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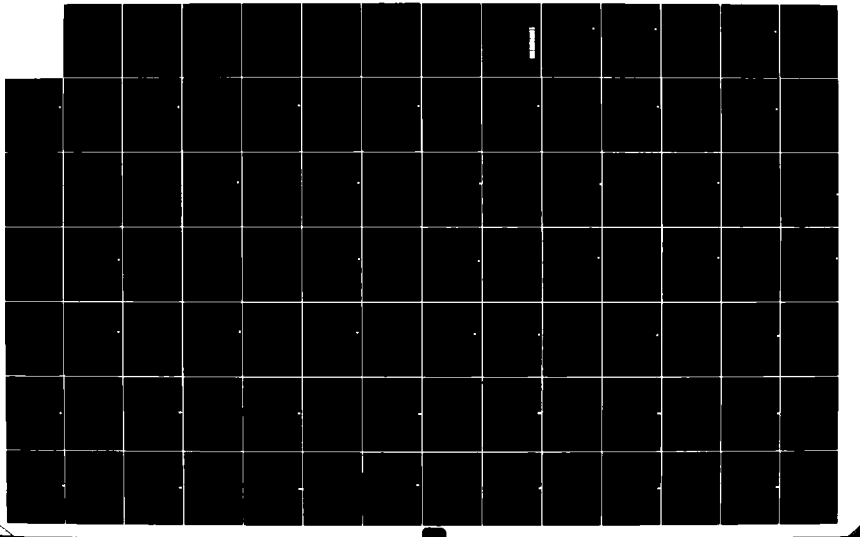
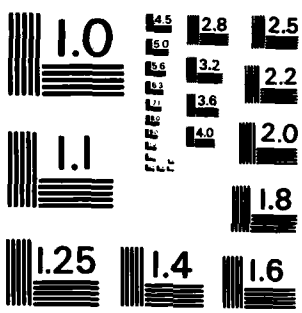




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

OFFICE OF THE
SECRETARY OF DEFENSE

JUSTIFICATION OF ESTIMATES FOR FISCAL YEAR 1984 SUBMITTED TO CONGRESS

JANUARY 1983

RESEARCH, DEVELOPMENT TEST AND EVALUATION DEFENSE AGENCIES

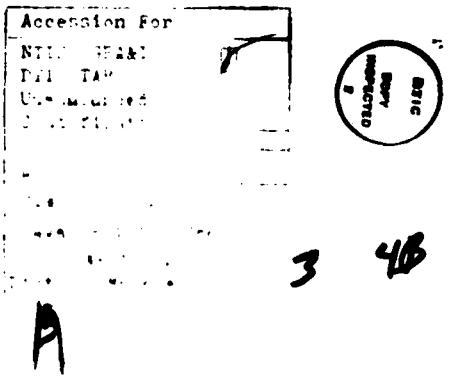
DIRECTOR OF TEST AND EVALUATION, DEFENSE

INDEX

APPROPRIATION LANGUAGE

RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES

For expenses of activities and agencies of the Department of Defense (other than the Military Departments), necessary for basic and applied scientific research, development, test and evaluation; advanced research projects as may be designated and determined by the Secretary of Defense, pursuant to law; maintenance, rehabilitation, lease, and operations of facilities and equipment, as authorized by law $2,153,189,000 $2,939,900,000 to remain available for obligation until September 30, 1984 1985: Provided, that such amounts as may be determined by the Secretary of Defense to have been made available in other appropriations available to the Department of Defense during the current fiscal year for programs related to advance research may be transferred to an merged with this appropriation to be available for the same purposes and time period: Provided further, that such amounts of this appropriation as may be determined by the Secretary of Defense may be transferred to carry out the purposes of advanced research to those appropriations for military functions under the Department of Defense which are being utilized for related programs to be merged with and to be available for the same time period as the appropriation to which transferred. (Department of Defense Appropriation Act, 1983; additional authorizing legislation to be proposed.)



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RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
Summary by Budget Activity
(Dollars in Thousands)

BUDGET ACTIVITY	FY 1982 ACTUAL	FY 1983 ESTIMATE	FY 1984 ESTIMATE	FY 1985 ESTIMATE
1. Technology Base	929,243	1,038,300	1,188,600	1,372,444
2. Advanced Technology Development	--	--	2,000	2,500
3. Strategic Programs	85,491	85,127	65,300	55,956
4. Tactical Programs	2,719	700	2,100	2,152
5. Intelligence & Communications	634,243	977,773	1,612,700	1,900,320
6. Defensewide Mission Support	45,950	51,289	69,200	82,530
TOTAL RDT&E - DIRECT	1,697,646	2,153,189	2,939,900	3,415,902
REIMBURSABLE	32,781	31,500	34,400	38,850
TOTAL PROGRAM	1,730,427	2,184,689	3,974,300	3,454,752

RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
Summary by Program Category
(Dollars in Thousands)

PROGRAM CATEGORY	FY 1982 ACTUAL	FY 1983 ESTIMATE	FY 1984 ESTIMATE	FY 1985 ESTIMATE
6.1 Research	94,140	102,800	110,400	127,174
6.2 Exploratory Development	835,103	935,500	1,078,200	1,245,270
6.3 Advanced Development	16,807	18,255	17,611	17,581
6.4 Engineering Development	6,247	7,052	5,819	8,546
6.5 Management and Support	45,950	49,289	67,000	80,562
TOTAL, RESEARCH & DEVELOPMENT (Program 6)	998,247	1,112,896	1,279,030	1,479,133
TOTAL, OPERATIONAL SYSTEMS	699,399	1,040,293	1,660,870	1,936,769
TOTAL DIRECT	1,697,646	2,153,189	2,939,900	3,415,902
REIMBURSABLE	32,781	31,500	34,400	38,850
GRAND TOTAL	1,730,427	2,184,689	2,974,300	3,454,752

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RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
TOA Summary by Defense Agency
(Dollars in Thousands)

AGENCY	FY 1982 ACTUAL	FY 1983 ESTIMATE	FY 1984 ESTIMATE	FY 1985 ESTIMATE
DEFENSE MAPPING AGENCY	23,034	70,300		
DEPARTMENT OF DEFENSE (OSD AND OASDS)	20,900	23,189	33,200	42,453
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY	675,462	729,600	867,700	996,700
NATIONAL SECURITY AGENCY				
DEFENSE NUCLEAR AGENCY	259,407	315,000	330,500	385,470
DEFENSE RECONNAISSANCE SUPPORT PROGRAM				
DEFENSE COMMUNICATIONS AGENCY	106,410	105,925	92,800	83,845
DEFENSE INTELLIGENCE AGENCY				
DEFENSE LOGISTICS AGENCY	17,774	20,000	24,600	28,477
UNIFORMED SERVICES UNIVERSITY OF HEALTH SCIENCES	1,650	1,800	1,800	1,874
TOTAL RDT&E, DEFENSE AGENCIES	1,697,646	2,153,189	2,939,900	3,415,902
Director, Test & Evaluation, Defense	53,000	55,000	56,800	60,248
GRAND TOTAL	1,750,646	2,208,189	2,996,700	3,476,150

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DEFENSE MAPPING AGENCY

OFFICE OF THE SECRETARY OF DEFENSE /JOINT CHIEFS OF STAFF

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

NATIONAL SECURITY AGENCY

DEFENSE NUCLEAR AGENCY

DEFENSE RECONNAISSANCE SUPPORT PROGRAM

DEFENSE COMMUNICATIONS AGENCY

DEFENSE INTELLIGENCE AGENCY

DEFENSE LOGISTICS AGENCY

UNIFORMED SERVICES UNIVERSITY OF HEALTH SCIENCES

DIRECTOR OF TEST AND EVALUATION

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RESEARCH, DEVELOPMENT, TEST AND EVALUATION DEFENSE AGENCIES

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

DEFENSE MAPPING AGENCY

FY 1984

JANUARY 1984

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DEPARTMENT OF DEFENSE, MILITARY
DEFENSE MAPPING AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
SUMMARY BY BUDGET ACTIVITY

($ in Thousands)

