,153	2,854	2,790	3,065	TBD	TBD

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604227F Flight Simulator Development

PROJECT: 2769

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Test and Evaluation Organizations Not Applicable											

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Government Furnished Property Not Applicable										
Subtotal Product Development				0	0	0	0	0	0	0
Subtotal Support and Management				39,651	3,153	2,854	2,790	3,065	TBD	TBD
Subtotal Test and Evaluation				0	0	0	0	0	0	0
Total Project				39,651	3,153	2,854	2,790	3,065	TBD	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604227F Flight Simulator Development

PROJECT: 3000

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3000 KC-135 Aircrew Training System	131	0	0	0	0	0	0	0	0	2,420

(U) A. Mission Description and Budget Item Justification

This project provides mission support for KC-135 aircrew training system development.

(U) FY 1996 ($ in Thousands):
- (U) $131 Mission Support
- (U) $131 Total

(U) FY 1997 ($ in Thousands): Not Applicable
- (U) $0 Total

(U) FY 1998 ($ in Thousands): Not Applicable
- (U) $0 Total

(U) FY 1999 ($ in Thousands): Not Applicable
- (U) $0 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604227F Flight Simulator Development

PROJECT: 3000

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	131	0	0	0	2,420
(U) Appropriated Value	134				
(U) Adjustments to Appropriated Value					
a. Cong/Gen Reductions	-3				
b. SBIR					
c. Omnibus or Other Above Threshold Reprogram					
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB					
(U) Current Budget Submit/President's Budget	131	0	0	0	2,420

(U) Change Summary Explanation:

Funding: FY96 includes $3 thousand in Congressional/general reductions.

Schedule: Not Applicable

Technical: Not Applicable

(U) **C. Other Program Funding Summary ($ in Thousands) Not Applicable**

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost

(U) **D. Schedule Profile Not Applicable**

FY 1996				FY 1997				FY 1998				FY 1999		
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development PROJECT 3000

(U) **A. Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Mission Support	131	0	0	0
(U) Total	131	0	0	0

(U) **B. Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Flight Safety Inc.	C/FP	Jul 92	2,137	2,137	2,137	0	0	0	0	0	2,137
Support and Management Organizations											
OG-LIRB and ASC/YWM	None	None	250	250	152	131	0	0	0	0	283

Test and Evaluation Organizations Not Applicable

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development PROJECT 3000

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: Not Applicable

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development				2,137	0	0	0	0	0	2,137
Subtotal Support and Management				152	131	0	0	0	0	283
Subtotal Test and Evaluation				0	0	0	0	0	0	0
Total Project				2,289	131	0	0	0	0	2,420

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604227F Flight Simulator Development

PROJECT: 4022

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4022 Simulator for Electronic Combat Training (SECT)	3,032	0	0	0	0	0	0	0	0	27,350

(U) **A. Mission Description and Budget Item Justification**

The SECT will replace outdated devices that support Electronic Warfare Officer Training. The simulator will train students in basic threat recognition and associated electronic combat procedures in a simulated airborne environment. This training is possible only with simulation due to environment, security, and range restrictions. This is a one-of-a-kind system with no scheduled production effort.

(U) FY 1996 ($ in Thousands):
- (U) $ 812 Deploy and complete on-site test of system at Corey Station NTC FL
- (U) $2,120 Complete hardware/software integration
- (U) $ 100 Mission Support
- (U) $3,032 Total

(U) FY 1997 ($ in Thousands): Not Applicable
- (U) $0 Total

(U) FY 1998 ($ in Thousands): Not Applicable
- (U) $0 Total

(U) FY 1999 ($ in Thousands): Not Applicable
- (U) $0 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604227F Flight Simulator Development

PROJECT: 4022

(U) B. **Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	3,420	0	0	0	27,738
(U) Appropriated Value	3,488				
(U) Adjustments to Appropriated Value					
a. Cong/Gen Reductions	-68				
b. SBIR					
c. Omnibus or Other Above Threshold Reprogram	-53				
d. Below Threshold Reprogramming	-335				
(U) Adjustments to Budget Years Since FY 1997 PB					
(U) Current Budget Submit/President's Budget	3,032	0	0	0	27,350

(U) Change Summary Explanation:

Funding: FY96 includes reductions totaling $456 thousand for Congressional/general reductions and reprogrammings.

Schedule: Not Applicable

Technical: Not Applicable

(U) C. **Other Program Funding Summary ($ in Thousands) Not Applicable**

(U) D. **Schedule Profile**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) System Delivery, Required Assets Available (RAA)				X*												

* Denotes milestone completion

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development
	PROJECT 4022

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Deploy and Complete On-Site System Test	812			
(U) Complete Hardware System Integration	2,120			
(U) Mission Support	100			
(U) Total	3,032	0	0	0

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
AAI Corp Hunt Valley MD	FPIF	Apr 92	26,714	26,714	23,782	2,932	0	0	0	0	26,714
Support and Management Organizations											
ASC/YWMT					536	100	0	0	0	0	636

Test and Evaluation Organizations Not Applicable

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604227F Flight Simulator Development PROJECT 4022

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: Not Applicable

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development				23,782	2,932	0	0	0	0	26,714
Subtotal Support and Management				536	100	0	0	0	0	636
Subtotal Test and Evaluation				0	0	0	0	0	0	0
Total Project				24,318	3,032	0	0	0	0	27,350

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604233F Specialized Undergraduate Pilot Trng

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	59,089	75,680	80,238	67,183	39,226	15,606	2,034	2,112	18,400	401,578
4102 Joint Primary Aircraft Training System (JPATS)	44,140	52,796	63,388	58,267	37,647	15,606	2,034	2,112	18,400	336,400
4376 T-38 Avionics Upgrade program (AUP)	14,949	22,884	16,850	8,916	1,579	0	0	0	0	65,178
Quantity of RDT&E Articles	0	2/12,700	0	0	0	0	0	0	0	3/64,600

(U) A. **Mission Description and Budget Item Justification**

Supports Air Education and Training Command's (AETC) implementation of Specialized Undergraduate Pilot Training (SUPT) and the Department of Defense initiative for joint pilot training. The Joint Primary Aircraft Training System (JPATS) is a joint USAF/USN venture to replace the Services' fleets of primary trainer aircraft (T-37 and T-34 respectively) and associated Ground Based Training System (GBTS). The Air Force is the Executive Service. The T-38 Avionics Upgrade Program (AUP) is an integrated modernization of the T-38 and AT-38 cockpits to support mission ready bomber/fighter training. This program is in Budget Activity 5, Engineering and Manufacturing Development, because much of the work in this program element involves the missionization of commercial aircraft, equipment, and components.

(U) **Acquisition Strategy:** Each acquisition has been competitively awarded with the intent of maximizing the use of commercially available equipment and best commercial practices. The JPATS Program competitively awarded two contracts: a firm fixed price contractor logistics support (CLS) contract and a fixed price incentive firm engineering & manufacturing development (EMD)/production contract with several options. The T-38 AUP competitively awarded three contracts to a single prime a) a cost plus award fee EMD contract with six firm fixed price production options; b) a firm fixed price CLS contract for avionics including Contractor Owned and Maintained Base Supply (COMBS); and c) a fixed price award fee maintenance contract for the current and new Aircrew Training Devices (ATDs).

(U) Note: The quantity of RDT&E articles shown above includes two T-38 AUP aircrew training devices ($12,700 thousand FY97). It also includes the JPATS test aircraft (T-1) funded with FY95 through FY01 funds ($51,900 thousand).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604233F Specialized Undergraduate Pilot Trng

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	58,999	84,291	70,721	44,993	391,203
(U) Appropriated Value	63,042	79,260			
(U) Adjustments to Appropriated Value					
a. Cong/Gen Reductions	-1,221	-1,682			
b. SBIR	-1,484	-1,898			
c. Omnibus or Other Above Threshold Reprogram	-1,248				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			+9,517	+22,190	
(U) Current Budget SubmitPresident's Budget	59,089	75,680	80,238	67,183	401,578

(U) Change Summary Explanation:

Funding: FY97 includes a $5,031 thousand Congressional reduction, a $1,898 thousand SBIR reduction, and $1,682 thousand in Congressional/general reductions. JPATS adjustments in FY98, FY99, and FY00 are based on rephased Ground Based Training System (GBTS) requirements and the transfer of all mission support funding to the Air Force. T-38 AUP contractor cost proposal estimates were higher than anticipated. Reductions in FY98 through FY03 funding are due to a one-time adjustment for Aeronautical Systems Center computer mission support and inflation rate changes.

Schedule: T-38 AUP EMD schedule stretched 10 months to accommodate delay in production schedule

Technical: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604233F Specialized Undergraduate Pilot Trng

(U) C. **Other Program Funding Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Aircraft Procurement, Air Force										
(U) JPATS, BA-3	15,300	67,072	65,415	92,545	92,441	122,993	181,680	190,755	672,700	1,577,300
(U) (Quantity)	(6)	(15)	(18)	(12)	(18)	(34)	(43)	(43)	(180)	(372)
(U) JPATS, BA-6								65,589	63,200	128,789
(U) Military Construction, Air Force										
(U) 0804741F, JPATS	0	0	2,488	3,174	0	0	3,200	0	7,400	16,262
(U) RDT&E, Navy, BA-7										
(U) 0603208N, Training System Aircraft, H1150, JPATS	1,075	1,857	0	0	0	0	0	0	0	10,229
(U) 0604233N, JPATS	0	0	403	613	324	0	0	0	0	1,340
(U) Aircraft Procurement, Navy										
(U) JPATS, BA-3	0	0	0	0	34,221	82,720	84,287	86,567	1,123,100	1,410,895
(U) (Quantity)	(0)	(0)	(0)	(0)	(8)	(24)	(24)	(24)	(259)	(339)
(U) APN 6 Spares	0	0	0	0	0	0	0	20,231	97,700	117,931
(U) Military Construction, Navy	0	0	0	0	5,663	1,289		1,289	TBD	TBD
(U) Aircraft Procurement, Air Force										
(U) T-38 Avionics Upgrade, BA-5	0	0	0	38,000	99,067	96,101	91,657	110,353	40,722	475,900
(U) (Quantity)	0	0	0	(45)	(90)	(90)	(90)	(90)	(20)	(425)

(U) D. **Schedule Profile**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Reference individual project data																

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604233F Specialized Undergraduate Pilot Trng

PROJECT: 4102

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4102 Joint Primary Aircraft Training System (JPATS)	44,140	52,796	63,388	58,267	37,647	15,606	2,034	2,112	18,400	336,400

(U) A. **Mission Description and Budget Item Justification**

The Joint Primary Aircraft Training System (JPATS) is a joint USAF/USN venture to replace the Services' fleet of primary trainer aircraft (T-37 and T-34, respectively) and associated Ground Based Training Systems (GBTS). The aircraft and GBTS will be used to train entry-level student aviators in the fundamentals of flying so they can transition into advanced tracks leading to qualification as military pilots, navigators, and naval flight officers. The program includes the purchase of aircraft, simulators, and other associated ground-based training devices, training integration management systems, instructional courseware, and logistics support. Funding reflects the requirements of the Sep 93 Operational Requirements Document. In Jun 95, Raytheon (Beech) Aircraft was selected as the aircraft prime contractor. Resolution of protests and contract award occurred in Feb 96.

(U) FY 1996 ($ in Thousands):

- (U) $38,036 Continue Airframe Structural Integrity Program (ASIP), Engine Structural Integrity Program (ENSIP), and missionization
- (U) $437 Continue contractor-conducted GBTS source selection
- (U) $154 Begin escape system and bird-strike testing
- (U) $82 Begin flight test program ($82 thousand);
- (U) $5,431 Continue mission support and Assistance and Advisory Support (A&AS)
- (U) $44,140 Total

(U) FY 1997 ($ in Thousands):

- (U) $33,178 Continue first aircraft development and complete aircraft Critical Design Review (CDR)
- (U) $14,206 Modify contract to support GBTS development
- (U) $1,000 Continue flight test program
- (U) $4,412 Mission support and A&AS
- (U) $52,796 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604233F Specialized Undergraduate Pilot Trng
	PROJECT 4102

(U) FY 1998 ($ in Thousands):
- (U) $11,610 Continue first aircraft ($11,610 thousand) development
- (U) $45,360 Continue Ground Based Training System (GBTS) development
- (U) $400 Continue flight test program
- (U) $6,018 Mission support and Assistance and Advisory Support (A&AS)
- (U) $63,388 Total

(U) FY 1999 ($ in Thousands):
- (U) $1,900 Deliver test aircraft
- (U) $51,059 Continue GBTS development and complete GBTS CDR
- (U) $100 Complete flight test program
- (U) $5,208 Mission support and A&AS
- (U) $58,267 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604233F Specialized Undergraduate Pilot Trng PROJECT 4102

(U) B. **Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	44,033	64,531	61,130	44,993	331,032
(U) Appropriated Value	47,024	55,300			
(U) Adjustments to Appropriated Value					
a. Cong/Gen Reductions	-911	-1,179			
b. SBIR	-1,107	-1,325			
c. Omnibus or Other Above Threshold Reprogram	-866				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			+2,258	+13,274	
(U) Current Budget Submit/President's Budget	44,140	52,796	63,388	58,267	336,400

(U) Change Summary Explanation:

Funding: FY97 includes a $9,231 thousand Congressional reduction, a $1,325 thousand SBIR reduction, and $1,179 in Congressional/general reductions. Adjustments in FY98, FY99, and FY00 are based on rephasing the Ground Based Training System (GBTS), transfer of all mission support funding to the Air Force. Reductions in FY98 through FY03 are due to a one-time adjustment for Aeronautical Systems Center computer mission support and revised inflation rates.

Schedule: N/A

Technical: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604233F Specialized Undergraduate Pilot Trng
	PROJECT 4102

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Aircraft Procurement, Air Force, BA-3										
(U) JPATS	125,300	67,072	65,415	92,545	92,441	122,993	181,680	190,755	672,700	1,577,300
(U) (Quantity)	(6)	(15)	(18)	(12)	(18)	(34)	(43)	(43)	(180)	(372)
(U) JPATS, BA-6								65,589	63,200	128,789
(U) Military Construction, Air Force										
(U) 0804741F, JPATS	0	0	2,488	3,174	0	0	3,200	0	7,400	16,262
(U) RDT&E, Navy, BA-7										
(U) 0603208N, Training System Aircraft, H1150, JPATS	1,075	1,857	0	0	0	0	0	0	0	10,229
(U) 0604233N, JPATS	0	0	403	613	324	0	0	0	0	1,340
(U) Aircraft Procurement, Navy, BA-3										
(U) JPATS	0	0	0	0	34,221	82,720	84,287	86,567	1,123,100	1,410,895
(U) (Quantity)	(0)	(0)	(0)	(0)	(8)	(24)	(24)	(24)	(259)	(339)
(U) APN 6 Spares	0	0	0	0	0	0	0	20,231	97,700	117,931
(U) Military Construction, Navy	0	0	0	0	5,663	1,289	0	1,289	TBD	TBD

(U) D. Schedule Profile

		FY 1996			FY 1997				FY 1998				FY 1999		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Aircraft Contract Award		X*														
(U) GBTS Subcontract							X									
(U) Aircraft CDR					X*											
(U) Aircraft T-1 First Flight										X						
(U) Delivery of Aircraft T-1													X			
(U) GBTS CDR																X
(U) Milestone III	1Q00															
(U) IOC Air Force	4Q01															
(U) IOC Navy	4Q03															

* Denotes completed milestone

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604233F Specialized Undergraduate Pilot Trng

PROJECT: 4102

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Aircraft Missionization/Test and Evaluation	38,036	33,178	11,610	1,900
(U) Ground Based Training System	437	14,206	45,360	51,059
(U) Mission Support	5,667	5,412	6,418	5,308
(U) Total	44,140	52,796	63,388	58,267

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Raytheon Aircraft Company	FPAF	5 Feb 96	82,800	105,500	32,455	38,036	33,178	11,610	1,900	5,985	123,164*
GBTS - TBD	TBD	5 Apr 97	TBD	TBD	N/A	437	14,206	45,360	51,059	42,966	154,028
Support and Management Organizations											
Misc	Misc	Misc	N/A	N/A	9,537	5,667	5,412	6,418	5,308	26,866	59,208
Test and Evaluation Organizations											

* Raytheon contract Total Program includes contract, "to ceiling," Engineering Change Order (ECO), and Award Fee

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604233F Specialized Undergraduate Pilot Trng	PROJECT 4102

(U) B. **Budget Acquisition History and Planning Information Continued ($ in Thousands)**

Government Furnished Property: Not Applicable

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development				32,455	38,473	47,384	56,970	52,959	48,951	277,192
Subtotal Support and Management				9,537	5,667	5,412	6,418	5,308	26,866	59,208
Subtotal Test and Evaluation										
Total Project				41,992	44,140	52,796	63,388	58,267	75,817	336,400

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604233F Specialized Undergraduate Pilot Trng

PROJECT: 4376

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4376 T-38 Avionics Upgrade program (AUP)	14,949	22,884	16,850	8,916	1,579	0	0	0	0	65,178

(U) A. **Mission Description and Budget Item Justification**

The T-38 Avionics Upgrade Program (AUP) is an integrated modernization of the T-38 and AT-38 cockpits to support mission-ready bomber and fighter training. The modernized digital cockpit will include Global Positioning System (GPS), Heads-Up Display (HUD), Inertial Navigation System (INS), Multi-function Displays (MFDs), Data Transfer System (DTS), No-Drop Bombing System (NDBS), and Hands-On Throttle and Stick (HOTAS) switchology. HUD symbology will be the new USAF standard recently certified as a primary flight reference. Also included is the acquisition of two types of Aircrew Training Devices (ATDs) to replace the existing T-51 simulators. The program includes the design, integration, test, and installation of the cockpit prototype in aircraft, ATDs, and other training devices.

(U) FY 1996 ($ in Thousands):
- (U) $14,949 Release RFP, receive proposals, and complete source selection process; award contract for Engineering and Manufacturing Development (EMD) with options for production, installation and support of 425 AT/T-38 aircraft; begin EMD
- (U) $14,949 Total

(U) FY 1997 ($ in Thousands):
- (U) $22,884 Continue EMD phase - conduct System Requirement Review; complete demonstrations and studies; develop software; software and system integration and contractor testing; conduct System/Software Design Reviews
- (U) $22,884 Total

(U) FY 1998 ($ in Thousands):
- (U) $16,850 Continue EMD phase; start and complete modification of EMD aircraft numbers one and two; complete contractor testing; complete integration first flight; conduct DT&E/IOT&E; perform production planning; perform manufacturing lineproofing; conduct ATD design reviews; start ATD CLS and Training Software Support Center (TSSC) site assessments; start ATD testing
- (U) $16,850 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604233F Specialized Undergraduate Pilot Trng
	PROJECT 4376

(U) FY 1999 ($ in Thousands):

- (U) $8,916 Complete flight test; conduct Functional Configuration Audit (FCA); conduct Production Readiness Review (PRR); obtain production Milestone III approval; continue Aircrew Training Device (ATD) Contractor Logistics Support (CLS) and Avionics Support (AVS) Contractor Owned and Maintained Base Supply (COMBS) planning; build ATD prototypes and continue ATD testing; complete Training Software Support Center (TSSC) delivery
- (U) $8,916 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	14,966	19,760	9,591	0	44,317
(U) Appropriated Value	16,018	23,960			
(U) Adjustments to Appropriated Value					
a. Cong/Gen Reductions	-310	-503			
b. SBIR	-377	-573			
c. Omnibus or Other Above Threshold Reprogram	-382				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			+7,259	+8,916	.
(U) Current Budget Submit/98 PB	14,949	22,884	16,850	8,916	65,178

(U) Change Summary Explanation:

Funding: FY97 includes Congressional transfer of $4,200 thousand from Project 4102 to cover higher than anticipated contractor bids, a $573 thousand SBIR reduction, and $503 thousand in Congressional/general reductions. FY98 and out contractor cost proposal estimates higher than anticipated. Reductions in FY98 through FY00 funding are due to a one-time adjustment for Aeronautical Systems Center computer mission support and inflation rate changes.

Schedule: EMD schedule stretched 10 months to accommodate delay in production schedule

Technical: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604233F Specialized Undergraduate Pilot Trng

PROJECT: 4376

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) 0804741F, T-38 Avionics Upgrade, BP 1100	0	0	0	38,000	99,067	96,101	91,657	110,353	40,722	475,900
(U) (Quantity)	0	0	0	(45)	(90)	(90)	(90)	(90)	(20)	(425)

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Complete Source Selection				X*												
(U) Contract Award				X*												
(U) Begin Engineering and Manufacturing Development (EMD)				X*												
(U) System Requirements Review					X*											
(U) Complete Test and Evaluation Master Plan						X										
(U) Initial Design Review							X									
(U) Complete Final Design Review									X							
(U) First Flight												X				
(U) DT&E Complete												X				
(U) IOT&E Complete													X			
(U) Functional Configuration Audit (FCA)													X			
(U) Milestone III Production Decision														X		
(U) First Production ATD Delivered (1QFY00)																
(U) First Production Aircraft Delivered (2QFY00)																

* Denotes completed milestone

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604233F Specialized Undergraduate Pilot Trng
	PROJECT 4376

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Avionics System Upgrade	7,154	13,143	4,346	794
(U) Aircrew Training Devices	1,628	3,065	4,187	1,397
(U) System Engineering/Program Management	3,059	2,125	1,990	1,118
(U) System Test and Evaluation	357	346	1,023	178
(U) Training	12	58	109	95
(U) EMD Data	117	94	173	234
(U) Mission Support Equipment	215	147	17	0
(U) Maintenance Support Equipment	7	6	5	0
(U) Award Fee	600	900	900	1,000
(U) Other Government Costs	1,800	3,000	4,100	4,100
(U) Total	14,949	22,884	16,850	8,916

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
McDonnell Douglas	CPAF	31 Jul 96	45,654	47,754	0	12,549	18,506	11,950	3,816	1,279	48,100
ASC/YTA WPAFB OH	Various	Annual	N/A	N/A	0	2,110	3,472	3,672	3,872	240	13,366

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604233F Specialized Undergraduate Pilot Trng

PROJECT: 4376

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Support and Management Organizations											
SA-ALC/LF Kelly AFB TX	616	Quarterly	N/A	N/A	0	60	60	60	60	0	240
AETC Randolph AFB TX	616	Quarterly	N/A	N/A	0	60	60	60	60	0	240
OO-ALC/LIR Ogden AFB UT	616	Quarterly	N/A	N/A	0	170	308	308	308	60	1,154
Test and Evaluation Organizations											
445 FLTS Edwards AFB CA	PO	Annual	N/A	N/A	0	0	400	600	200	0	1,200
AFOTEC Kirtland AFB NM	PO	Annual	N/A	N/A	0	0	78	200	600	0	878

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604233F Specialized Undergraduate Pilot Trng	PROJECT 4376

(U) B. **Budget Acquisition History and Planning Information Continued ($ in Thousands)**

Government Furnished Property: Not Applicable

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development				0	14,659	21,978	15,622	7,688	1,519	61,466
Subtotal Support and Management				0	290	428	428	428	60	1,634
Subtotal Test and Evaluation				0	0	478	800	800	0	2,078
Total Project				0	14,949	22,884	16,850	8,916	1,579	65,178

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604239F F-22 EMD

PROJECT: 4069

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4069 Advanced Tactical Fighter - FSD	2,154,196	1,818,462	2,071,234	1,464,782	1,132,961	974,208	765,429	169,434	0	22,398,214
Quantity of RDT&E Articles	0	1	1	2	3	2	0	0	0	9*

***Unit cost of RDT&E articles not separately priced.**

(U) **A. Mission Description and Budget Item Justification**

This program is in budget activity 5 - Engineering and Manufacturing Development, Research Category 6.4 because the F-22 Program is developing the next-generation air superiority fighter for the USAF to counter emerging worldwide threats. The F-22 is designed to penetrate enemy airspace and achieve a first look, first kill capability against multiple targets. The F-22 is characterized by a low observable, highly maneuverable airframe, advanced integrated avionics, and aerodynamic performance that allows supersonic cruise without the use of afterburner. The F-22 is currently in the Engineering and Manufacturing Development (EMD) phase of acquisition and plans to release long lead production funding for Lot 1 aircraft in FY98. The EMD contract is Cost Plus Award Fee with Lockheed Martin Aeronautical Systems (LMAS) and Pratt & Whitney (P&W) to produce the F119 engines. The engines are provided to LMAS as Government Furnished Equipment (GFE).

The EMD phase effort consists of:

- Design, development, fabrication, test and delivery of nine flight test vehicles and two ground test vehicles (static and fatigue).
- Design, development, fabrication, and delivery of 26 flight qualified engines.
- Design, development, fabrication, integration, and test of the EMD avionics suite including air-to-surface provision.
- Updating the YF-22 Avionics Flying Laboratory with EMD assets and software to become a Flying Test Bed (FTB) to support avionics integration.
- Design, development, and test of F-22 weapons system support and training system.
- Renovation of facilities at Edwards Air Force Base (AFB) in support of the F-22 program.

Note: Total Cost includes $3,779,811 of Demonstration and Validation funding prior to FY92 funded in PE 0603230F.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604239F F-22 EMD PROJECT 4069

(U) FY 1996 ($ in Thousands):

- (U) $1,208,489 Air Vehicle
  - Continued assembly of Engineering and Manufacturing Development (EMD) aircraft #1. (NSP)
  - Initiated assembly of EMD aircraft #2. (NSP)
  - Software Block 0 released. (NSP)
  - Fabricated Support System elements for F-22 first flight. (NSP)
  - Completed Training System Requirements Description Review Update. (NSP)
  - Completed fabrication and delivery of Support Equipment in support of final assembly. (NSP)
  - Fabricated and delivered Support Equipment to support flight test. (NSP)
- (U) $551,000 Avionics
  - Began mission software Block 2 detailed design. (NSP)
  - Conducted mission software Block 2 PDR. (NSP)
  - Completed mission software Block 1 coding. (NSP)
  - Inertial Reference System (IRS) first article delivered. (NSP)
  - Initiated mission software Block 3 design. (NSP)
  - Continued Flying Test Bed (FTB) design/kit fabrication. (NSP)
- (U) $299,168 Engine
  - Continued engine development test program and initial flight clearance qualification. (NSP)
  - Added (2) ground test engines (7 total). (NSP)
  - Built and tested initial flight test engines. (NSP)
  - Delivered and validated engine support system products. (NSP)
- (U) $95,539 Other Government Cost
  - Manpower, computer networks, control room modifications at Edwards AFB
  - Continued support of engine development test program
  - Started sled test program at Holloman AFB
  - Further stores separation and bay acoustics wind tunnel testing at Arnold Engineering Development Center (AEDC)
  - Phase II aperture measurements at Rome Labs, and first session variable sidestick controller testing at VISTA labs
  - Mission support of the SPO; travel, computer costs, training, communications, misc contracts, etc.
  - Procurement of required government furnished equipment (GFE)
- (U) $2,154,196 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604239F F-22 EMD
	PROJECT 4069

(U) FY 1997 ($ in Thousands):