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
1. Technology Base	-	-	-	-
2. *Advanced Technology Development*	-	-	-	-
3. Strategic Programs	-	-	-	-
4. Tactical Programs	-	-	-	-
5. Intelligence & Communications	23,034	70,300	123,500	
6. Defensewide Mission Support	-	-	-	
TOTAL RDT&E - DIRECT	23,034	70,300	123,500	
Reimbursements	5,475	2,000	2,000	
TOTAL PROGRAM	28,509	72,300	125,500	

DEPARTMENT OF DEFENSE, MILITARY
DEFENSE MAPPING AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
SUMMARY BY PROGRAM CATEGORY

($ in Thousands)

		FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
6.1	Research	-	-	-	-
6.2	Exploratory Development	-	-	-	-
6.3	Advanced Development	15,787	16,993	16,384	16,293
6.4	Engineering Development	6,247	7,052	5,819	8,546
6.5	Management and Support	-	-	-	-
	Total Research & Development (Program 6)	22,034	24,045	22,203	24,839
	Total Operational Systems Program	-	-	-	-
	Total Intelligence & Communications (Program 3)	1,000	46,255	101,297	
	Total RDT&E - Direct	23,034	70,300	123,500	
	Reimbursements	5,475	2,000	2,000	2,000
	TOTAL PROGRAM	28,509	72,300	125,500	

DEPARTMENT OF DEFENSE, MILITARY
DEFENSE MAPPING AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
DETAILS BY BUDGET ACTVITY

($ in Thousands)

			FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Descriptive Summary Page No.
5. Intelligence & Communications							
Element Code	Project No.	Title					
3.51.59.B		DEFENSE RECONNAISSANCE SUPPORT PROGRAM (DRSP)	1,000	46,255	101,297		
	Subtotal, DRSP		1,000	46,255	101,297		
6.3	ADVANCED DEVELOPMENT						
6.37.01.B		MC&G INVESTIGATIONS AND PROTOTYPE DEVELOPMENT	15,787	16,993	16,384	16,293	
	Subtotal, Advanced Development Category		15,787	16,993	16,384	16,293	
6.4	ENGINEERING DEVELOPMENT						
6.47.01.B		MC&G DEVELOPMENT ENGINEERING AND TESTS	6,247	7,052	5,819	8,546	
	Subtotal, Engineering Development Category		6,247	7,052	5,819	8,546	
	TOTAL, Intelligence & Communications		23,034	70,300	123,500		

FY 1984 RDT&E DESCRIPTIVE SUMMARY

(U) Program Element: # 35159B

(U) Title: Defense Mapping Agency (DMA) Support
Defense Reconnaissance Support Program (DRSP)

(U) USDR&E Mission Area: # 321

(U) Budget Activity: #5 - Intelligence & Communications

A. (S) RESOURCES: ($ in Thousands).

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1000	46255*	101297		Continuing	N/A
A.	Acquisition Systems Development	1000	17355	21678			
B.	Exploitation Modernization Development		28900	79619			

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED. During FY 1982, DMA established a new component, the Special Program Office for Exploitation Modernization (SPOEM), whose mission is to develop the capability to produce DMA products by digital/softcopy techniques from advanced acquisition systems and enhance production capabilities to utilize hardcopy source material from a new collection system. The description of the funding planned for this program element and projects is at a higher classification level and contained in the Tactical Intelligence and Related Activities (TIARA), Defense Reconnaissance Support Program (DRSP) Vol. VI, Congressional Justification Book (CJB.)

*Does not include $17.8 million financed in Program Element 35159I

gram Element: # 35159B (Con't) (U) Title: Defense Mapping Agency (DMA) Support
Defense Reconnaissance Support Program (DRSP)

R&E Mission Area: # 321 (U) Budget Activity: #5 - Intelligence & Communications

	FY 1982	FY 1983	FY 1984	FY 1985
Procurement	-	4877	5229	
O&M	-	7016	9624	

FY 1984 RDT&E DESCRIPTIVE SUMMARY

(THIS SUMMARY IS UNCLASSIFIED)

Program Element: # 63701B

Title: Mapping, Charting and Geodesy (MC&G) Investigations and Prototype Development

USDR&E Mission Area: 321

Budget Activity: #5 - Intelligence & Communications

A. RESOURCES (PROJECT LISTING): ($ in Thousands).

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	15787	16993	16384	16293	Continuing	N/A
A.	Geodesy, Geophysics and Related Data Collection	5225	7562	7640	7558		
B.	Imagery/Feature Analysis and Data Base Management	2949	4055	4084	4496		
C.	Automated Cartography	864	718	618	604		
D.	Computer Science	3214	2053	1226	885		
E.	Hydrography	2717	908	806	785		
F.	Radar, Sensor Simulation and Terrain Analysis	280	862	940	743		
G.	Graphic Arts	538	835	1070	1222		

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: DMA's primary mission is to support the Unified and Specified Commands and the Military Services by providing MC&G products and services that are critical to successful military operations. The DMA RDT&E program is designed to continuously increase the capabilities of the DMA Production Centers so that they may rapidly and effectively satisfy the current and projected DoD MC&G requirements. Specifically, PE # 63701B provides the broad based RDT&E program for investigations and prototype developments necessary to meet MC&G requirements in the near term as well as the long range time frame.

Program Element: # 63701B (Con't)

Title: Mapping, Charting and Geodesy (MC&G) Investigations and Prototype Development

USDR&E Mission Area: # 321

Budget Activity: #5 - Intelligence & Communications

C. BASIS FOR FY 1984 RDT&E REQUEST: The FY 1984 reques will provide for DMA's on-going exploitation of the more promising technological developments with major emphasis on the continuous automation of DMA's production processes and facilities. Up to FY 1983, this program element included all advanced developments of the emerging DMA Digital Production System. In FY 1982, DMA established a new component, the Special Program for Exploitation Modernization (SPOEM), whose mission is to develop a pilot digital exploitation system, and where possible, to integrate prototype components into DMA's current production system. The thrust of this program element (PE # 63701B) is to (1) continue with those developments required to more fully automate the MC&G data extraction process and the development of optimum spatial data bases, (2) continue with on-going developments in satisfying current MC&G requirements, and (3) continue with developments of new capabilities to produce new MC&G products.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: There is a decrease of $2.2 million in the above cost estimates for FY 1984 as compared to the same data in the FY 1983 Descriptive Summary. The estimates made in the FY 1983 Descriptive Summary included investigations and developments of prototype components for DMA's expanding digital production system. This work effort has been transferred to DMA's Special Program Office for Exploitation Modernization. (See DMA Descriptive Summary for PE # 35159B.)

E. OTHER APPROPRIATION FUNDS. N/A

Program Element: # 63701B (Con't) Title: Mapping, Charting and Geodesy (MC&G) Investigations and Prototype Development

USDR&E Mission Area: #321 Budget Activity: #5 - Intelligence & Communications

F. DETAILED BACKGROUND AND DESCRIPTION. This program element is a continuous on-going RDT&E effort within DMA. The projects are directed toward developing and maintaining a broad based RDT&E MC&G program to ensure productivity, responsiveness and flexibility in meeting DoD's MC&G requirements. Automated/computerized production techniques, essential in improving MC&G product generation efficiency, are developed, particularly in the application of digital technology and in the labor intensive areas. Specifically, critical developments are pursued in the areas of advanced feature/imagery analysis, digital algorithms and processing techniques, data base storage and management, and wideband communication. A major segment of the program provides for continuous Geodetic and Geophysical (G&G) developments, including related data collection systems, which will provide the necessary positional, gravitational and navigational data required to ensure the effectiveness of ICBM and SLBM systems. (See DMA Descriptive Summary for PE # 63701B, Project #A, Geodesy, Geophysics and Related Collection Activities.) Other significant project activities include:

1. Developments in improving hydrographic data collection related to coastal bathymetry, detection of navigation hazards, and remote sensing techniques, e.g., the Hydrographic Airborne Laser Sounder (HALS.)

2. Developments in sensor image simulations/data base simulations for portraying the earth's positions and topographic/terrain characteristics in support of new weapons sensor simulators and command and control systems.

3. Development of an interactive clustered cartographic system for processing and editing Digital Feature Analysis Data (DFAD.)

4. Developments in the assessment of feature extraction processes in softcopy/digital domain and the various algorithms that support the softcopy extraction.

5. Development of a digital map reproduction capability as well as improvements in graphic (hardcopy) production and display processes.