– (U) $978,012 Air Vehicle
- Complete assembly of Engineering and Manufacturing Development (EMD) aircraft #1. (NSP)
- Continue assembly of EMD aircraft #2. (NSP)
- Initiate assembly of EMD aircraft #3. (NSP)
- Conduct Interim Production Readiness Review (PRR). (NSP)
- Conduct First Flight Readiness Review (FRR). (NSP)
- Conduct F-22 first flight. (NSP)
- Begin installation systems on Flying Test Bed (FTB) (NSP)
- Initiate structural modification of Flying Test Bed (FTB). (NSP)
- Initiate assembly of static article. (NSP)
- Tech order data for First Development Test & Evaluation (DT&E) aircraft available. (NSP)
- Integrated Maintenance Information System (IMIS) for flight test available. (NSP)
- Supply Support Provisioning Management System implemented. (NSP)
- Complete initial supportability assessment. (NSP)

– (U) $545,250 Avionics
- Complete Block 1 Computer Software Component (CSC) integration. (NSP)
- Continue Avionics Integration Laboratory (AIL) integration in preparation of Block 1 integration testing. (NSP)
- Initiate FTB modifications, fabrication, and installation, conduct air worthiness review. (NSP)
- Complete mission software Block 2 coding and unit test. (NSP)
- Conduct mission software Block 3 Preliminary Design Review (PDR). (NSP)

– (U) $209,000 Engine
-Initiate production engine qualification testing (NSP)
-Deliver and support initial flight test engines (NSP)
-Begin verification of engine support system products (NSP)
-Continue engine development test program and complete initial flight clearance qualification (NSP)
-Add one ground test engine (8 total) (NSP)
-Continue to build and test additional flight test engines (NSP)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604239F F-22 EMD PROJECT 4069

– (U) $86,200 Other Government Cost
- Manpower and flight test support at Edwards AFB.
- Continued support of engine testing.
- Continue sled test program at Holloman AFB.
- Further phase II aperture measurements at Rome Labs, second session variable sidestick controller testing at VISTA labs.
- Additional stores separation wind tunnel testing at AEDC.
- Mission support of the SPO; travel, computer costs, training, communications, misc contracts, etc.
- Procurement of required government furnished equipment (GFE).

– (U) $1,818,462 Total

(U) FY 1998 ($ in Thousands):

– (U) $1,284,261 Air Vehicle
- Complete assembly of Engineering and Manufacturing Development (EMD) aircraft #2. (NSP)
- Continue assembly of EMD aircraft #3. (NSP)
- Initiate assembly of EMD aircraft # 4 and #5. (NSP)
- Conduct final Production Readiness Review (PRR) (NSP)
- Continue systems installations on Flying Test Bed (FTB) (NSP)
- Initiate assembly of fatigue article. (NSP)
- Begin static test (NSP)

– (U) $434,560 Avionics
- Complete Avionics Integration Laboratory (AIL) Block 1 integration (NSP)
- Continue incorporating Avionics hardware into the FTB (NSP)
- Begin testing avionics software on the FTB (NSP)
- Begin mission software Block 2 integration (NSP)
- Begin AIL integration in preparation of Block 2 integration testing (NSP)
- Conduct mission software Block 3 Critical Design Review (CDR) (NSP)
- Complete mission software Block 3 code and unit test (NSP)
- Begin mission software Block 3 integration (NSP)
- Deliver and install avionics hardware on the first avionics test aircraft (NSP)

– (U) $221,413 Engine
- Continue production engine qualification testing (NSP)
- Continue to deliver and support flight test engines (NSP)
- Continue verification of engine support system products (NSP)
- Continue to build and test additional flight test engines (NSP)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604239F F-22 EMD
	PROJECT 4069

– (U) $131,000 Other Government Cost
- Manpower, flight test and flight test support at Edwards AFB
- Continued support of engine testing
- Completion of stores separation testing at AEDC
- Completion of sled test program at Holloman AFB
- Continue aperture measurements at Rome Labs
- Avionics ground testing at various government test facilities
- Mission support of the SPO; travel, computer costs, misc contracts, etc.
- Procurement of required government furnished equipment (GFE)

– (U) $2,071,234 Total

(U) FY 1999 ($ in Thousands):

– (U) $853,971 Air Vehicle
- Complete assembly of EMD aircraft #3 and #4. (NSP)
- Continue assembly of EMD aircraft #5. (NSP)
- Initiate assembly of EMD aircraft #6-8. (NSP)
- First Flight Readiness Review (FRR) for aircraft #4. (NSP)
- Begin fatigue test. (NSP)

– (U) $313,288 Avionics
- First flight of the first avionics test aircraft (NSP)
- Continue testing avionics software on the FTB (NSP)
- Complete mission software Block 2 integration (NSP)
- Complete Avionics Integration Laboratory (AIL) Block 2 integration (NSP)
- Complete mission software Block 3 integration (NSP)
- Begin AIL integration in preparation of Block 3 integration testing (NSP)

– (U) $178,423 Engine
- Continue to deliver and support flight test engines (NSP)
- Continue verification of engine support system products (NSP)
- Continue building and testing flight test engines (NSP)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604239F F-22 EMD
	PROJECT 4069

– (U) $119,100 Other Government Cost
- Manpower, flight test, and flight test support at Edwards AFB
- Continued support of engine testing
- Completion of aperture measurements at Rome Labs
- Continued avionics ground testing at various government facilities
- Mission support of the SPO; travel, computer costs, misc contracts, etc.
- Procurement of required government furnished equipment (GFE)

– (U) $1,464,782 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	2,164,897	2,002,959	2,214,512	1,418,283	21,181,483
(U) Appropriated Value	2,238,718	1,906,021			
(U) Adjustments to Appropriated Value					
a. General Congressional Reductions	-43,830	-38,130			-81,960
b. SBIR	-29,987	-47,653			-77,640
c. Omnibus & Other Above Threshold Reprogramming					
d. BTR	1,200				1,200
e. Rescission	-11,905	-1,776			-13,681
(U) Adjustments to Budget Years Since FY97 PB			-143,278	46,499	1,388,812
(U) Current Budget Submit/FY98 PB	2,154,196	1,818,462	2,071,234	1,464,782	22,398,214

(U) Change Summary Explanation:
Funding: (FY98 PB)
- The appropriated value was adjusted for general congressional reductions by $43.8M in FY96 and $38.1M in FY97.
- The appropriated value was adjusted for SBIR reductions by $29.9M in FY96 and $47.6M in FY97.
- The appropriated value was adjusted for BTR increase by $1.2M in FY96 for Air Force Electronic Key Management System.
- The appropriated value was adjusted for rescissions by $11.9M in FY96 for Bosnia and $1.7M cancellation of RDT&E funds in FY97, section 8138.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604239F F-22 EMD

- The adjustments to budget years since the FY97 PB include deferral of the F-22 B model, deletion of funding for one PPV aircraft and 3 engines,and reductions for non-pay inflation and miscellaneous RDT&E adjustments. The results of the Joint Estimate Team (JET) have been incorporated, including deletion of remaining 3 PPV aircraft and 9 engines with the funds retained.

Schedule: (FY98 PB)
- The restructured program recommended by the JET incorporates more time to develop and test the avionics system which delays the completion of DT&E, the start and completion of dedicated IOT&E, the Milestone III decision for high rate production, and full contract award for high rate production.
- The following EMD aircraft deliveries have slipped: #3 from FY98 to FY99, #5-6 from FY99 to FY00 and #8-9 from FY00 to FY01.

Technical: (FY98 PB) None

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
(U) Military Construction (PE 0604239F)	12,100	4,390	0	0	0	0			0	**21,040
(U) Military Construction (PE 0207219F)	0	0	0	7,440	0	0			184,873	192,313
(U) Aircraft Procurement (PE 0207219F)	0	81,262	80,864	937,146	1,743,862	2,689,122	3,576,433	4,853,980	34,290,646	48,253,315

* F-22 MILCON funding zeroed in FY00-03 must be programmed in the next budget cycle to meet beddown requirements.
** Includes $4,550M of FY95 & prior funds.
The aircraft procurement costs represent the JET estimate incorporating the Tier I and Tier II initiatives which are cost avoidance program enhancements.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE
	February 1997

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
5 - Engineering and Manufacturing Development	0604239F F-22 EMD	4069

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Aircraft Delivered (EMD Test Article)							1					1			1	1
Program Milestones																
- DAB Review LRIP LL									X							
- DAB MS III, 4QFY03																
Engineering Milestones																
- Mid Fuselage Delivery				X												
- First Flight Test Engine Delivery				X												
- First Flight							X									
- Final PRR											X					
- First Avionics Flight																X
T&E Milestones																
- DT&E First Flight							X									
- Dedicated IOT&E, 4QFY02																

EMD = Engineering & Manufacturing Development, DAB = Defense Acquisition Board, LRIP = Low Rate Initial Production, LL = Long Lead, MS = Milestone, DT&E = Developmental Test & Evaluation, IOT&E = Initial Operational Test & Evaluation

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604239F F-22 EMD
	PROJECT 4069

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Air Vehicle/Avionics	1,759,489	1,523,262	1,718,821	1,167,259
(U) Engine	299,168	209,000	221,413	178,423
(U) Government Cost				
- Government Test	67,404	55,200	74,800	78,500
- Mission Support	18,460	16,000	15,000	14,000
- HAZMAT	0	2,500	25,000	23,000
- GFE	9,675	12,500	16,200	3,600
(U) Total	2,154,196	1,818,462	2,071,234	1,464,782

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Lockheed (Air Veh)	C/CPAF	Aug 91	11,755,300	14,829,104	6,544,394	1,759,489	1,523,262	1,718,821	1,167,259	2,115,879	14,829,104
Pratt & Whitney	C/CPAF	Aug 91	1,971,160	2,503,894	1,320,437	299,168	209,000	221,413	178,423	275,453	2,503,894
Support and Management Organizations											
Support Contracts	Various	Various			6,655	1,500	4,000	27,247	25,303	31,813	96,518
In House Support	Various	Various			45,324	16,960	14,500	12,753	11,697	48,187	149,421

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604239F F-22 EMD PROJECT 4069

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Test and Evaluation Organizations											
AEDC	PO				90,070	21,850	18,300	21,300	10,700	11,100	173,320
AFFTC	PO				36,153	35,438	27,100	43,300	59,500	553,500	754,991
All Other Tests	Various	Various			11,738	10,116	9,800	10,200	8,300	1,300	51,454

* Note: The Project Office EAC includes the following items not included in the Performing Activity (ie Contractor) EAC - Base Fee, Award Fee, SPO Planned CCPs (Bogey List), SPO FY96 POM initiatives not yet on contract, E,C,R Firm Risk Items, and other adjustments based on results of the Joint Estimate Team (JET).

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
GFE	Various	Various	Various	12,926	9,675	12,500	16,200	3,600	4,800	59,701
Support and Management Property		N/A	N/A	0	0	0	0	0	0	0
Test and Evaluation Property		N/A	N/A	0	0	0	0	0	0	0

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604239F F-22 EMD	PROJECT 4069

Item Description	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development	7,877,757	2,068,332	1,744,762	1,956,434	1,349,282	2,396,132	17,392,699
Subtotal Support and Management	51,979	18,460	18,500	40,000	37,000	80,000	245,939
Subtotal Test and Evaluation	137,961	67,404	55,200	74,800	78,500	565,900	979,765
Total Project	*11,847,508	2,154,196	1,818,462	2,071,234	1,464,782	3,042,032	*22,398,214

* Includes $3,779,811 of Demonstration and Validation funding prior to FY 92 funded in PE 0603230F.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604240F B-2 Advanced Technology Bomber

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	587,538	595,496	355,750	44,894	209,461	72,042	13,257	13,971	0	24,696,293
3843 B-2 (Advanced Technology Bomber)	587,538	484,873	355,750	44,894	209,461	72,042	13,257	13,971	0	24,585,670
4609 B-2 Enhancements–	0	110,623	0	0	0	0	0	0	0	110,623
Quantity of RDT&E Articles	1*		0	0	0	0	0	0	0	6

* AV-1, an RDT&E test article is being upgraded to Block-30 configuration with procurement funding as directed by the President of the United States.

(U) **A. Mission Description and Budget Item Justification**

The B-2 Advanced Technology Bomber is America's most advanced long-range strike aircraft. This all-wing, two crew member aircraft has twin weapons bays of over 20,000 pounds capacity each and employs a wide array of signature reduction technologies to greatly enhance both its ability to penetrate enemy defenses and its ability to survive in a highly defended target environment. The B-2 provides global force projection capability and the ability to influence an enemy with insensitivity to the location of enemy assets or the availability of forward basing. This program is in budget activity 5- Engineering and Manufacturing Development because of the concurrency in developing, testing, producing, and deploying the B-2.

(U) FY 1996 ($ in Thousands):
- $153,349 Continued developmental test and evaluation
- $74,904 Continued development and support acquisition
- $359,285 Continued primary hardware development
- $587,538 Total

(U) FY 1997 ($ in Thousands):
- $108,071 Continued developmental test and evaluation
- $69,632 Continued development and support acquisition
- $417,793 Continued primary hardware development
- $595,496 Total (Includes FY 97 Congressional Add of $116M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber

(U) FY 1998 ($ in Thousands):

–	$28,142	Continued developmental test and evaluation (Close out CTF and maintain minimal flight test infrastructure)
–	$327,608	Continued development and support acquisition (Rework of EMD A/Vs, TPS development)
	–	Continued primary hardware development
–	$355,750	Total

(U) FY 1999 ($ in Thousands):

–	$12,200	Continued developmental test and evaluation (Maintain minimal flight test infrastructure)
–	$32,694	Continued development and support acquisition (Rework of EMD A/Vs, TPS development)
	–	Continued primary hardware development
–	$44,894	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 97)	623,616	528,454	346,611	221,997	24,799,018
(U) Appropriated Value	623,616	624,454			
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions	-12,421	-13,186			
b. SBIR	-15,628	-15,772			
c. Omnibus or Other Above Threshold Reprogram	-6,616				
d. Below Threshold Reprogramming	2,407				
e. Rescission	-3,820				
(U) Adjustments to Budget Years Since FY 1997 PB			9,139	-177,103	-102,725
(U) Current Budget Submit/FY98 President's Budget	587,538	595,496	355,750	44,894	24,696,293

(U) Change Summary Explanation:

Funding:

FY 96: Reflects Congressional General Reductions of $12.4M, $15.6M SBIR reductions, a reduction of $6.6M for Omnibus/Other Above Threshold Reprogramming (i.e. Bosnia) an addition of $2.4M for Below Threshold Reprogramming, and a reduction of $3.8M for Rescission Reprogramming.

FY 97: Congress added $116M for conventional weapons acceleration (JSOW, GAM-113, Generic Weapons Interface System), cut $20M for EMD curtailment tooling, $13.2 M for General Reductions/Anit-terrorism, and $15.8M for SBIR.

FY 98: Added $12.1M to maintain a minimum flight test infrastructure at Edwards AFB for post Block 30 testing and a decrease of $2.8M for Adjustments to Budget Year Since FY 1997 PB.

FY 99: Added $12.2M to maintain a minimum flight test infrastructure at Edwards AFB for post Block 30 testing and $24M for JASSM integration and a decrease of $1.3M for Adjustments to Budget Year Since FY 1997 PB. Decremented FY99 baseline program funding by $212M. The FY99 projected requirements will be re-evaluated during the Department's FY99 program review.

FY 00 - 03: Added $53.6M to maintain a minimum flight test infrastructure at Edwards AFB for post Block 30 testing and $113.0M for JASSM integration and a decrease of $13.7M for Adjustments to Budget Year Since FY 1997 PB.

Schedule: N/A

Technical: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber

(U) C. **Other Program Funding Summary ($ in Thousands)**

	FY1996/P	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	To Complete	Total Cost
A/C Proc, AF, Combat A/C/BA01/B-2A	17,352,441	91,303	174,086						17,617,830
A/C Proc, AF, Post Prod Support/BA07				235,466	123,524	31,040	17,716	27,398	435,144
A/C Proc, AF, Modifications/BA05/B-2A	105,431	6,100	13,853	16,275	22,205	12,565	14,071	17,398	207,898
A/C Proc, AF, Cmn Spt Eq/BA07/Items<$2M	4,476	471	491	493	493	494	475	954	8,347
A/C Proc, AF, A/C Replen Spares/BA06/B-2A	0	0	0	0	0	0	0	0	0
A/C Proc, AF, A/C Intital Spares/BA06/B-2A	961,491	34,950	67,924	27,520	25,976	6,945	4,860	900	1,130,566
Proc (Other), AF/BA 02,03, 04/B-2A	37,268	19,014	10,888	6,284	6,143	6,593	8,254	8,202	102,646
Military Construction/BA01	47,600	0	27,074	0	0	0	0	0	74,674
A/C Proc, AF, A/C Spt Eqpt & Fac/BA07/ Bomber, Industrial Base Support	100,399	0	0	0	0	0	0	0	100,399
A/C Proc, AF, A/C Spt Eqpt & Fac/BA07/ Industrial Preparedness/PE708011F	8,500	3,600	0	0	0	0	0	0	12,100
Missile Proc, AF, Oth Missiles/BA42/ GPS Aided Munition/PE28030F	24,823	0	0	0	0	0	0	0	24,823
Related RDT&E	None								

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete Envelope Expansion		X														
Complete GPS Testing		X														
Block 20 First Delivery				X												
Complete Arctic & Tropic Testing				X												
Complete GATS Testing			X													
Flight Test Complete								X								
Block 30 First Delivery								X								
Initial Operational Capability (IOC)						X										
Full Operational Capability (FOC)															X	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604240F B-2 Advanced Technology Bomber

PROJECT: 3843

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3843 B-2 (Advanced Technology Bomber)	587,538	484,873	355,750	44,894	209,461	72,042	13,257	13,971	0	24,585,670

(U) A. **Mission Description and Budget Item Justification**

The B-2 Advanced Technology Bomber is America's most advanced long-range strike aircraft. This all-wing, two crew member aircraft has twin weapons bays of over 20,000 pounds capacity each and employs a wide array of signature reduction technologies to greatly enhance both its ability to penetrate enemy defenses and its ability to survive in a highly defended target environment. The B-2 provides global force projection capability and the ability to influence an enemy with insensitivity to the location of enemy assets or the availability of forward basing. This program is in budget activity 5 - Engineering Manufacturing Development because of the concurrency in developing, testing, producing, and deploying the B-2.

(U) FY 1996 ($ in Thousands):
- $153,349 Continued developmental test and evaluation
- $74,904 Continued development and support acquisition
- $359,285 Continued primary hardware development
- $587,538 Total

(U) FY 1997 ($ in Thousands):
- $101,371 Continued developmental test and evaluation
- $51,332 Continued development and support acquisition
- $332,170 Continued primary hardware development
- $484,873 Total

(U) FY 1998 ($ in Thousands):
- $28,142 Continued developmental test and evaluation (Close out CTF and maintain minimal flight test infrastructure)
- $327,608 Continued development and support acquisition (Rework of EMD A/Vs, TPS development)
- Continued primary hardware development
- $355,750 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber
	PROJECT 3843

(U) FY 1999 ($ in Thousands):

- $12,200 Continued developmental test and evaluation (Maintain minimal flight test infrastructure)
- $32,694 Continued development and support acquisition (Rework of EMD A/Vs, TPS development)
- – Continued primary hardware development
- $44,894 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 97)	623,616	528,454	346,611	221,997	24,711,796
(U) Appropriated Value	623,616	508,454			
(U) Adjustments to Appropriated Value					
a. Cong Gen Reductions	-12,421	-10,739			
b. SBIR	-15,628	-12,842			
c. Omnibus or Other Above Threshold Reprogram	-6,616				
d. Below Threshold Reprogramming	2,407				
e. Recission Reprogrammings	-3,820				
(U) Adjustments to Budget Years Since FY 1997 PB			9,139	-177,103	-126,125
(U) Current Budget Submit/FY98 President's Budget	587,538	484,873	355,750	44,894	24,585,671

(U) Change Summary Explanation:

Funding:

FY 96: Reflects Congressional General Reductions of $12.4M, $15.6M SBIR reductions, a reduction of $6.6M for Omnibus/Other Above Threshold Reprogramming (i.e. Bosnia) an addition of $2.4M for Below Threshold Reprogramming, and a reduction of $3.8M for Rescission Reprogramming.

FY 97: Congress cut $20M for EMD curtailment tooling, $10.7 M for General Reductions/Anit-terrorism, and $12.8M for SBIR.

FY 98: Added $12.1M to maintain a minimum flight test infrastructure at Edwards AFB for post Block 30 testing and a decrease of $2.8M for Adjustments to Budget Year Since FY 1997 PB.

FY 99: Added $12.2M to maintain a minimum flight test infrastructure at Edwards AFB for post Block 30 testing and $24M for JASSM integration and a decrease of $1.3M for Adjustments to Budget Year Since FY 1997 PB. Decremented FY99 baseline program funding by $212M. The FY99 projected requirements will be re-evaluated during the Department's FY99 program review.

FY 00 - 03: Added $53.6M to maintain a minimum flight test infrastructure at Edwards AFB for post Block 30 testing and $113.0M for JASSM integration and a decrease of $13.7M for Adjustments to Budget Year Since FY 1997 PB..

Schedule: N/A

Technical: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604240F B-2 Advanced Technology Bomber

PROJECT: 3843

(U) C. Other Program Funding Summary ($ in Thousands)

	FY1996/P	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	To Complete	Total Cost
A/C Proc, AF, Combat A/C/BA01/B-2A	17,352,441	91,303	174,086						17,617,830
A/C Proc, AF, Post Prod Support/BA07				235,466	123,524	31,040	17,716	27,398	435,144
A/C Proc, AF, Modifications/BA05/B-2A	105,431	6,100	13,853	16,275	22,205	12,565	14,071	17,398	207,898
A/C Proc, AF, Cmn Spt Eq/BA07/Items<$2M	4,476	471	491	493	493	494	475	954	8,347
A/C Proc, AF, A/C Replen Spares/BA06/B-2A	0	0	0	0	0	0	0	0	0
A/C Proc, AF, A/C Intital Spares/BA06/B-2A	961,491	34,950	67,924	27,520	25,976	6,945	4,860	900	1,130,566
Proc (Other), AF/BA 02,03, 04/B-2A	37,268	19,014	10,888	6,284	6,143	6,593	8,254	8,202	102,646
Military Construction/BA01	47,600	0	27,074	0	0	0	0	0	74,674
A/C Proc, AF, A/C Spt Eqpt & Fac/BA07/ Bomber, Industrial Base Support	100,399	0	0	0	0	0	0	0	100,399
A/C Proc, AF, A/C Spt Eqpt & Fac/BA07/ Industrial Preparedness/PE708011F	8,500	3,600	0	0	0	0	0	0	12,100
Missile Proc, AF, Oth Missiles/BA42/ GPS Aided Munition/PE28030F	24,823	0	0	0	0	0	0	0	24,823
Related RDT&E	None								

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber
	PROJECT 3843

(U) D. **Schedule Profile**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete Envelope Expansion		X														
Complete GPS Testing		X														
Block 20 First Delivery				X												
Complete Arctic & Tropic Testing				X												
Complete GATS Testing			X													
Flight Test Complete								X								
Block 30 First Delivery								X								
Initial Operational Capability (IOC)						X										
Full Operational Capability (FOC)															X	

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604240F B-2 Advanced Technology Bomber

PROJECT: 3843

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
Equipment Development & Evaluation	496,378	425,175	320,319	26,114
Government Test	51,370	30,135	28,142	12,200
Other Government Costs (OGC)	1,668	2,327	1,400	500
Other	38,122	27,236	5,889	6,080
Total Project	587,538	484,873	355,750	44,894

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations										
Air Vehicle - NG	CPIF/AF	20,951,667	21,225,427	19,818,898	449,959	394,928	301,540	17,917	242,185	21,225,427
Aircrew Training	CPIF	561,359	561,359	561,145	0	214	0	0	0	561,359
Mission Planning	Multiple	301,191	301,191	217,546	35,114	21,555	18,779	8,197	0	301,191
Support and Management Organizations										
Other Govt Costs	N/A	N/A	579,566	573,071	1,668	2,327	1,400	500	600	579,566
Direct Release	N/A	N/A	367,857	278,085	38,122	27,236	5,889	6,080	12,445	367,857
Test and Evaluation Organizations										
Govt Test	N/A	N/A	856,582	681,234	51,370	30,135	28,142	12,200	53,501	856,582

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber
	PROJECT 3843

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
Engines - G.E.	Multiple	Multiple	N/A	556,979	7,105	4,901	0	0	0	568,985
AARL - Boeing	FPIF	Jun 88	N/A	116,926	4,200	3,577	0	0	0	124,703
Support and Management Property										
None										
Test and Evaluation Property										
None										
Subtotal Product Development				21,271,494	496,378	425,175	320,319	26,114	242,185	22,781,665
Subtotal Support and Management				851,156	39,790	29,563	7,289	6,580	13,045	947,423
Subtotal Test and Evaluation				681,234	51,370	30,135	28,142	12,200	53,501	856,582
Total Project				22,803,884	587,538	484,873	355,750	44,894	308,731	24,585,670

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604240F B-2 Advanced Technology Bomber

PROJECT: 4609

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4609 B-2 Enhancements–	0	110,623	0	0	0	0	0	0	0	110,623

(U) A. **Mission Description and Budget Item Justification**

B-2 enhancements will be accomplished via a Multi Stage Improvement Program (MSIP) that will plan, study, design, integrate, test, produce and support the implementation of Air Combat Command's future B-2 weapon system requirements defined in the Bomber Configuration Plan. Post Block-30 improvements pursued in this program includes projects to enhance lethality, survivability, reliability, maintainability, etc.. This program is in budget activity 5 - Engineering Manufacturing Development, because of the concurrency in developing, testing, producing, and deploying the B-2.

(U) FY 1996 ($ in Thousands):
- $0
- $0
- $0
- $0 Total

(U) FY 1997 ($ in Thousands):
- $ 6,700 Continue developmental test and evaluation
- $18,300 Continue development and support acquisition
- $85,623 Continue primary hardware development.
- $110,623 Total

(U) FY 1998 ($ in Thousands):
- $0
- $0
- $0
- $0 Total

(U) FY 1999 ($ in Thousands):
- $0
- $0
- $0
- $0 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber
	PROJECT 4609

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	0	0	0	0	0
(U) Appropriated Value	0	116,000	0	0	116,000
(U) Adjustments to Appropriated Value					
a. Cong Reductions		-2,447			
b. SBIR		-2,930			
c. Omnibus or Other Above Threshold Reprogram					
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB					
(U) Current Budget Submit/President's Budget		110,623			110,623

(U) Change Summary Explanation:

Funding:

FY 97: Congress added $116M to accelerate post block-30 capabilities, cut $2.4M for General Reductions/Anit-terrorism, and $2.9M for SBIR.