6. Development of an optical character recognition system to provide DMA with the capability to digitize and identify, by computer/automated techniques, a wide variety of symbols involved in DMA's production system.

7. Upgrading the hardware and software of the Remote Work Processing Facilities (RWPF) at DMA Production Centers to more efficiently test and evaluate digital technology for use in DMA's emerging digital production system, including algorithm implementation on the upgraded RWPF, and to develop a training program for techniques and production personnel in exploitation of softcopy source materials for MC&G products.

8. Continued development of an experimental digital facility (EDIF) to provide a test-bed for demonstrating the feasibility of digitally producing MC&G products in a laboratory environment.

G. RELATED ACTIVITIES. Defense Research Sciences Exploratory Development programs are conducted by the Army, Navy and Air Force laboratories to support continuing evolutionary development of equipment and techniques. The Director, Defense Mapping Agency (DMA), as Program Manager for DoD Mapping, Charting and Geodesy, maintains cognizance of these programs to assure that efforts are directed toward valid capability development objectives and to preclude unwarranted duplication.

H. WORK PERFORMED BY. U.S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia; Naval Ocean Research and Development Activity, Bay St. Louis, Mississippi; U.S Air Force Rome Air Development Center, Griffiss Air Force Base, Rome, New York; Air Force Geophysics Laboratory, Hanscom AFB, Massachusetts; Naval Surface Weapons Center, Dahlgren, Virginia; Naval Sea Systems Command, Washington, D.C.; Defense Advanced Research Projects Agency, Arlington, Virginia; and Aerospace Corporation Los Angeles, California.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS.

1. FY 1982 Accomplishments. With the exception of the RWPF upgrade (started in FY 1983), progress in all of the investigations and prototype developments described above in paragraph F. was made in FY 1982. Efforts completed represent various stages of modifications and improvements in existing production processes with the implementation of additional automation in support of DMA's emerging digital production system; system hardware/software designs, tests, evaluations and implementation of accepted developments; and analyses and evaluations of the current and future DMA Production Systems to determine the most feasible ways to improve MC&G source data collection, data processing and product generation eifficiency.

Program Element: # 63701B (Con't) Title: Mapping, Charting and Geodesy (MC&G) Investigations and Prototype Development

USDR&E Mission Area: # 321 Budget Activity: # 5 - Intelligence & Communications

2. FY 1983 Program. The major developments described above in paragraph F. will be continued during FY 1983. The RWPF upgrade will be initiated to maintain momentum of digital technology transfer. Software/hardware developments will continue within the constraints of the existing RWPF. The clustered cartographic processing system will be phased into production by the end of FY 1983. New initiatives in developing a digital map reproduction capability in DMA will be started. This effort will address the software development requirements for digital color proof and the digital laser platemaker. Also, a new initiative to develop an automated system for combining film negatives for reproducing colors will be undertaken.

3. FY 1984 Program. The major developments described above in paragraph F. will be continued during FY 1984. A system sensor image simulation (SIS) application software package will be completed and become operational during this year. Considerable emphasis will be placed on the RWPF upgrade and other developments to facilitate the application of digital technology in DMA's production processes, including the development of algorithms to improve the accuracy of digital image correlations. Software for the maintenance of the Clustered Cartographic Processing System will be developed. Basically, this year will be a follow-on of the FY 1983 program.

4. Program to Completion. This is a continuing program element.

5. Milestones. N/A. This is a continuing program element.

6. Explanation of Milestone Changes. N/A

J. TEST AND EVALUATION DATA. N/A

Project: # A
Program Element: # 63701B

Title: Geodesy, Geophysics and Related Data Collection Mapping, Charting and Geodesy (MC&G) Investigations and Prototype Development

USDR&E Mission Area: # 321

Budget Activity: # 5 - Intelligence & Communications

F. DETAILED BACKGROUND AND DESCRIPTION.

1. User requirements for geodetic and geophysical (G&G) support are constantly increasing with an attendant requirement to improve the accuracy of existing G&G data in support of emerging and more sophisticated weapons systems. Rapid and economical methods of satisfying these requirements must significantly precede weapons systems developments to prevent geodetic and geophysical limitations on system CEP (circular error probable) and flexibility. The activities in the G&G project provide the necessary RDT&E developments to ensure the effectiveness of ICBM and SLBM systems. In support of these systems, DMA is required:

(a) to collect MC&G data using advanced sensors and satellite technology,

(b) to produce launch and target positions, including astro-geodetic deflection of the vertical,

(c) to provide navigation checkpoints, and

(d) to provide measurements of the earth's gravitational field.

2. In direct support of the G&G related collection activities, satellite technology such as the Global Positioning System (GPS) is fully exploited by DMA to meet and exceed the capabilities of existing methods for obtaining accurate and efficient geodetic measurements. Also, a major advanced sensor/G&G data collection capability is being undertaken by DMA; it is the development of two moving base gravity gradiometers to perform surface and airborne gravity surveys. Significant applications of these instruments for future strategic weapons systems is expected.

3. Other G&G tasks being developed include:

(a) an active/passive airborne bathymetry data collection system using a multispectral scanner with laser calibrations,

(b) a high accuracy field deployable inertial survey system to determine latitude, longitude and azimuth,

(c) a GPS ephemeris generation capability to support geodetic receiver development and other related research utilizing GPS, and

(d) a DoD data processing system for GEOSAT, a radar altimeter satellite, which will generate precision orbits, reduce the satellite data to geophysical parameters, make environmental corrections and distribute the geophysical data to DoD users.

G. RELATED ACTIVITIES. Defense Research Sciences Exploratory Development programs are conducted by the Army, Navy and Air Force laboratories to support continuing evolutionary development of equipment and techniques. The Director, Defense Mapping Agency (DMA), as Program Manager for DoD Mapping, Charting and Geodesy, maintains cognizance of these programs to assure that efforts are directed toward valid capability development objectives and to preclude unwarranted duplication.

H. WORK PERFORMED BY. U.S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia; Naval Surface Weapons Center, Dahlgren, Virginia; U.S. Naval Oceanographic Office, Bay St. Louis, Mississippi; Naval Sea Systems Command, Washington, D.C.; and Air Force Geophysics Laboratory, Hanscom AFB, Massachusetts.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS.

1. FY 1982 Accomplishments. Successful launch of the first GPS package (GPSPAC), a satellite receiver designed by DMA, was accomplished in FY 1982. The GPSPAC was launched aboard the NASA LANDSAT-D satellite, and the subsequent reduction of orbital information was accomplished by using software also developed by DMA under this R&D project. Progress was made toward the delivery of the prototype GPS geodetic ground receiver and development of the moving base gravity gradiometers.

2. FY 1983 Program. The GPS geodetic receiver program will be completed during FY 1983, with delivery of the first unit in the second quarter of FY 1983. The Gravity Gradiometer Survey System designed to perform large area gravity surveys from airborne platforms will be further developed, and a contract to develop and test the gradiometer will also be awarded during the second quarter of FY 1983. Operational testing of a precise GPS ephemeris generation capability being developed by DMA will be undertaken during the year.

Project: # A (Cont'd) Title: Geodesy, Geophysics and Related Data Collection
Program Element: # 63701B Title: Mapping, Charting and Geodesy (MC&G) Investigations and Prototype Development
USDR&E Mission Area: # 321 Budget Activity: #5 - Intelligence & Communications

3. FY 1984 Program. Further development of the Gravity Gradiometer Survey System will be a major G&G effort during FY 1984. With the delivery of the first system (planned for FY 1985), DMA's gravity collection capability will be revolutionized. Larger areas of gravity data will be collected in a more efficient manner and at a higher degree of accuracy. A GEOSAT Altimetry Satellite will be launched in FY 1984, and large scale data reduction support will be undertaken using software being developed. Also, the first GPSPAC mission will be completed and a performance evaluation will be conducted to establish the baseline performance for future GPS missions. Other on-going efforts will include:

(a) technique developments in the area of inertial positioning which will define specifications for future inertial positioning systems,

(b) astro-geodetic surveying developments to improve positional accuracy and automate the labor intensive surveying techniques,

(c) developments to improve methods of computing satellite orbits used for geodetic positioning,

(d) development of a world geodetic model to obtain a more precise geodetic reference frame, and

(e) other geodetic/geophysical activities in support of DoD advanced weapons systems development.