Schedule: N/A

Technical: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber
	PROJECT 4609

(U) C. Other Program Funding Summary ($ in Thousands)

	FY1996/P	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	To Complete	Total Cost
A/C Proc, AF, Combat A/C/BA01/B-2A	17,352,441	91,303	174,086						17,617,830
A/C Proc, AF, Post Prod Support/BA07				235,466	123,524	31,040	17,716	27,398	435,144
A/C Proc, AF, Modifications/BA05/B-2A	105,431	6,100	13,853	16,275	22,205	12,565	14,071	17,398	207,898
A/C Proc, AF, Cmn Spt Eq/BA07/Items<$2M	4,476	471	491	493	493	494	475	954	8,347
A/C Proc, AF, A/C Replen Spares/BA06/B-2A	0	0	0	0	0	0	0	0	0
A/C Proc, AF, A/C Intital Spares/BA06/B-2A	961,491	34,950	67,924	27,520	25,976	6,945	4,860	900	1,130,566
Proc (Other), AF/BA 02,03, 04/B-2A	37,268	19,014	10,888	6,284	6,143	6,593	8,254	8,202	102,646
Military Construction/BA01	47,600	0	27,074	0	0	0	0	0	74,674
A/C Proc, AF, A/C Spt Eqpt & Fac/BA07/ Bomber, Industrial Base Support	100,399	0	0	0	0	0	0	0	100,399
A/C Proc, AF, A/C Spt Eqpt & Fac/BA07/ Industrial Preparedness/PE708011F	8,500	3,600	0	0	0	0	0	0	12,100
Missile Proc, AF, Oth Missiles/BA42/ GPS Aided Munition/PE28030F	24,823	0	0	0	0	0	0	0	24,823
Related RDT&E	None								

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
MSIP PMD DIRECTION RECEIVED					X											
SAMP/J&A APPROVAL						X										
CONTRACT AWARD							X									

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber
	PROJECT 4609

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
Equipment Development & Evaluation		100,623		
Government Test		6,700		
Other Government Costs		3,300		
Total		110,623		

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Northrop-Grumman	TBD	Apr 97 (projected)		85,623	0	0	85,623	0	0	0	85,623
Mission Planning	TBD	Mar 97 (projected)		15,000	0	0	15,000	0	0	0	15,000
Support and Management Organizations											
OGC	N/A	N/A		3,300	0	0	3,300	0	0	0	3,300
Test and Evaluation Organizations											
Govt Test	N/A	N/A		6,700	0	0	6,700	0	0	0	6,700

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604240F B-2 Advanced Technology Bomber PROJECT 4609

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
Support and Management Property										
Test and Evaluation Property										
Subtotal Product Development						100,623				100,623
Subtotal Support and Management						3,300				3,300
Subtotal Test and Evaluation						6,700				6,700
Total Project						110,623				110,623

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604243F Mnpwr Pers & Trng Development

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	4,953	4,689	4,534	4,230	4,353	4,412	4,492	4,596	Continuing	Continuing
3818 Maintenance Skills Tutor (MST)	3,943	3,769	4,139	4,230	4,353	4,412	4,492	4,596	Continuing	Continuing
4369 Air Education and Training Management System (AETMS)	1,010	920	395	0	0	0	0	0	0	2,325
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification**

This program develops manpower, personnel, and training (MPT) technologies to improve effectiveness of Air Force training, performance, assessment, personnel acquisition, job assignment, force management, and human performance in weapon systems. Program performs foundation studies, analyses, and risk-reduction activities to support MPT requirements for the combat air forces, other Air Force agencies, and the total force. MSTs are designed to leverage senior maintenance personnel experience, through the use of artificial intelligence, for use in training junior specialists. AETMS will be the major Air Education and Training Command (AETC) training system with emphasis on centralized training for a decentralized training environment. AETC will benefit from more standardized training command-wide. This program is in Budget Activity 5 as it provides for the development and engineering of training and tutorial systems.

(U) **Acquisition Strategy:**

MST - Full and open competition, inclusive of small disadvantaged firms, for a Cost Plus Award Fee (CPAF), Indefinite Delivery Indefinite Quantity (IDIQ) contract. Individual delivery orders will be negotiated and awarded for each tutor development, Cognitive Task Analysis (CTA), or other parts of the statement of work.

AETMS - Engineering Change Proposals (ECPs) to be incorporated by modifying current Firm Fixed Price (FFP) contract with Lockheed Martin.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604243F Mnpwr Pers & Trng Development

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	5,006	4,940	5,194	4,269	Continuing
(U) Appropriated Value	5,300	4,940			
(U) Adjustments to Appropriated Value					
a. Cong/General Reductions	-137	-145			
b. SBIR	-103	-106			
c. Omnibus or Other Above Threshold Reprogram	-107				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			-660	-39	
(U) Current Budget Submit/98 PB	4,953	4,689	4,534	4,230	Continuing

(U) Change Summary Explanation:

Funding: FY97 includes reductions totaling $251 thousand for Congressional/general reductions and SBIR. FY98 reductions include a reduction in the scale of a study to determine the applicability of AETMS to other education management systems. FY98 through FY03 include reductions for a one-time adjustment for computer mission support and inflation rate changes.

Schedule: Not Applicable

Technical: Not Applicable

(U) **C. Other Program Funding Summary ($ in Thousands) Not Applicable**

FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost

(U) **D. Schedule Profile**

FY 1996				FY 1997				FY 1998				FY 1999		
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604243F Mnpwr Pers & Trng Development

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

Reference individual project data

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 1997
BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE: 0604243F Mnpwr Pers & Trng Development / PROJECT: 3818

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3818 Maintenance Skills Tutor (MST)	3,943	3,769	4,139	4,230	4,353	4,412	4,492	4,596	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification**

The MST program fields multiple, computer-based tutors, intelligent tutoring systems, and training delivery systems for the Combat Air Forces, other Air Force agencies, and the Guard/Reserves to improve training of complex skills for a broad range of Air Force jobs--primarily aircraft maintenance troubleshooting. The program also conducts foundation studies, analyses, and risk-reduction activities to support training requirements. These MSTs may include some initial skills training, but primary emphasis is on the more difficult cognitive skills such as understanding and troubleshooting problems that the maintenance-aiding equipment and systems are unable to diagnose. Four of the initial tutors will be fieldable test/research assets developed by Armstrong Lab under the Basic Job Skills (BJS) program. The System Program Office (SPO) is developing two tutors as a pre-EMD cost and schedule risk reduction effort. This effort was approved by the Designated Acquisition Commander (DAC), HSC/CC, with support from the users. The Air Force will reuse the core tutor software models from this effort for the remaining five tutors. The last five tutors will be developed during Engineering and Manufacturing Development (EMD).

(U) FY 1996 ($ in Thousands):

- (U) $2,707 Continue development, begin operational evaluation and fielding of the F-16 flightline Avionics A Shop Tutor
- (U) $ 380 Continue operational evaluation and upgrade of F-15 and F-16 avionics Tutors
- (U) $ 301 Begin Cognitive Task Assessment (CTA) and development of F-16 flightline Avionics B Shop Tutors
- (U) $ 94 Continue evaluation and modification of tutor authoring software
- (U) $ 461 Begin development of the Acquisition Tutor
- (U) $3,943 Total

(U) FY 1997 ($ in Thousands):

- (U) $1,215 Complete development, begin operational evaluation and fielding of the F-16 flightline Avionics A Shop Tutor
- (U) $2,454 Continue development of the F-16 flightline Avionics B Shop Tutor
- (U) $ 100 Continue evaluation of tutor authoring software
- (U) TBD Complete development and begin operational evaluation of the Acquisition Tutor
- (U) TBD Conduct foundation studies, analyses, and risk-reduction activities to support the requirements of the Combat Air Forces, other Air Force agencies, and the total force
- (U) $3,769 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604243F Mnpwr Pers & Trng Development
	PROJECT 3818

(U) FY 1998 ($ in Thousands):
- (U) $2,824 Continue development; begin operational evaluation and fielding of the F-16 flightline Avionics B Shop tutor
- (U) $1,215 Begin Cognitive Task Analysis (CTA) for the F-16 Tactical Aircraft Maintenance Specialist (TAMS) I (Tutor 9)
- (U) $ 100 Continue evaluation and modification of tutor authoring software
- (U) TBD Conduct foundation studies, analyses, and risk-reduction activities to support the requirements of the Combat Air Forces, other Air Force agencies, and the total force
- (U) $4,139 Total

(U) FY 1999 ($ in Thousands):
- (U) $2,602 Begin development, operational evaluation, and fielding of the F-16 TAMS I (Tutor 9)
- (U) $1,528 Begin CTA for TAMS II (Tutor 10)
- (U) $ 100 Continue evaluation and modification of tutor authoring software
- (U) TBD Conduct foundation studies, analyses, and risk-reduction activities to support the requirements of the Combat Air Forces, other Air Force agencies, and the total force
- (U) $4,230 Total

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	3,996	3,979	4,173	4,269	Continuing
(U) Appropriated Value	4,270	3,979			
(U) Adjustments to Appropriated Value					
a. Cong/General Reductions	-117	-125			
b. SBIR	-103	-85			
c. Omnibus or Other Above Threshold Reprogram	-107				
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			-34	-39	
(U) Current Budget Submit/98 PB	3,943	3,769	4,139	4,230	Continuing

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604243F Mnpwr Pers & Trng Development PROJECT 3818

(U) Change Summary Explanation:

Funding: FY97 includes reductions totaling $210 thousand for Congressional/general reductions and SBIR. FY98 through FY03 include reductions for a one-time adjustment for computer mission support and for inflation rate changes.

Schedule: Not Applicable

Technical: Not Applicable

(U) C. Other Program Funding Summary ($ in Thousands) Not Applicable

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) F-16 C Shop Tutor					X**											
(U) F-16 C Shop OPS EVAL & Interim Contractor Support (ICS)					X*			X**								
(U) F-16 A Shop Tutor							X**									
(U) F-16 A OPS EVAL & ICS							X*				X**					
(U) F-15 C Shop OPS EVAL & ICS (LAB DEV)								X**								
(U) F-15 A Shop OPS EVAL & ICS (LAB DEV)											X**					
(U) F-16 B Shop Development											X*				X**	
(U) F-16 Tactical Aircraft Maintenance Specialist (TAMS) I Development														X*		
(U) F-16 TAMS II Development																X*

* Denotes milestone start

** Denotes milestone completion

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604243F Mnpwr Pers & Trng Development
	PROJECT 3818

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Software Development	1,896	1,754	2,569	3,009
(U) Interim Contractor Support (ICS) software maintenance	202	172	160	208
(U) Contractor Engineering Support Total	690	578	580	529
(U) Cognitive Task Analysis Support	637	864	400	0
(U) Govt Logistics Mgt Support	291	250	290	339
(U) Govt Audio/Visual support	12	0	0	0
(U) Travel	67	91	98	102
(U) Misc	148	60	42	43
(U) Total	3,943	3,769	4,139	4,230

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE: February 1997
BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE: 0604243F Mnpwr Pers & Trng Development — PROJECT: 3818

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Bolt, Beranek, & Newman (BBN)	SS/CPFF & CPAF	Feb 94	4,379	4,379	3,242	965	172	0	0	0	4,379
Univ. Pittsburgh	SS/CP	Feb 93	1,481	1,481	1,278	203	0	0	0	0	1,481
Galaxy Scientific	SS/CPFF	Jan 94	761	761	746	15	0	0	0	0	761
TBD	C/CPFF	Feb 97	N/A	12,327	0	0	1,250	2,069	3,079	5,929	12,327
Support and Management Organizations											
Various	N/A	N/A	N/A	N/A	4,476	2,123	1,483	1,170	1,151	TBD	TBD

Test and Evaluation Organizations: Not Applicable

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604243F Mnpwr Pers & Trng Development	PROJECT 3818

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property Cognitive Task Analysis (CTA) data provided by the SPO to the software development contractors. The data describes the systems/subsystems/components and the faults/problems to be simulated. CTA data collection and analysis performed by the SPO Scientific and Engineering Technical Assistance (SETA) contractor (Operational Technologies (OPTECH)).										
	C/CPFF	Feb 94	Continuing	1,639	637	864	900	0	0	4,040
Support and Management Property: Not Applicable										
Test and Evaluation Property: Not Applicable										
Subtotal Product Development				6,905	1,820	2,286	2,969	3,079	5,929	22,988
Subtotal Support and Management				4,476	2,123	1,483	1,170	1,151	TBD	TBD
Subtotal Test and Evaluation				0	0	0	0	0	0	0
Total Project				11,381	3,943	3,769	4,139	4,230	TBD	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604243F Mnpwr Pers & Trng Development

PROJECT: 4369

COST (*$ In Thousands*)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4369 Air Education and Training Management System (AETMS)	1,010	920	395	0	0	0	0	0	0	2,325

(U) This project was generated by the transfer of the Advanced Training System (ATS) project from PE 64227F, Training Systems Development, beginning in FY96.

(U) **A. Mission Description and Budget Item Justification**

AETMS expands ATS to support technical training and professional education at all AETC training activities. In this way, it provides a single command-wide training development, delivery, and management system. Program performs foundation studies, analyses, and risk-reduction activities to support training requirements. The program uses commercial hardware and software to yield a reliable and more easily maintainable system. AETMS builds upon the existing ATS and other commercial/newly developed software, thus simplifying development.

(U) FY 1996 ($ in Thousands):
- (U) $ 130 Complete software redevelopment of portions of ATS for tech training
- (U) $ 880 Initiate migration of proven ATS functionality to AETMS architecture
- (U) $1,010 Total

(U) FY 1997 ($ in Thousands):
- (U) $ 77 Residual tasks associated with the program management responsibility transfer of ATS to AETC
- (U) $843 Initiate software development studies to incorporate AETMS (professional education) functionality
- (U) $920 Total

(U) FY 1998 ($ in Thousands):
- (U) $395 Continue software development studies to incorporate AETMS (professional education) functionality
- (U) $395 Total

(U) FY 1999 ($ in Thousands): Not Applicable
- (U) $0 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604243F Mnpwr Pers & Trng Development	PROJECT 4369

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	1,010	961	1,021	0	2,992
(U) Appropriated Value	1,030	961			
(U) Adjustments to Appropriated Value					
a. Cong Reductions	-20	-19			
b. SBIR		-22			
c. Omnibus or Other Above Threshold Reprogram					
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1997 PB			-626	0	
(U) Current Budget Submit/98 PB	1,010	920	395	0	2,325

(U) Change Summary Explanation:

Funding: FY97 includes reductions totaling $41 thousand for Congressional/general reductions and SIBR. FY98 reductions include a reduction in the scale of a study to determine the applicability of AETMS to other Education Management Systems (EMS). FY98 also includes reductions for a one-time adjustment for computer mission support and an inflation rate change.

Schedule: Not Applicable

Technical: Not Applicable

(U) C. Other Program Funding Summary ($ in Thousands): None

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604243F Mnpwr Pers & Trng Development PROJECT 4369

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Redevelopment for tech training						X**										
(U) Development/Studies for AETMS (Professional Education)						X*			X**							
(U) Develop/Install prototype of AETMS Education Management System (EMS) at a professional education site									X*			X**				

* Denotes milestone start
** Denotes milestone completion

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604243F Mnpwr Pers & Trng Development
	PROJECT 4369

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Software Development/Studies	152	573	200	0
(U) TEAMS	236	125	55	0
(U) Travel	29	30	29	0
(U) Training Development	0	0	0	0
(U) Contract Administration	114	192	30	0
(U) AETMS	479	0	81	0
(U) Total	1,010	920	395	0

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Lockheed Martin	C/FFP/IF/ AFT	May 89	31,675	31,675	31,044*	631	0	0	0	0	31,675*
TBD	BOA	TBD		854	0	0	573	281	0	0	854
Support and Management Organizations											
HSC/YARA				N/A	0	379	347	114	0	0	840

Test and Evaluation Organizations Not Applicable

* Note: Actual funding prior to FY96 was included in PE 64227F, Flight Simulator Development, Project 3135, Advanced Training System

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE: February 1997
BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE: 0604243F Mnpwr Pers & Trng Development	PROJECT: 4369

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
DT III/IV HW & SW	PR			482*	0	0	0	0	0	482*
Support and Management Property: Not Applicable										
Test and Evaluation Property: Not Applicable										
Subtotal Product Development				(32,526)	631	573	281	0	0	1,485
Subtotal Support and Management				0	379	347	114	0	0	840
Subtotal Test and Evaluation				0	0	0	0	0	0	0
Total Project				(32,526)	1,010	920	395	0	0	2,325

* Note: Actual funding prior to FY96 was included in PE 64227F, Flight Simulator Development, Project 3135, Advanced Training System

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604270F EW Development

	COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	48,674	97,458	78,465	87,889	78,785	48,379	68,355	35,620	Continuing	TBD
1011	Joint Service Electronic Combat Systems Tester (JSECST)	7,345	10,638	9,490	5,944	0	0	0	0	0	33,417
2462	Compass Call (CC)	1,281	1,682	1,284	798	781	867	2,717	2,763	Continuing	TBD
3891	Advanced IR Countermeasures (AIRCM) (Includes CMWS and ASTE)	40,048	40,913	31,983	38,088	45,538	18,085	28,113	0	TBD	TBD
3945	RF Towed Decoy Systems	0	44,225	35,708	43,059	32,466	29,427	37,525	32,857	Continuing	TBD
	Quantity of RDT&E Articles	*	*	*	*	*	*	*	*	N/A	N/A

(U) A. **Mission Description and Budget Item Justification**

This program element (PE) consolidates engineering development efforts related to Air Force Electronic Warfare (EW) requirements. It centralizes USAF funding for, and management of, common EW systems development. A key criterion for included projects is the need for developmental activities, therefore the use of RDT&E funds, in transitioning EW technologies to installed operational capability. This PE executes projects IAW the DoD EW Master Plan to provide Infrared (IR), and Radio Frequency (RF) aircraft self protect and communications jamming systems and their test equipment to deter, detect, deceive and counter enemy acquisition and tracking of DoD operational platforms. The vast majority of projects contained herein are joint in nature and will lead to common systems responses to common threats.

* Refer to individual projects for breakouts of RDT&E articles

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	50,203	104,423	89,510	102,087	TBD
(U) Appropriated Value	50,203	101,923			
(U) Adjustments to Appropriated Value					
a. General Congressional Reduction	-983	-2,061			
b. Omnibus/other Above Threshold Reprogramming	-913				
c. Below Threshold Reprogramming	1,987				
d. SBIR	-1,128	-2,309			
e. Rescissions	-492	-95			
(U) Adjustments to Budget Years Since FY97 PB			-11,045	-14,198	
(U) Current Budget Submit/98 PB	48,674	97,458	78,465	87,889	TBD

(U) B. Program Change Summary ($ in Thousands):- (Continued)

(U) Change Summary Explanation:

Funding: FY98/99 funding was decreased during the FY98 PB build to fund higher AF priorities. The majority of the funding decrease reflects the cancellation of CMWS integration activities on F-15C/E aircraft. FY99 adjustment includes JSECST plus-up for development of Test Program Sets for EW equipment on F-15E, F-16, A-10, & C-130 aircraft.

Schedule: See Project Summaries.

Technical: See Project Summaries.

(U) C. Other Program Funding Summary ($ in Thousands): See Project Summaries.

(U) D. Schedule Profile: See Project Summaries.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604270F EW Development

PROJECT: 1011

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1011 Joint Service Electronic Combat Systems Tester (JSECST)	7,345	10,638	9,490	5,944	0	0	0	0	0	33,417
Quantity of RDT&E Articles										
JSECST QTY	0	0	5	0	0	0	0	0	N/A	N/A
JSECST $	0	0	1,250	0	0	0	0	0	N/A	N/A

(U) A. Mission Description and Budget Item Justification

(U) The JSECST will fill both an Air Force and Navy operational requirement for a small, adaptable, and highly mobile tester capable of verifying the system level performance of installed electronic countermeasures systems. Present maintenance concepts rely on the built-in-test (BIT) capabilities of the line replaceable units (LRUs) to verify system performance. This method fails to detect failures in LRU interfaces and installed aircraft (Group A) hardware. Particular emphasis will be placed on size and weight since the test set must deploy with the operational unit.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development PROJECT 1011

(U) A. Mission Description and Budget Item Justification: - (Continued)

(U) **FY 1996**

–	(U)	$NSP	RFP Release
–	(U)	$5,482	Begin EMD efforts (Including Test Program Set (TPS) Development)
–	(U)	$1,400	SPO Support
–	(U)	$463	Development Test Preparation
–	(U)	$7,345	Total

(U) **FY 1997**

–	(U)	$7,315	Continue EMD Effort
–	(U)	$1,340	SPO Support
–	(U)	$867	Government Test
–	(U)	$1,116	TPS Lab Support
–	(U)	$10,638	Total

(U) **FY 1998**

–	(U)	$5,618	Complete EMD Effort
–	(U)	$1,618	SPO Support
–	(U)	$1,138	DT/OT Support
–	(U)	$1,116	TPS Lab Support
–	(U)	$9,490	Total

(U) **FY 1999**

–	(U)	$5,944	Follow on Platform (F-15E, F-16, A-10, C-130) TPS Development
–	(U)	$5,944	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 1011

(U) B. Program Change Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	7,837	11,163	9,571	0	*32,388
(U) Appropriated Value	7,837	11,163			
(U) Adjustments to Appropriated Value					
a. General Congressional Reduction	-153	-223			
b. Omnibus/other Above Threshold Reprogramming	-80				
c. Below Threshold Reprogramming					
d. SBIR	-176	-292			
e. Rescissions	-83	-10			
(U) Adjustments to Budget Years Since FY97 PB			-81	5,944	5,863
(U) Current Budget Submit/98 PB	7,345	10,638	9,490	5,944	*37,857

* Total includes prior year funds.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 1011

(U) B. Program Change Summary ($ in Thousands):- (Continued)

(U) Change Summary Explanation:

Funding: FY98 funding was decreased during the FY98 PB build to fund higher AF priorities. FY99 funding ($5.944M) added in FY98 POM for follow-on TPS development.

Schedule: None.

Technical: None.

(U) C. Other Program Funding Summary ($ in Thousands):

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Aircraft Procurement, AF				17,175	22,926	24,566			0	64,667
(U) PE 27442F(Common ECM)										
(In Service Direct Ground Support Equipment)										

(U) D. Schedule Profile:

	FY 1996				FY 1997				FY 1998				FY 1999		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) EMD Contract Award		X														
(U) SRR			X													
(U) SFR				X												
(U) PDR					X											
(U) CDR							X									
(U) TRR										X						
(U) DT&E										X						
(U) IOT&E											X					
(U) FCA												X	X			
(U) MS III														X		
(U) Production Lots award														X		

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604270F EW Development

PROJECT: 1011

(U) A. **Project Cost Breakdown ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) EMD Contract	5,482	7,315	5,618	
(U) SPO Support	1,400	1,449	1,618	
(U) Government Test	463	867		
(U) TPS Lab Support		1,007	1,116	
(U) DT/OT Support			1,138	
(U) Follow On Platform (F-16, A-10, C-130) TPS Development				5,944
(U) Total	7,345	10,638	9,490	5,944

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands):**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
AAI	CPAF	Mar 96	18,415	18,415		5,482	7,315	5,618			18,415
Support and Management Organizations											
ASC/LNA, NAVAIR, Wright Labs		Various	16,954	16,954	4,420	1,400	2,456	2,734	5,944		16,954
Test and Evaluation Organizations											
AFDTC, Eglin AFB FL						463	867	1,138			2,468

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development PROJECT 1011

(U) B. Budget Acquisition History and Planning Information ($ in Thousands): (Continued)

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property										
Misc	Misc									
Subtotal Product Development					5,482	7,315	5,618			18,415
Subtotal Support and Management				4,420	1,400	2,456	2,734	5,944		16,954
Subtotal Test and Evaluation					463	867	1,138			2,468
Total Project				4,420	7,345	10,638	9,490	5,944		37,837

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development	PROJECT 1011

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2462 Compass Call (CC)	1,281	1,682	1,284	798	781	867	2,717	2,763	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	N/A	N/A

(U) A. Mission Description and Budget Item Justification:

(U) COMPASS CALL (CC) is an EC-130H developed for command and control warfare (C2W) as a stand-off jamming platform to disrupt enemy air defenses and ground operations. It is optimally employed as part of an integrated electronic combat (EC) package as it complements both present and future air, ground, and sea based systems to provide theater commanders with a coordinated jamming platform. This program element provides a continuing technology program to keep the EC-130H current with the rapidly evolving threat.

(U) Ongoing development programs are:

- (U) HBS (High Band System) - Integrates HBS countermeasures into CC Block 30 platform. Contractor: MAGNAVOX, Ft Wayne, IN.
- (U) P-35
- (U) HBE (High Band Exciter) - ECP to HBS, Contractor: MAGNAVOX, Ft. Wayne, IN.
- (U) TRACS (Tactical Radio Acquisition and Countermeasures) - Contractor: Lockheed-Sanders, Nashua, NH.

NOTE: Previous submissions of the descriptive summary for this project included a classified version. It was determined a classified version was not required for this and future submissions.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development PROJECT 2462

(U) A. **Mission Description and Budget Item Justification:** (Continued)

(U) **FY 1996**

- (U) $824 Complete integration of Block 3 upgrades (HBS and JM/SA) on aircraft
  - Conduct flight test of Block 3 upgrades
  - Correct test deficiencies
  - Complete users manuals/training
- (U) $457 Continue TRACS EMD
- (U) $1,281 Total

(U) **FY 1997**

- (U) $484 Support IOT&E of Block 3 upgrades
- (U) $650 Continue TRACS EMD
- (U) $548 Develop counters to evolving threat
- (U) $1,682 Total

(U) **FY 1998**

- (U) $420 Continue TRACS EMD
- (U) $320 HBE Upgrade
- (U) $419 Continue developing counters to evolving threat
- (U) $125 Program Office Support
- (U) $1,284 Total

(U) **FY 1999**

- (U) $717 Continue developing counters to evolving threat
- (U) $81 Program Office Support
- (U) $798 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	1,351	1,718	1295	805	TBD
(U) Appropriated Value	1,351	1,718			
(U) Adjustments to Appropriated Value					
a. General Congressional Reductions	-26	-34			
b. Omnibus/other Above Threshold Reprogramming	-14				
c. Below Threshold Reprogramming					
d. SBIR	-30				
e. Rescissions		-2			
(U) Adjustments to Budget Years Since FY97 PB			-11	-7	
(U) Current Budget Submit/98 PB	1,281	1,682	1,284	798	TBD

(U) Change Summary Explanation:

Funding: FY98/99 funding was decreased during the FY98 PB build to fund higher AF priorities.

Schedule: None.

Technical: None.