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

5. Milestone: N/A. This is a continuing project.

6. Explanation of Milestone Changes: N/A

J. TEST AND EVALUATION DATA: N/A

FY 1984 RDT&E Descriptive Summary

(THIS SUMMARY IS UNCLASSIFIED)

Program Element: # 64701B

Title: Mapping, Charting and Geodesy (MC&G) Engineering Development and Test

USDR&E Mission Area: # 321

Budget Activity: #5 - Intelligence & Communications

A. RESOURCES (PROJECT LISTING): ($ in Thousands).

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6247	7052	5819	8546	Continuing	N/A
A.	Geodesy, Geophysics and Related Data Collection	439	282	255	387		
B.	Imagery/Feature Analysis and Data Base Management	622	1759	1194	1482		
C.	Automated Cartography	3527	3823	2603	3430		
D.	Computer Science	297	282	915	1976		
E.	Hydrography	158	108	135	203		
F.	Radar, Sensor Simulation and Terrain Analysis	1089	736	664	978		
G.	Graphic Arts	115	62	53	90		

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: DMA's primary mission is to support the Unified and Specified Commands and Military Services by providing MC&G products and services that are critical to successful military operations. The DMA RDT&E program is designed to continuously increase the capabilities of the DMA Production Centers so that they may rapidly and effectively satisfy the current and projected DoD MC&G requirements. Further, this element provides necessary follow-on engineering development and test of systems and equipment originating in PE # 63701B to meet MC&G RDT&E requirements in the near term as well as the long range time frame.

Program Element: # 64701B (Con't) Title: Mapping, Charting and Geodesy (MC&G) Engineering Development and Test

USDR&E Mission Area: # 321 Budget Activity: # 5 - Intelligence & Communications

C. BASIS FOR FY 1984 RDT&E REQUEST: The FY 1984 request will provide for DMA's on-going exploitation of the more promising technological developments with major emphasis on the continuous automation of DMA's production processes and facilities. Up to FY 1983, this program element included all advanced developments of the emerging DMA Digital Production System. In FY 1982, DMA established a new component, the Special Program Office for Exploitation Modernization (SPOEM), whose mission is to develop a pilot digital exploitation system, and where possible, to integrate prototype components into DMA's current production system. The thrust of this program element (PE # 64701B) is to (1) continue with those developments required to more fully automate the MC&G data extraction process and the development of optimum spatial data bases, (2) continue with on-going developments in satisfying current MC&G requirements, and (3) continue with developments of new capabilities to produce new MC&G products.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY. There is a decrease of $6.8 million in the cost data estimate for FY 1984 as compared to this estimate in the FY 1983 Descriptive Summary. The estimates made in the FY 1983 Descriptive Summary included engineering developments and test of components for DMA's expanding digital production system. This work effort has been transferred to DMA's Special Program Office for Exploitation Modernization (SPOEM) which has recently been established to implement the digital system. (See DMA Descriptive Summary for PE # 35159B.)

E. OTHER APPROPRIATION FUNDS. N/A

7. Development of computer intelligence software for accessing and extracting files and other knowledge from existing data base for specific DMA products, e.g., the Automated Airfield Information File (AAFIF) and Terrain Analysis Trafficability Maps.

8. Development of Inertial Positioning System (IPS) field survey hardware and software capable of determining the deflection of the vertical and other geodetic parameters to meet requirements of advanced DoD weapons systems.

9. Development of a comprehensive digital cartographic technology to provide an efficient and error-free manipulation of image and symbolic information in visual and data base formats for a wide variety of production functions which require analog (graphic) data input, display and information retrieval.

10. Generation of an improved radar reference scene to be used in the PERSHING II missile terminal guidance system, referred to as PRESS (Pershing Reference Scene System.)

G. RELATED ACTIVITIES. Defense Research Sciences Exploratory Development programs are conducted by the Army, Navy and Air Force laboratories to support continuing evolutionary development of equipment and techniques. The Director, Defense Mapping Agency (DMA), as Program Manager for DoD Mapping, Charting and Geodesy, maintains cognizance of these programs to assure that efforts are directed toward valid capability development objectives and to preclude unwarranted duplication.

H. WORK PERFORMED BY. U.S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia; Naval Ocean Research and Development Activity, Bay St. Louis, Mississippi; U.S. Air Force Rome Air Development Center, Griffiss Air Force Base, Rome, New York; Air Force Geophysics Laboratory, Hanscom AFB, Massachusetts; Naval Surface Weapons Center, Dahlgren, Virginia; Naval Sea Systems Command, Washington, D.C.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS.

1. FY 1982 Accomplishments. With the exception of the rapid coordinate transformation device, the on-going developments described above in paragraph F. were advanced during FY 1982. Specific digital data processing techniques and prototype components for DMA's Digital Production System were further developed, specifically, advancements in the design of a universal rectifier for digital imagery from electro-optical sensor systems and a digital stereo comparator/compiler for use in DMA Production Centers.

Program Element: # 64701B (Con't) Title: Mapping, Charting and Geodesy (MC&G) Engineering Development and Test

USDR&E Mission Area: # 321 Budget Activity: # 5 - Intelligence & Communications

F. DETAILED BACKGROUND AND DESCRIPTION. On-going engineering developments and testing of MC&G equipment and systems are pursued to improve DMA production capabilities in support of current and future MC&G requirements. Emphasis will be placed on expanding automation in the production areas that are labor intensive and in areas that are being upgraded with digital technology; MC&G feature extraction improvements (digital and analog); radar scene/data base generation; advance computerized production techniques; and enhancements for improved geodetic positioning. Major project activities include:

1. Development of various system components/equipment for improved terrain analysis. The end product will provide DMA with a capability to digitally produce and revise a terrain analysis data base and derivative products.

2. Development of a comprehensive integrated cartographic production operations at DMA Production Centers. Implementation will include a computer simulation of present and projected cartographic systems with the simulation used to optimize production flow.

3. Development of a source assessment system which will provide DMA with an automated capability to compare, evaluate and upgrade existing cartographic products and data base materials with new sources of data (maps, charts, imagery, digitally formatted data.)

4. Development of a cartographic compilation/revision system which will accommodate the initial compilation of new chart products and the recompilation/revision of existing chart products. The system is to automate, to the fullest extent possible, the basic compilation functions of feature identification, feature selection and feature delineation.

5. Implementation of new digital techniques on the Remote Work Processing Facility (RWPF) located at each DMA Production Center. The RWPF was established by DMA to test and evaluate emerging digital technology.

6. Development of a rapid coordinate transformation device which can be readily interfaced with a variety of mini computer systems within the DMA Production System. The device will augment existing systems to speed up and relieve computation-bound processes.

2. FY 1983 Program. The major developments described above in paragraph F. will be continued during FY 1983. The development of the rapid coordinate transformation device will actually be initiated during this year. The continuous upgrading of automated processes and equipment to facilitate the application of digital technology within DMA's Production System will receive major emphasis during FY 1983.

3. FY 1984 Program. All of the major developments described above in paragraph F. will be continued during FY 1984. Emphasis will continue to be placed on automation, upgrading equipment and systems to validate the application of digital technology, and developing new production subsystems and techniques that will be required by the DMA Production System in the near term and long range.

4. Program to Completion. This is a continuing program element.

5. Milestones. N/A. This is a continuing program element.

6. Explanation of Milestone Changes. N/A

J. TEST AND EVALUATION DATA. N/A

RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS
OF THE OFFICE OF THE SECRETARY OF DEFENSE RESEARCH AND DEVELOPMENT PROGRAM

FY 1984

JANUARY, 1984

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PROGRAM ELEMENT DESCRIPTIVE SUMMARIES

INTRODUCTION AND EXPLANATION OF CONTENTS

1. General. This program, which contains six program elements, provides technical and general support to the Office of Secretary of Defense and the Organization of the Joint Chiefs of Staff.

2. Comparison of FY1982 and FY1983 Data:

FY1982:

Program Element	Title	Previous Year Data	Current Year Data	Remarks
PE65104D	Technical Support to Under Secretary of Defense (Research and Engineering)	12,100	12,100	No change
PE65106D	General Support to Program Analysis and Evaluation	2,200	2,200	No change
PE65107D	General Support for Policy	2,100	2,100	No change
PE65108D	General Support for Net Assessment	1,900	1,900	No change
PE65109D	General Support for Manpower Reserve Affairs and Logistics	2,600	2,600	No change
PE01015D	Technology Transfer and Control	-	-	No change
	Total	20,900	20,900	

FY1983:

Program Element	Title	Previous Year Data	Current Year Data	Remarks
PE65104D	Technical Support to Under Secretary of Defense (Research and Engineering)	16,649	11,013	Congressional reduction
PE65106D	General Support to Program Analysis and Evaluation	3,712	1,835	Congressional reduction
PE65107D	General Support for Policy	4,419	3,294	Congressional reduction
PE65108D	General Support for Net Assessment	4,006	3,212	Congressional reduction
PE65109D	General Support for Manpower Reserve Affairs and Logistics	3,014	1,835	Congressional reduction
PE01015D	Technology Transfer and Control	-	2,000	New program established by Congressional Action
	Total	31,800	23,189	

3. Relationship of FY1984 Budget Structure to the FY1983 Budget approved by Congress

Program Element		Remarks
PE0105D	Technology Transfer and Control	New Program element resulting from Congressional action

4. Classification: [Unclassified]

DEPARTMENT OF DEFENSE - MILITARY
SUPPORT TO SECRETARY OF DEFENSE ACTIVITIES AND ORGANIZATION OF THE JOINT CHIEFS OF STAFF
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES

SUMMARY BY BUDGET ACTIVITY
($ in Thousands)

	FY1982 ACTUAL	FY1983 ESTIMATE	FY1984 ESTIMATE	FY1985 ESTIMATE
6. Programwide Management & Support	20,900	23,189	33,200	42,453
TOTAL RDT&E - Direct	20,900	23,189	33,200	42,453
Reimbursements	257	1,500	1,500	1,500
TOTAL PROGRAM	21,157	24,689	34,700	43,953

DEPARTMENT OF DEFENSE - MILITARY
SUPPORT TO SECRETARY OF DEFENSE ACTIVITIES AND ORGANIZATION OF THE JOINT CHIEFS OF STAFF
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES

PROGRAM ELEMENT LISTING
($ in Thousands)

Element Code	Title	FY1982 ACTUAL	FY1983 ESTIMATE	FY1984 ESTIMATE	FY1985 ESTIMATE
6.5 MANAGEMENT AND SUPPORT					
65104D	Technical Support to OUSDR&E	12,100	11,013	15,932	22,141
65106D	General Support, PA&E	2,200	1,835	3,185	4,400
65107D	General Support, Policy/ISA	2,100	3,294	4,858	4,865
65108D	General Support, Net Assessment	1,900	3,212	4,337	4,938
65109D	General Support, MRA&L	2,600	1,835	2,688	4,141
01015D	Technology Transfer and Control	-	2,000	2,200	1,968
	Grand Total	20,900	23,189	33,200	42,453

FY 1984 DESCRIPTIVE SUMMARY

Program Element #65104D
Category Management and Support

Title: Technical Support
Budget Activity: #6 Defense Wide Mission Support

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY1982 Actual	FY1983 Estimate	FY1984 Estimate	FY1985 Estimate	Additional to Completion	Total Estimated Costs
	Total for Program Element	12,100	11,013	15,932	22,141	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Funds technical studies related to research, development, weapon system selection, and defense planning in support of the Office of the Under Secretary of Defense, Research and Engineering (including C^3I and AE) and the Organization of the Joint Chiefs of Staff. Studies are utilized to address the myriad of complex issues and dynamic problems facing the Department, both in the long and short run: examining and assessing the implications and consequences of current and alternative policies, plans, operations, strategies and budgets; understanding and gaining insight into the complex multifaceted technological, military, political, and acquisition environment in which future defense decisions and problems will be posed, considered, and made. Studies constitute an essential tool of management. They provide independent and objective analyses and new ideas for supporting the mission of the Department of Defense. The tasks identified (through a rigorous formal internal analysis) for accomplishment in FY 1984 have been selected on the basis of critical OJCS needs, technical complexity and anticipated value as input to JCS decisions or operations. The FY 1984 tasks in the study program will provide both direct and indirect support to the JCS. Direct support will be provided through information essential to the Joint Chiefs of Staff in their role as military advisors to the National Command Authorities. Indirect support will be in the form of new and improved methodologies and analytical tools--the foundation on which sound JCS decisions are made.

C. BASIS FOR FY 1984 REQUEST: Presently known and predicted defense issues and their impact on defense tactics, long range planning, and future weapon system requirements; key nuclear and chemical weapon issues; Congressionally-mandated program for continued Military Critical Technology List (MCTL) development, the integration of the MCTL into the export control process, including technical support of COCOM

FY 1984 DESCRIPTIVE SUMMARY

Program Element #65104D
Category Management and Support

Title: Technical Support
Budget Activity: #6 Defense Wide Mission Support

negotiations; to identify time phased mixes of C^3I systems that satisfy the needs of the weapons systems that they must support; plan and perform mission-oriented evaluations; perform technology assessments; and to identify promising technologies which may ameliorate existing deficiencies; assess alternative military plans programs and requirements; evaluate Defense Acquisition Policy/Strategy and Industrial Preparedness; long range acquisition planning to support defense strategy and policy development; options to improve the European Theater air command and control system; development of joint logistics and strategic mobility methodologies and evaluations; operational test and evaluation of strategic missiles; general purpose forces gaming improvements; systems options for improving joint tactical C^3 capabilities; war game models, impact and value of preimpact attack assessment information. The Organization of the Joint Chiefs of Staff (OJCS) has new as well as continuing or ongoing contract studies and analysis needs. These research tasks are designed to improve and enhance the planning and operational capabilities of the OJCS. The program will provide direct support to key decisionmaking personnel and will expand the information and knowledge base available to them for carrying out their functions.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: The FY 1984 program included herein differs from that presented in the FY 1983 Descriptive Summary in that: The FY 1983 program will emphasize architectural planning efforts in the area of strategic connectivity; improve the planning and execution of a mission-oriented evaluation of the C^3I weapon systems; develop techniques for improving capabilities to assess and enhance readiness; (focus more strongly on implementation of the MCTL in the export control process); newly emerging systems will be examined on an as-required basis; long range acquisition resource planning will be expanded to address the interrelationship of Defense long range plans with the National Economy and the production/capitalization planning in the defense industrial base and reinstitute net technical assessment. The FY 1984 study tasks will provide methodologies for more precise and comprehensive logistics and strategic mobility evaluations, more comprehensive capabilities assessments of integrated joint air, land, and naval forces operating over the full spectrum of conflict against postulated threats, and analysis supporting arms negotiations. The contract studies and analysis of the OJCS provide investigation of key issues about which concerns exist but for which the technical capabilities are either not available or are already fully utilized.

26 E. OTHER APPROPRIATION FUNDS: Not applicable to this P.E.

FY 1984 DESCRIPTIVE SUMMARY

Program Element #65104D
Category Management and Support

Title: Technical Support
Budget Activity: #6 Defense Wide Mission Support

F. DETAILED BACKGROUND AND DESCRIPTION: This program provides studies and analyses support to meet the needs of the Under Secretary of Defense, Research and Engineering, the Organization of the Joint Chiefs of Staff (OJCS). The key objective of the OUSDRE program is to provide detailed analyses, independent assessments and innovative ideas which assist planners and decisionmakers to use our appropriated resources more efficiently and with these resources improve the effectiveness of the deployed military forces. These funds are used to support the USDRE in the exercise of his responsibilities which include: (1) overall responsibility for the defense RDT&E program for acquisition policy; (2) development of an integrated long range strategy for the allocation and use of research, development and procurement resouces; (3) maintaining our technological superiority and translating our technologies into deployed military forces; (4) exploiting more fully the technological and industrial strengths of our allies, our own industrial base and our existing military forces and capabilities; (5) improving our understanding of the US/USSR technology balance and the impact of Soviet R&D and acquisition programs on our defense posture; and (6) meeting our export control responsibilities for arms and defense-related technologies. The statutory functions for the Joint Chiefs of Staff require the JCS to prepare plans, policies and doctrine and provide for the direction of operations by the unified and specified commands when directed by the Secretary of Defense. Their specific responsibilities include: (1) serving as the principal military advisers to the President, the NSC and the Secretary of Defense; (2) serving as military staff in the chain of operational command to the unified and specified commands; (3) providing strategic direction of the Armed Forces; (4) reviewing plans, programs and requirements; (5) providing US military representation to international security organizations, mutual defense boards, and commissions; and (6) provide statements of military requirements and strategic guidance for use in the development of budgets, military aid programs, industrial mobilization plans, and research and development programs. The studies and analyses performed for OSD/OJCS provide objective assessments for use in evaluating existing and proposed weapon systems, increasing force effectiveness, improving methods employed in force planning, and estimating the relative standing of selected US, NATO, and Soviet weapons technologies. The types of studies conducted include analytic comparisons of functionally similar weapon systems; analysis of the effectiveness of fire support, close air support and air defense; analysis of command and control systems; and the development of combat models for the support of force planning. The USDRE and the OJCS require such assistance, separate from the Service sponsors, to provide independent and objective basis for the selection of proper courses of action in carrying out their responsibilities.