(U) **C. Other Program Funding Summary ($ in Thousands):**

(U) Aircraft Procurement, AF

(U) PE 27253F (Compass Call)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Mods (Compass Call; MN 1001) BA-5	0	2,997	7,552	7,802	7,975	8,156	8,648	8,830	Cont.	N/A
(U) Acft Replen Spares & Repairs BA-6	8,068	585	5,867	6,325	6,499	6,662	9,513	7,109	Cont.	N/A
(U) Acft Initial Spares & Repairs BA-6	2,488	1	0	1,743	9,379	9,984	13,194	8,997	Cont.	N/A
(U) Other Charges BA-7	7,736	0	0	24,647	27,747	49,882	48,644	27,075	0	N/A
(U) TOTAL	18,292	3,583	13,419	40,517	51,600	74,684	79,999	52,011	Cont.	N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development PROJECT 2462

(U) D. **Schedule Profile:**

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) BLOCK 30 System Integration	X															
(U) TRACS CDR																
(U) TRACS ECP2 (Note 1)																
(U) P-35 ECP 3																
(U) HBE CDR (Note 2)										X						
(U) Block 30 CONUS Flight Test	X	X	X													
(U) BLOCK 30 OCONUS Flight Test			X													
(U) AFOTEC OT&E	X	X	X	X	X	X										
(U) 1st BLK 30 Delivery to ACC			X													

(U) Note 1: TRACS is a continuing program to keep the aircraft current with the evolving threat

(U) Note 2: Preplanned ECP to HBE program completes 2 Qtr FY98 (Additional frequency coverage using new generation amplifiers)

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 2462

(U) A. **Project Cost Breakdown ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) HBE/HBS	388	484	320	0
(U) TRACS	457	650	420	0
(U) P-35	97	0	0	0
(U) ADCAT	0	0	0	0
(U) CCMS Ops	0	0	0	0
(U) Travel	49	49	49	49
(U) Miscellaneous	290	499	495	749
(U) Total	1,281	1,682	1,284	798

(U) NOTE: ADCAT funding was for contract closeout. CCMS operations funding completed a previous program.

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands):**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Magnavox	SS/CPAF	2Q			22,739	388	484	320	0	0	23,931
GTE	SS/CPIF	2Q			8,875	97	0	0	0	0	8,972
Sanders	SS/CPIF	2Q			25,556	457	650	420	0	0	27,083

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 2462

(U) B. Budget Acquisition History and Planning Information ($ in Thousands): (Continued)

Performing Organizations: (Continued)

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Support and Management Organizations											
Misc (SPO, Labs)	Various	1-4Q			2,718	242	454	479	753	Continuing	TBD

Test and Evaluation Organizations: Air Warfare Center conducts tests using its own funds.

Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Product Development Property										
Misc	Misc			1,500	97	94	70	45	Continuing	TBD
Subtotal Product Development Organizations				57,170	942	1,134	740	0	0	59,986
Subtotal Support and Management				1,618	242	454	479	753	Continuing	TBD
Subtotal Development Property				1,500	97	94	70	45	Continuing	Cont
Total Project				61,788	1,281	1,682	1,284	798	Continuing	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE: February 1997
BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE: 0604270F EW Development	PROJECT: 3891

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3891 Advanced IR Countermeasures (AIRCM) (Includes CMWS and ASTE)	40,048	40,913	31,983	38,088	45,538	18,085	28,113	0	TBD	TBD
Quantity of RDT&E Articles										
CMWS Qty	0	0	20	30	0	0	0	0	N/A	N/A
CMWS $	12,300	13,396	6,157	3,534	0	0	0	0	N/A	N/A
ASTE Qty	0	0	3,466	0	0	0	0	0	N/A	N/A
ASTE $	1,356	996	262	0	0	0	0	0	N/A	N/A

(U) A. **Mission Description and Budget Item Justification:**

The AIRCM project integrates two principal efforts to develop aircraft self-protection capabilities against an increasing number of sophisticated surface-to-air missile (SAM) threats. The first effort will provide timely warning of a SAM attack by developing and fielding the tri-service Common Missile Warning System (CMWS), with planned growth to directable countermeasures. The second effort will provide advanced expendable countermeasures by developing and fielding the Advanced Strategic and Tactical Infrared Expendable (ASTE) flare. The AIRCM project will result in an integrated, yet tailored, self-protect capability for current generation combat, airlift and special operations aircraft. Project objective is to increase aircraft survivability against advanced SAMs which may employ such features as next-generation electro-optics, dual infrared and radio frequency seekers. This project was formed in FY96 by combining the FY95 USAF/USN Advanced Missile Warning program with the Advanced Strategic and Tactical Infrared Expendables effort. Management as a consolidated AIRCM project will lead to optimal execution and suite performance. The project plan is an integral part of a Joint Service IRCM program and maximizes commonality across Air Force, Navy, and Army aircraft. Both subprojects entered EMD in Jun 95. Internal CMWS installation is planned for the F-16 and A-10 aircraft, and is a candidate for the C-17 and B-1. The ASTE flare will be functionally compatible with existing dispenser systems and will be employed across multiple USAF and USN weapon systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 3891

(U) A. **Mission Description and Budget Item Justification:** (Continued)

(U) **FY 1996 The following figures reflect activities associated with the project 3891 (CMWS and ASTE) programs:**

CMWS Program: (For the ASTE Program breakout refer to page 18)

(U) **FY 1996**

–	(U)	$19,588	Joint Program Costs
–	(U)	$4,000	F-15 aircraft (Group A) EMD integration
–	(U)	$6,000	F-16 aircraft (Group A) EMD integration
–	(U)	$100	A-10 aircraft (Group A) EMD integration
–	(U)	$3,064	Test and Evaluation (AF only)
–	(U)	$1,850	Modeling and Simulation (AF only)
–	(U)	$341	Mission Support
–	(U)	$2,000	Partnership Process
–	(U)	$567	Other Government Cost
–	(U)	$37,510	Total

(U) **FY 1997**

–	(U)	$18,913	Common Missile Warning System Joint Program Costs
–	(U)	$6,500	F-15 aircraft (Group A) EMD integration
–	(U)	$3,533	F-16 aircraft (Group A) EMD integration
–	(U)	$400	A-10 aircraft (Group A) EMD integration
–	(U)	$2,888	Test and Evaluation (AF only)
–	(U)	$1,477	Modeling and Simulation (AF only)
–	(U)	$2,086	Mission Support
–	(U)	$384	Other Government Cost
–	(U)	$36,181	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 3891

(U) A. **Mission Description and Budget Item Justification:** (Continued)

CMWS Program:

(U) **FY 1998**

–	(U)	$3,200	Common Missile Warning System Joint Program Costs
–	(U)	$11,000	F-16 aircraft (Group A) EMD integration
–	(U)	$2,500	A-10 aircraft (Group A) EMD integration
–	(U)	$6,765	Test and Evaluation (AF only)
–	(U)	$1,500	Modeling and Simulation (AF only)
–	(U)	$3,678	Mission Support
–	(U)	$28,643	Total

(U) **FY 1999**

–	(U)	$6,900	Common Missile Warning System Joint Program Costs
–	(U)	$14,400	F-16 aircraft (Group A) EMD integration
–	(U)	$8,200	A-10 aircraft (Group A) EMD integration
–	(U)	$4,786	Test and Evaluation (AF only)
–	(U)	$1,300	Modeling and Simulation (AF only)
–	(U)	$2,502	Mission Support
–	(U)	$38,088	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 3891

(U) A. **Mission Description and Budget Item Justification:** (Continued)

ASTE Program:

(U) **FY 1996**

–	(U)	$1,375	Joint Program Costs
–	(U)	$ 0	Test and Evaluation
–	(U)	$ 0	Verification and Validation
–	(U)	$ 90	Modeling & Analysis
–	(U)	$ 32	Other Government Costs
–	(U)	$1,041	Mission Support
–	(U)	$2,538	Total

(U) **FY 1997**

–	(U)	$1,486	Joint Program Costs
–	(U)	$ 748	Test and Evaluation
–	(U)	$ 226	Verification and Validation
–	(U)	$ 369	Modeling & Analysis
–	(U)	$ 126	Other Government Costs
–	(U)	$1,777	Mission Support
–	(U)	$4,732	Total

(U) **FY 1998**

–	(U)	$ 534	Joint Program Costs
–	(U)	$1,396	Test and Evaluation
–	(U)	$ 150	Verification and Validation
–	(U)	$ 180	Modeling & Analysis
–	(U)	$ 0	Other Government Costs
–	(U)	$1,080	Mission Support
–	(U)	$3,340	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 3891

(U) A. **Mission Description and Budget Item Justification:** (Continued)

ASTE Program:

(U) **FY 1999**

–	(U)	$	0	Joint Program Costs
–	(U)	$	0	Test and Evaluation
–	(U)	$	0	Verification and Validation
–	(U)	$	0	Modeling & Analysis
–	(U)	$	0	Other Government Costs
–	(U)	$	0	Mission Support
–	(U)	$	0	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development	PROJECT 3891

(U) **B. Program Change Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	41,015	44,052	42,636	57,819	TBD
(U) Appropriated Value	41,015	42,802			
(U) Adjustments to Appropriated Value					
a. General Congressional Reductions	-804	-879			
b. Omnibus/other Above Threshold Reprogramming	-819				
c. Below Threshold Reprogramming	1,987				
d. SBIR	-922	-970			
e. Rescissions	-409	-40			
(U) Adjustment to budget year since FY97 PB			-10,653	-19,731	
(U) Current Budget Submit/98 PB	40,048	40,913	31,983	38,088	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 3891

(U) **B. Program Change Summary ($ in Thousands):** (Continued)

(U) Change Summary Explanation:

Funding: FY98 and FY99 funding was decreased during the FY98 PB build to fund higher AF priorities. It reflects the AF decision to cancel CMWS integration activities on F-15/C/E aircraft. FY96 $2,000M increase for EW Partnership Process.

Schedule: ASTE EMD contract award occured in 1QFY96. ASTE schedule streamlined by combining covert and fighter design milestones, driven by technical reason below. CMWS schedule changed from calendar-based to event-driven, to minimize program risk, sliding CDR from 4QFY96 to 2QFY97.

Technical: ASTE program changes reflect recent USN decision to pursue square flare form factor design (current USAF configuration) making the new flare common across the two services.

(U) **C. Other Program Funding Summary ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Aircraft Procurement, AF				7,822	28,344	51,895	76,712	104,995	590,393	860,161
(U) PE 27442F (Missile Warning only) BA-5										
(U) Mods (F-16/A-10 Common Msl Wrn Sys; MN CMWS)										
(U) Procurement of Ammunition, AF (ASTE)										
(U) PE28030F BA-1, Appn 3011				3,000	5,000	5,000	5,000	5,000		

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604270F EW Development

PROJECT: 3891

(U) D. Schedule Profile:

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Project 3891, AIRCM																
(U) ASTE EMD Contract Award	X															
(U) ASTE PDR - Covert				X												
(U) ASTE CDR - Covert								X								
(U) ASTE DT&E - Covert									X	X	X					
(U) ASTE OT&E - Covert											X	X	X			
(U) ASTE MS III - Covert														X		
(U) ASTE PDR - Fighter					X											
(U) ASTE CDR - Fighter							X	X								
(U) ASTE DT&E - Fighter									X	X	X					
(U) ASTE OT&E Fighter											X	X	X			
(U) ASTE MS III - Fighter														X		
(U) CMWS System Design Review		X														
(U) CMWS PDR			X													
(U) CMWS CDR					X	X										
(U) CMWS Contractor Qual Test										X	X	X	X			
(U) CMWS Platform Integration						X	X	X	X	X	X					
(U) CMWS DT&E											X	X	X	X		
(U) CMWS IOT&E (Sep99-Aug 00)															X	X
(U) CMWS MSIII (Mar 00)																

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
PROJECT 3891	

(U) A. **Project Cost Breakdown ($ in Thousands):**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) CMWS Program				
(U) CMWS Group B	19,588	18,913	3,200	6,900
(U) F-15 Aircraft (group A) EMD integration	4,000	6,500		
(U) F-16 Aircraft (group A) EMD integration	6,000	3,533	11,000	14,400
(U) A-10 Aircraft (group A) EMD integration	100	400	2,500	8,200
(U) CMWS Test	3,064	2,888	6,765	4,786
(U) CMWS Modeling and Simulation	1,850	1,477	1,500	1,300
(U) CMWS Mission Support	341	2,086	3,678	2,502
(U) Other Government Costs	567	384		
(U) EW Partnership Process	2,000			
(U) ASTE Program				
(U) ASTE Joint Program Costs	1,375	1,486	534	
(U) ASTE Test & Evaluation	0	748	1,396	
(U) ASTE Verification & Validation	0	226	150	
(U) ASTE Modeling and Analysis	90	369	180	
(U) ASTE Other Government Costs	32	126	0	
(U) ASTE Mission Support	1,041	1,777	1,080	
(U) Total	40,048	40,913	31,983	38,088

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development	PROJECT 3891

(U) B. Budget Acquisition History and Planning Information ($ in Thousands):

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Prime Contractors											
ASTE - Tracor		Nov 95	8,342	8,342	4,947	1,375	1,486	534	0		8,342
CMWS - Sanders		Sep 95	76,600	76,600	7,250	19,588	18,913	3,200	6,900	27,649	83,500
Total Prime					12,197	20,963	20,399	3,734	6,900	27,649	91,842
CMWS Integration (Airframe contractors)			98,300	98,300	6,500	10,100	10,433	13,500	22,600	35,167	98,300
Support and Management Organizations											
ASC/LN, Wright Labs, Naval Surface Warfare Center											
ASTE (Includes DT&E)			38,704	38,704	33,837	1,163	2,498	1,206			38,704
CMWS		Sep 95	24,100	24,100	3,290	908	2,470	3,678	2,502	11,252	24,100
EW Partnership Process					0.0	2,000	0.0	0.0	0.0	0.0	2,000
Total Support & Mgmt					37,127	4,071	4,968	4,884	2,502	11,252	64,804

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 3891

Performing Organizations: (Continued)

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Test and Evaluation Organizations											
CMWS (AFOTEC or Navy test organization)		2Q	TBD	TBD		4,914	4,365	8,265	6,086	TBD	TBD
ASTE - 46TW, OPTEVFOR, PAX-RIVER		2Q	TBD	TBD		0.0	748	1,600	0.0	0.0	2,384
Total Test and Eval						4,914	5,113	9,865	6,086	TBD	TBD
Total Project						40,048	40,913	31,983	38,088	TBD	TBD

Government Furnished Property: Not Applicable

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604270F EW Development

PROJECT: 3945

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3945 RF Towed Decoy Systems	0	44,225	35,708	43,059	32,466	29,427	37,525	32,857	Continuing	TBD
Quantity of RDT&E Articles										
B-1 Qty (IDECM only)	0	2	2	1	0	0	0	0	N/A	N/A
B-1 $	0	4,301	8,336	7,012	1,036	0	0	0	N/A	N/A
F-15 Qty (IDECM only)	0	0	1	2	1	0	0	0	N/A	N/A
F-15 $	0	0	2,910	6,740	1,699	0	0	0	N/A	N/A

(U) A. Mission Description and Budget Item Justification

(U) This project develops, integrates and tests radio frequency (RF) towed decoy systems on several aircraft. RF towed decoys are low cost, end game countermeasures that provide increased survivability against monopulse, semi-active, and active RF missile threats. The program is developing two classes of decoy systems, the Advanced Airborne Expendable Decoy (AAED) and the Integrated Defensive Electronic Countermeasures (IDECM) Fiber Optic Towed Decoy (FOTD). Both of these efforts are joint programs with the Navy as lead service. Air Force funding pays for unique Air Force development requirements and integration and test on Air Force platforms.