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FY 1984 DESCRIPTIVE SUMMARY

Program Element #65104D
Category Management and Support

Title: Technical Support
Budget Activity: #6 Defense Wide Mission Support

G. RELATED ACTIVITIES: Other programs contributing to the effort are those studies, analyses, tests and evaluations policy and resource plans, and net assessments performed by the Army, Navy, Air Force, OSD Net Assessment, the Defense Intelligence Agency, other segments of OSD, and the CIA.

H. WORK PERFORMED BY: The Institute for Defense Analyses; RAND Corporation, RDA, MITRE, SAI; BETAC; EG&G; IBM, B-K Dynamics; LMI; the Analytic Science Corporation; System Planning Corporation; Logicon; GRC.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Program: The following major studies and analyses were performed: Development of a generic Environmental Impact Statement for a nuclear weapon storage facility; evaluation of the potential role of future special nuclear weapon designs in support of US intervention forces; assessment of vulnerability of US/NATO air bases and support facilities; estimates of costs and capabilities of appropriate area air defense systems; analysis of current data and mobilization potential of the US shipbuilding and support industries; development of quantitatively oriented framework for estimating the expected savings from the use of competition early in the production phase of (Army) weapon systems procurement; analysis to resolve specific issues in the effectiveness of air-to-air weapons; revision of the MCTL and implementation of the MCTL in the export control process; development of an integrated plan for integrating sensor, commo and data processing systems for European Theater; evaluation of the operational test program for strategic ballistic missile weapon systems; evaluation of logistic and mobility requirements; evaluation of cost and effectiveness measures for various chemical weapons systems; improve cost estimating for major weapon systems; computed mobilization requirements for Industrial Preparedness Planning; continued assessment of Space Shuttle performance improvement options; cruise missile penetration capabilities.

2. FY 1983 Program: Requirements for studies and analyses include: develop a mission-oriented evaluation of the C^3I weapons systems that support the air battle; generate an architectural plan for identifying and evaluating alternative options for C^3I support to theater nuclear forces; develop and

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evaluate alternative space-based systems configurations that would be supportive of hemisphere surveillance requirements and responsive to the needs of tactical commanders, develop indepth, technical support for US positions for upcoming international negotiations for multilateral control of technology and products of Soviet Bloc and continue work for development and implementation of the MCTL; continue assessment of competition as an acquisition strategy in procurement of selected weapon systems; continue analysis of air-to-air missile performance; and integrated anti-air warfare; continue analysis of alternatives to existing basing concepts for US/NATO Tactical Air Forces; investigate reinstitution of the construction of US Navy ships in US shipyards, examine performance and military value of nuclear versus non-nuclear surface combatant ships; evaluate alternative air support forces; examine low cost tactical weapon concepts; identify critical issues in OTH radars for maritime air surveillance; develop systems options for enhancing light divisions; alternatives for Joint Rapid Deployment Force (JRDF) air defense; assess ammunition production base balance and long term requirements study; determine optimized chemical weapon stockpile mix and examine safety, security, and command and control issues associated with chemical weapons; examine advanced command and control issues associated with chemical weapons; examine advanced command and control concepts for nuclear weapons; assess the military utility of a standoff, air delivered, earth penetrator, nuclear weapon system; assess critical material needs related to national security; design and develop a plan to test policies and procedures for mobilization/surging; focus on major acquisition plans; assess Space Shuttle issues and cruise missile survivability; explore emerging technologies on the combat capabilities of future aircraft.

3. FY 1984 and FY 1985 Programs: The anticipated study program will consist of: Studies and analyses comparing the use of long range missiles (S-A, A-A, S-S) with the uses of aircraft with short range weapons; long range surveillance and targeting systems and their capability to provide targeting information for advanced weapon systems; studies and analysis relevant to area air defense problems, as well as studies and analyses in the area of maritime AAW, ASW, strike warfare, defense of CVGB, projection of naval power; create an architectural plan identifying and evaluating options for enhancing connectivity to the strategic forces; initiate the planning and execution of a mission-oriented

FY 1984 DESCRIPTIVE SUMMARY

Program Element #65104D
Category Management and Support

Title: Technical Support
Budget Activity: #6 Defense Wide Mission Support

evaluation of the C^3I weapons systems that support the land battle in an integrated battlefield; support air defense modernization efforts by examining technological alternatives in an operational context; proceed with development and implementation of MCTL; improve nuclear accident response planning; examine major issues associated with employment of theater nuclear forces; improve capabilities for crisis management; improve the acquisition process; improve industrial preparedness policy and strategy; focus long range planning to meet future defense needs; examine issues associated with our ability to conduct protracted nuclear war.

4. Program to Completion: The study program is a continuing program.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65106D
DoD Mission Area: Management and Support

Title: General Support - PA&E
Budget Activity: #6 - Defensewide Management and Support

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2,200	1,835	3,185	4,400	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides the contractual costs to support technical studies on behalf of the Office of the Director, Program Analysis and Evaluation. ODPA&E provides independent analytical support to the Secretary on cost, effectiveness, choices between alternative weapon systems and force structures, and on issues in the development and evaluation of alternative defense programs. Thus, the problems confronting PA&E are not limited to a specific area but cover the entire defense spectrum.

C. BASIS FOR FY 1984 RDT&E REQUEST: Funds are required to support technical research and independent studies for use in analyzing and evaluating proposed and alternative defense programs to ensure that DoD programs are designed to accommodate operational requirements and promote the readiness and efficiency of the U.S. Armed Forces.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: Cost Data for FY 1983 reflects projects requiring new or more intensive treatment in FY 1983, and also many projects that were deferred because of reduced FY 1982 funding. Key examples are the investigation of US defense posture in potential trouble spots, alternative defense measures for management of potential crisis situations, and investigation of causes of cost growth of weapon systems.

E. OTHER APPROPRIATION FUNDS: None.

F. DETAILED BACKGROUND AND DESCRIPTION: These technical research studies are aimed at problem areas of DoD force planning and major force-oriented programs. The thrust of this research program is to serve one or more of the following key purposes: (1) develop new and improved methodologies to be used in evaluating alternative defense programs, force structures, and weapon systems acquisition; (2) examine critical technical problems across Service lines; (3) obtain independent and objective appraisals of critical problems; and/or (4) obtain technical expertise not available within DoD.

G. RELATED ACTIVITIES: Other programs related in part to this effort are technical studies by the Under Secretary of Defense for Research and Engineering, the Undersecretary of Defense for Policy, Defense Advanced Research Projects Agency, Defense Nuclear Agency, the organization of the Joint Chiefs of Staff, and the Army, Navy and Air Force.