(U) AAED: The Air Force ALE-50 program is developing, integrating, and testing a modified version of the Navy's ALE-50 decoy system for the F-16 and B-1B. The components of the F-16 system include: the F-16 pylon assembly (modified 16S350 pylon), launcher/controller, magazines, canister, towline assembly, and the AAED. The major components of the B-1B system include: the multi-platform launch controller (MPLC), launcher, magazine, canister, towline assembly and the AAED.

(U) IDECM: The Navy's goal in IDECM is to develop an integrated ECM suite for the F/A-18E/F. The Air Force is participating in IDECM to jointly develop a common IDECM techniques generator (TG) and a high power FOTD. Air Force funding pays for unique Air Force development costs under IDECM as well as integration and test on the F-15. The DSUP program will fund integration and test of IDECM hardware on the B-1B.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development

(U) A. Mission Description and Budget Item Justification - (Continued)

(U) *FY 1996 ($ in Thousands):
- (U) $0 Total *

(U) FY 1997 ($ in Thousands):
- (U) $6,649 ALE-50 Common
- (U) $0 ALE-50 F-16
- (U) $10,579 ALE-50 B-1
- (U) $6,468 IDECM Common
- (U) $3,159 IDECM F-15
- (U) $13,820 Test Support
- (U) $3,550 Mission Support
- (U) $44,225 Total

(U) FY 1998 ($ in Thousands):
- (U) $1,502 ALE-50 Common
- (U) $0 ALE-50 F-16
- (U) $3,200 ALE-50 B-1
- (U) $12,520 IDECM Common
- (U) $15,870 IDECM F-15
- (U) $500 Test Support
- (U) $2,116 Mission Support
- (U) $35,708 Total

* Funding for this effort transferred from multiple formerly classified projects in FY97.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development

(U) A. Mission Description and Budget Item Justification - (Continued)

(U) FY 1999 ($ in Thousands):

–	(U)	$0	ALE-50 Common
–	(U)	$0	ALE-50 F-16
–	(U)	$0	ALE-50 B-1
–	(U)	$15,282	IDECM Common
–	(U)	$26,450	IDECM F-15
–	(U)	$0	Test Support
–	(U)	$1,327	Mission Support
–	(U)	$43,059	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 3945

(U) B. Program Change Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	*	47,490	36,008	43,463	TBD
(U) Appropriated Value		46,240			
(U) Adjustments to Appropriated Value					
a. General Congressional Reductions		-925			
b. Omnibus or Other Above Threshold Reprogram					
c. Below Threshold Reprogramming					
d. SBIR		-1,047			
e. Rescissions		-43			
(U) Adjustments to Budget Years Since FY 1997 PB			-300	-404	
(U) Current Budget Submit / 98 PB		44,225	35,708	43,059	TBD

* Funding for this effort transferred from multiple formerly classified projects in FY97.

(U) Change Summary Explanation:

Funding: FY98/99 funding decreased during FY98 PB build to fund higher AF priorities.

Schedule: B-1 AAED 1st Flight Readiness Review slid to Jan 97 due to more time required for OT&E Report. B-1 DSUP MS II slid from 2Q 97 to 3Q 97 due to schedule slips in convening the JROC.

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Aircraft Procurement, AF		45,548	100,156	81,300	92,425	116,429	133,691	151,713	TBD	TBD
(U) PE 27442F										

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development PROJECT 3945

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) B-1B 1st Flight Readiness Review*						X										
(U) F-16 AAED Milestone III					X											
(U) F-15/IDECM Integration Contract Award							X									
(U) B-1B AAED Milestone III										X						
(U) B-1 DSUP Milestone II							X									

* See Change Summary

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
PROJECT 3945	

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999
(U) B-1 AAED EMD	*	10,579	3,200	0
(U) USAF IDECM Development		6,468	12,520	15,282
(U) F-15 IDECM Integration		3,159	15,870	26,450
(U) Mission and Test Support		17,370	2,616	1,327
(U) USAF AN/ALE-50 EMD		6,649	1,502	0
(U) Total		44,225	35,708	43,059

* Funding for this effort transferred from multiple formerly classified projects in FY97.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development PROJECT 3945

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations											
Prime Contractors											
B-1 AAED - Rockwell/ (Boeing North American)		Apr 95	23,088	23,088		*	9,059	3,200	0.00	0.00	TBD
ESGD- Raytheon											
USAF AN/ALE-50 EMD Support Contract - ESGD Raytheon		Jan 96	8,231	8,231		*	5,485	760	0.00	0.00	TBD
USAF IDECM Development - Sanders		Nov 95	32,121	35,184		*	4,388	12,520	15,282	2,994	TBD
F-15 IDECM Integration - McAir/Northrop/Lockheed-Martin		Aug 97	101,029	101,029			3,159	15,870	26,450	55,550	101,029
Misc Development Contracts						*	4,279	742	0.00	TBD	TBD
ALQ-184(V)9 ESGD-Raytheon		Jan 96	6,741	7,191		*	485	0.00	0.00	TBD	TBD
Total Prime							26,855	33,092	41,732	TBD	TBD

* Funding for this effort transferred from multiple formerly classified projects in FY97.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development
	PROJECT 3945

(U) B. Budget Acquisition History and Planning Information ($ in Thousands): (Continued)

Performing Organizations: (Continued)

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Support and Management Organizations											
ASC/LN/YD/YP											
AAED		1Q				*	1,480	0.00	0.00	TBD	TBD
IDECM		1Q				*	2,070	2,116	1,327	TBD	TBD
Total Support & Management							3,550	2,116	1,327	TBD	TBD
Test and Evaluation Organizations											
AFOTEC		1Q					2,700	500	0.00	TBD	TBD
AFFTC							11,120	0.00	0.00	TBD	TBD
Total Test & Evaluation							13,820	500	0.00	TBD	TBD

* Funding for this effort transferred from multiple formerly classified projects in FY97.

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property: None.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604270F EW Development PROJECT 3945

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands): (Continued)

Government Furnished Property: (Continued)

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Test and Evaluation Property										
Subtotal Product Development					*	26,855	33,092	41,732	TBD	TBD
Subtotal Support and Management					*	3,550	2,116	1,327	TBD	TBD
Subtotal Test and Evaluation					*	13,820	500	0.0	TBD	TBD
Total Project						44,225	35,708	43,059	TBD	TBD

* Funding for this effort transferred from multiple formerly classified projects in FY97.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604321F Combat Intelligence System - EMD

PROJECT: 2758

COST ($ In Thousands)	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2758 Combat Intelligence System (CIS)	3,619	2,791	0	0	0	0	0	0	TBD	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) Note: AF has moved funds to PE0207414F starting in FY 98.

(U) A. Mission Description and Budget Item Justification

(U) Combat Intelligence System (CIS) is the Air Force's single, standard automated intelligence system optimizing both component and unit-level intelligence functions to provide warfighters with the most accurate and timely intelligence data available. CIS is the core capability for automating the receipt, correlation, and dissemination of intelligence information to a variety of intelligence and operational systems which support combat planning and execution. As the intelligence segment to Theater Battle Management Core Systems (TBMCS), it provides an automated capability at the component and unit levels to rapidly receive and process all-source intelligence data to support Contingency Theater Automated Planning System (CTAPS). CIS builds and maintains in-theater situational awareness during deployment to the theater and provides indications and warning support after arrival. CIS provides the capability to receive all-source intelligence near-real-time from national, theater, tactical reconnaissance, and intelligence functions. CIS is electronically interoperable and compatible with other intelligence systems providing an integrated system capable of intelligence support to decision makers, battle planners, mission planners, and warfighters. The category of research being performed in this program is Engineering and Manufacturing Development because it is developing new capabilities and upgrading current systems.

(U) **Acquisition Strategy**: Full and open competition has lead to a cost plus award fee contract with Lockheed Martin Command and Control Systems to develop capabilities and integrate this system and software.

(U) FY 1996
- (U) $ 588 Continue Special Compartmented Information (SCI) level correlation enhancements.
- (U) $2,763 Continue CIS software development under TBMCS to include targeting, damage assessment, and mission reporting.
- (U) $ 268 Conduct studies for future CIS intelligence interoperability with Global Command and Control System.
- (U) $3,619 Total

(U) FY 1997
- (U) $1,359 Continue software development under TBMCS for version 1.0.
- (U) $ 432 Implement results of studies into CIS software under TBMCS.
- (U) $1,000 Continue studies for CIS intelligence interoperability.
- (U) $2,791 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604321F Combat Intelligence System - EMD PROJECT 2758

(U) **B. Program Change Summary ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999	Total Cost
(U) FY97 President's Budget	3,617	1,943	1,625	995	TBD
(U) Appropriated Value	3,938	2,943			
(U) Adjustments to Appropriated Value		-84			
a. Cong Reductions	-159	-68			
b. Small Business Innovative Research	-81				
c. Below Threshold Reprogramming	-1				
d. Rescissions (incls Bosnia)	-78				
(U) Adjustment to Budget Since FY 1997 PB			-1,625	-995	
(U) FY 1998/1999 Biennial Budget	3,619	2,791	0	0	TBD

(U) Change Summary Explanation:

Funding: Funds moved to PE0207414F starting in FY98.

Schedule: Not Applicable

Technical: Not Applicable

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604321F Combat Intelligence System - EMD

PROJECT: 2758

(U) C. Other Program Funding Summary ($ in Thousands)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
(U) RDT&E, PE 0207431F, Combat Air Intelligence System (CAIS)	0	7,385	0	0	0	0	0	0	0	7,385
(U) Other Procurement, PE 0207431F, CAIS	3,597	4,293	5,487	4,886	6,666	5,189	4,813	4,829	Cont	TBD
(U) Other Procurement, PE 0207414F, Combat Intelligence System (Proc)	9,114	9,705	15,252	13,173	18,730	14,631	12,077	12,125	Cont	TBD
(U) O&M, PE 0207431, CAIS	10,826	3,479	3,330	3,353	4,326	5,371	5,488	5,615	Cont	TBD
(U) RDT&E, PE 0305158F, Const Source	1,989	1,954	0	0	0	0	0	0	Cont	TBD
(U) Other Procurement, PE 0305158F, Constant Source	968	1,951	0	0	0	0	0	0	0	2,919

(U) D. Schedule Profile

	FY 1996				FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) CIS 1.2 Release							X									
(U) TBMCS Contract Awarded	X															
(U) TBMCS V1.0 Preliminary Design Review (PDR)					X											
(U) TBMCS V1.0 In Plant Test											X					
(U) TBMCS V1.0 Release												X				
(U) TBMCS V2.0 PBR														X		

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1997
BUDGET ACTIVITY 5 - Engineering and Manufacturing Development	PE NUMBER AND TITLE 0604321F Combat Intelligence System - EMD PROJECT 2758

(U) A. **Project Cost Breakdown ($ in Thousands)**

	FY 1996	FY 1997	FY 1998	FY 1999
(U) Software Development	2,577	2,370		
(U) Test and Evaluation	118	70		
(U) Program Management Support	297	73		
(U) Travel	181	0		
(U) Government Engineering Support	251	212		
(U) System Engineering Support	195	66		
(U) Total	3,619	2,791		

(U) B. **Budget Acquisition History and Planning Information ($ in Thousands)**

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Total Program
Product Development Organizations										
BTG, Inc F19628-92-D0005	SS/CPAF	Sep 92	3,154	3,154	1,575	588				3,101
Lockheed Martin Cmd & Ctrl Systems and various others F19628-95-C0143	SS/CPAF	Oct 95	TBD	TBD	4,884	2,421	2,370			TBD
Support and Management Organizations										
TEMS	Ongoing	Various				251	212			TBD

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE: February 1997

BUDGET ACTIVITY: 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE: 0604321F Combat Intelligence System - EMD

PROJECT: 2758

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1996	Budget FY 1996	Budget FY 1997	Budget FY 1998	Budget FY 1999	Total Program
MITRE	Ongoing					195	66			TBD
Miscellaneous	Various	Various				48	73			TBD
Test and Evaluation Organizations										
Test Support	Ongoing					116	70			TBD
Government Furnished Property: Not Applicable										
Subtotal Product Development					6,459	3,009	2,370			TBD
Subtotal Support and Management					3,492	494	351			TBD
Subtotal Test and Evaluation					87	116	70			TBD
Total Project					10,038	3,619	2,791			TBD

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