Program Element: #65106D
DoD Mission Area: Management and Support

Title: General Support - PA&E
Budget Activity: #6 - Defensewide Management and Support

H. WORK PERFORMED BY: This work is managed by the Office of the Director, Program Analysis and Evaluation. Current contractors include The Analytical Sciences Corporation, Arlington, Virginia; Institute for Defense Analyses, Arlington, Virginia; Rand Corporation, Santa Monica, California; General Research Corporation, McLean, Virginia; Information Spectrum, Inc., Arlington, Virginia; Ramcor, Inc., Vienna, Virginia; Science Applications, Inc., Littleton, Colorado; Systems Planning Corporation, Arlington, Virginia; Tecolote Research, Inc., Santa Barbara, California; BDM, McLean, Virginia; Northrop Corporation, Hawthorne, California; CACI, Arlington, Virginia; TRW, Inc., McLean, Virginia; MITRE, McLean, Virginia; Decision Engineering, Pascagoula, Mississippi; and Information Management, Inc., Las Vegas, Nevada.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: Prior studies have produced better data and methodology for analyzing and evaluating alternative Defense programs and resource allocations. Cost savings and efficiencies of far greater significance than our small level of funding have resulted from previous studies. Continuing studies of defense industry overhead costs have identified the critical role of these costs in total weapon system acquisition programs and have permitted analysts to recommend the most efficient production rates thereby minimizing cost growth for aircraft weapon systems. These estimates led to better decision-making on controlling cost growth and have resulted in program redirections on programming resources. One independent assessment resulted in a program decision to increase the sortie rate of U.S. combat aircraft rather than buying new aircraft. In addition to the Air Force meeting force planning objectives in Europe, $500M was saved. Missile and radar data bases developed through this study program are vital to the recurring cost analysis of systems undergoing normal DSARC or special program reviews. As a direct result of analyses based on these data bases, the DSARC recently directed a program office to stop ongoing work on a major weapon system and conduct a new competition to find a cheaper way to accomplish acquisition objectives. The savings that ultimately will result from this decision are expected to be in the range of hundreds of millions of dollars. Other significant past accomplishments include technical studies of weapon effectiveness and capabilities; development of guidelines on parametric cost estimating relationships for new weapon systems for use by Service cost organizations; independent analyses of life cycle cost estimates for proposed systems; development of methodology to evaluate strategic force program alternatives; evaluation of the survivability of forces; the modification and application of mathematical models for examining the deployment of US forces in various scenarios; development of comparable performance data for US, USSR, and free world foreign combat aircraft; development of models to estimate the reinforcement capability of Warsaw Pact forces; and analyses of comparative force balances.

2. FY 1983 Program: The FY 1983 program continues the emphasis for improved understanding, data and methodologies for analyzing and evaluating technical issues and alternative defense programs. Research and studies are being conducted of a space defense system that could survive during conventional and nuclear warfare. Research is continuing to develop improved methodology for estimating the cost of proposed weapon systems and to provide independent analyses of cost estimates. Studies are being made of alternative force deployments and programs in foreign areas including particularly the readiness and vulnerability of forces. Studies are also underway to examine alternative general purpose force structures in the areas of land, naval, and tactical air.

Program Element: #65106D
DoD Mission Area: Management and Support

Title: General Support - PA&E
Budget Activity: #6 - Defensewide Management and Support

3. FY 1984 Planned Program: The planned program for FY 1984 reflects the increasing demand for independent technical research, studies and advice on complex and controversial programs. Research studies are planned of strategic offensive and defensive programs including alternative means of supporting US forces and comparisons of the utility and cost of the alternatives. Research will be conducted to develop better methods and data for estimating development hardware and design costs. Independent analyses will be obtained of proposed new weapon systems. Research is planned for unique problems that affect defense program costs such as development of a model covering production and component costs (i.e. base material, subcontracted items, material average (quality assurance and scrap), miscellaneous materials, touch labor (FAIT), maintenance labor, manufacturing support labor, engineering support labor, quality assurance labor, and program management) to be used in estimating costs of components as a function of the costs of other components and production costs as a function of RDT&E prototypes. Independent research and studies will be made of alternative force mixes and the readiness of forces in foreign areas. In the area of general purpose forces, research will be conducted to develop better methods to evaluate alternative force structures and weapon system effectiveness particularly in support of DSARC and Program Reviews and to compare alternate weapon systems.

4. FY 1985 Planned Program: The FY 1985 program will continue the emphasis on developing better understanding, data and methodologies for use in analyzing and evaluating alternative force structure, weapons acquisition programs, and resource allocation. Specific projects are not yet identified, but the program will give emphasis to technical issues and program issues which will become critical for decision at that point in time.

5. Program to Completion: This is a continuing program to improve the technical and analytical base and methods used in the analysis and evaluation of alternative defense programs and weapon systems.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

:lement: #65107D
:gory: Management and Support

Title: General Support-Policy
Budget Activity: #6 Programwide Management and Support

:RCES (Project Listing): ($ In Thousands)

Under Secretary of Defense (Policy)	FY 1982 Actual	FY 1983 Program	FY 1984 Estimate	FY 1985 Estimate	Add'l to Completion	Total Est. Costs
Total For Program Element	2,100	3,294	4,858	4,865	Continuing	Continuing

DESCRIPTION OF ELEMENT: The funds provided to this program element support military interdepartmental studies and policy research projects on national security issues under the cognizance of the Under Secretary of Defense (Policy). ıl requirements of all DoD Policy staff components except the Director, Net Assessment, are included in this request.

S FOR FY 1984 RDT&E REQUEST: This consolidated request is intended to provide the Under Secretary of Defense (Policy), stant Secretary (International Security Policy), the Assistant Secretary (International Security Affairs) and subsidiary nponents with independent, expert technical assessments and analysis of policy opions on subjects for which DoD does in house expertise. The request is based on a research agenda reflecting the USD(P)'s priority concerns: improvements fense posture and mobilization base with respect to Soviet strategic and conventional threats; correlation of US forces, ınd strategy; enhanced security measures to assure continuing access to energy sources and strategic materials; ening of NATO political cohesion and commitment to force improvements; revitalization of regional collective security ties and commitments and improved sensitivity of DoD to the costs associated with alternative policies and strategies. ırea, research funded under the program provides analytical capabilities only when DoD or other USG staff capabilities equate. Research is obtained from public and private universities, research institutes, and firms whose perspectives er from those of DoD, thus providing a wide range of inputs to policy development. This research complements rather laces in-house analysis. This request does not include personal services consulting.

ARISION WITH FY 1983 DESCRIPTIVE SUMMARY: The FY 1984 program is intended to continue support at the FY 1983 effort adjusted for inflation, for new starts, plus continuity funding for multi-year studies, reflecting a ongoing support to multi-year research programs associated with the Department's effort to (1) align policy and with the actual strategic and conventional power projection capabilities of US forces in the near-term, and medium-to- longer-term force enhancements directly to the projected threat environment. Policy study funding for ınd FY 1984 continues to represent a modest collateral investment in overall resource planning, based on (1) improved ıts of the international politico-military environment, and (2) development of associated policy initiatives.

E. OTHER APPROPRIATION FUNDS: None.

F. DETAILED BACKGROUND DESCRIPTION: The FY 1984 Policy studies program has been developed on the basis of: (a) incremental funding requirements of existing contracts, (b) an assessment of new research requirements, particularly those that can be met by co-funding with other agencies and/or through competition. (c) evaluation of available staff assests, results from prior year programs and work sponsored by other agencies and (d) a desire to support a balanced and responsive program that supplements basic research on future policy directions with analytical support on near-term issues. The program continues to stress interdisciplinary study efforts, developing new information, articulating varied perceptions of defense issues and options, and evaluating differing policy options. Management of the program is subject to USD(Policy) review and approval, and is guided by the following criteria:

- Validated utility of anticipated findings for the policy development requirements of the staff component requesting the study,
- Demonstrated relevance of research to the overall mission of the Office of the Under Secretary (Policy),
- Anticipated contribution of research results to effective forecasting of security requirements,
- Technical feasibility, including access to required information sources,
- Priority of subject matter,
- Non-availability of research from other sources, including staff analysis,
- Propriety of DoD sponsorship (as opposed to sponsorship by other agencies),
- Economy and efficiency of research approach, and
- Prospects for economies and efficiencies elsewhere in DoD as a result of studies conducted under the USD(P) program.

G. RELATED ACTIVITIES: The Policy Research program is developed with an awareness of the results of, and plans for, relevant politico-military analyses performed by other DoD elements, e.g., OSD Net Assessment, OASD(PA&E), OJCS and the military services, as well as studies of the State Department, intelligence community, ACDA, and non-government scholars. OUSD (Policy) co-funds research with other government agencies where a mutuality of substantive interest provides the opportunity to achieve additional economy and efficiency. To strengthen coordination of research planning and management in the politico-military area, OUSD (Policy) continues to participate actively in appropriate inter-departmental working groups and provides a single point of independent review for research requirements identified by sub-components. This process prevents duplication of effort within the Policy Research program and permits centralized prioritization of study requests generated at staff level.

H. WORK PERFORMED BY: The FY 1984 program is planned to be performed by a variety of organizations including academic study centers, commercial analytical organizations, not-for-profit organizations, Federal Contract Research Centers, and selected DoD elements having research capabilities relevant to OUSD (Policy) needs. Research organizations presently performing studies and potential organizations representing the range available for selection in FY 1984 include: the Rand Corporation, Institute for Defense Analysis, Hudson, AISI, Stanford Research Institute, the National Defense University, US Military Academy, R&D Associates, Georgetown University, U.S. Air Force Academy, University of Southern California, and others. Once a project contractor is selected, a close working relationship is established between DoD staff personnel concerned with the results of the research and the contractor's technical staff. Senior DoD personnel (including the Under Secretary for Policy) participate directly in study task development and approval, in-process review, and the final evaluation and utilization of research results.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1983 and Prior Accomplishments: Recent policy studies reflect a change in USD(P) philosophy concerning the types of projects to which research resources should be applied. Previously, a number of Policy studies had a general, political science flavor, and addressed international issues of concern to DoD and other agencies. Although such studies broaden the perspective of decisionmakers, it is often difficult to identify the specific utility of findings with respect to more parochial defense concerns. In the past two years we have devoted an increasing share of our resources to (a) integrated analysis of politico/economic/military questions, and (b) shorter studies (both in terms of time to prepare and length of product), focusing on nearer-term (but not operational) questions. We believe study pay-offs have become more identifiable. Notable pay-offs include: better criteria for identifying the consequences of arms control alternatives, both in terms of U.S. mission responsibilities and verfication of Soviet compliance, better criteria for identification of ambiguous warning indicators, development of a technical data for evaluating technology transfer requests, including tighter controls on transfers of military-significant technologies to the Soviet Bloc, and better industrial mobilization planning and understanding of the economic consequences of transfers of resources to defense.

2. FY 1984 Planned Program: The program of studies proposed for FY 1984 represents a prioritized selection of presently identified external research requirements for OUSD(P) components exclusive of Net Assessment. The thrust of the program will be to create the analytical tools needed to insure long-term correlation between programs and policy. A description of studies now planned for FY 84, as well as continuing FY 82-83 projects requiring incremental funding, is attached.

Project Description/Contractor

	Actual ($ In Thousands) FY82 Program*	Planned ($ In Thousands) FY83 Program	Proposed ($ In Thousands) FY84 Program
1. Projects Completed (Total)	2,100	3,294	4,858
2. *Continuing Projects*			
	FY 82	FY 83	FY 84
a. Strategic Policy Research (Rand)	750	895	1,000
b. Integrated Long-Term Defense Strategy (Pan Heuristics)	800	300	1,000
c. TNF Doctrine and Force Levels (USC)	52	50	
d. Analysis of Soviet Declaratory Policy (Soviet Watch Program) (ACSI)	118	100	
e. NATO Burdensharing-Economic Analysis (USMA&USAFA)	7	7	7
New Projects for FY 1983 (New Start)			
a. U.S. Vulnerability to International Terrorism (TBS)		62	125
b. Long Term Policy Implications of Intrusive Verification (TBS)		60	60
c. Analytical Support for Strategic Forces Policy (ANSER)		100	150
d. Korea, The Great Powers and U.S.-Korean Policy in the 1980s (RAND)		120	120
e. Soviet Negotiating Strategies (TBS)		40	
f. Analysis of Ballistic Missile Throw-weight Constraints on U.S. Force Planning and Effectiveness (TBS)		50	50
g. Arms Transfer Policy Planning (SYCOR)		50	50

* (Projects will not total FY82 program because only those FY82 projects requiring FY83 or FY84 funding are listed)

Project Description/Contractor

3. New Projects for FY83 (Continued)

	FY 82	FY 83	FY 84
h. Sub-Saharan Africa Force Capabilities (TBS)		75	50
i. Foreign Offset and Coproduction Concessions (TBS)		60	60
j. U.S. Def. Aims (Rockwell International)		80	40
k. NATO Policy Development (TBS)		50	50
l. Security Aspects of Nuclear Proliferation (TBS)		116	
m. Critical Near East, and Asian Issues Workshop (TBS)		60	60
n. Analysis of Palestine Liberation Organization (TBS)		75	25
o. Net Assessment of U.S.-Soviet Security Assistance Outlays (TBS)		50	50
p. Sanctions as Non-proliferation Policy Tools (TBS)		50	45
q. Oil Supply Disruption Analysis (TBS)		80	40
r. Analysis of the Effects of Possible START Constraints on US Force Effectiveness (TBS)		70	50
s. Economic and Financial Vulnerability of Key LDCs (TBS)		70	
t. Support/Criteria Definition for Technology Transfer Controls (TBS)		50	148
u. Projected Patterns in Nuclear Technology Trade and Its Potential for Diversion to Nuclear Weapons Purposes (TBS)		75	
v. Central American Politico-Military Trends and their Implications for the United States (TBS)		80	70
w. Analysis of Telemetry Denial/Encryption Constraints for START (TBS)		70	50
x. Prospects for U.S. Policy in Southeast Asia (TBS)		100	120
y. Specific Verification Studies (2) (TBS)		50	30
z. Critical African Issues Workshop (TBS)		57	43

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oject Description/Contractor

3. New Projects for FY83 (Continued)

	FY 82	FY 83	FY 84
aa. Economic Competition with the USSR (TBS)		60	43
bb. Economic Mobilization (TBS)		22	
cc. Space Policy for the Shuttle Era (TBS)		60	30

4. New Projects for FY 1984 (NEW START)

a. Cruise Missile Mass Fire Option (TBS)	100
b. Base Rights Negotiations (TBS)	150
c. Muslim Impact in East Asia (TBS)	120
d. Coproduction Impact on Less Developed Countries (TBS)	70
e. Soviet Influence in Mexico (TBS)	85
f. Special Operations Forces (TBS)	103
g. Expatriate Presence in the Persian Gulf Region (TBS)	60
h. Security Assistance Programs in Africa Workshop (Battelle)	100
i. Project LINK Model Extension (Wharton Econometrics)	15
j. Allied Force Aging and the High Cost of U.S. Weapons Systems for Export (TBS)	25
k. Potential Security Challenges to the U.S. and Its Allies in Micronesia TBS)	166
l. The Semiconductor Industry and Its Implications for National Security (RFP)	30
m. Brazil - A World Power (TBS)	75
n. Use of Nuclear Devices By Terrorists (TBS)	125
o. An Eastern Caribbean Defense Force (TBS)	75

5. FY 1985 Planned Program: The FY 1985 program is expected to require funding at a level similar to that established for FY84. Level constant dollar funding during the period assumes a continued requirement for politico-military analysis with no increase in staff analytical capability. Most of the new projects for FY84 are costed incrementally. Portions of estimated "cost to complete" for such projects will occur in FY85. If the FY 1983 and FY 1984 programs develop as anticipated, the FY 1985 program will concentrate study resources in topical areas identified above. The Policy Study Program in part anticipates and in part responds to politico-military developments. To the extent allowed by stabilization of international regimes, we will attempt to reduce funding requirements for studies that respond to international developments.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65108D
DOD Mission Area: ____

Title: General Support to Net Assessment (OSD/NA)
Budget Activity: #6 Programwide Management and Support

A. RESOURCES: (PROJECT LISTING) ($ IN THOUSANDS)

Project Number	Title	FY 1982 Actual	FY 1983 Estimated	FY 1984 Estimated	FY 1985 Estimated	Additional to Completion	Total Estimated Cost
	TOTAL NET ASSESSMENT	1,900	3,212	4,337	4,938	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT: This element provides contractual support for the Office of the Secretary of Defense Net Assessment (OSD/NA). These funds are used to conduct net assessments or for studies to support assessments of military balances done for the Secretary of Defense to respond to his concerns about the balances, and to improve Net Assessment methodology. This element also developes assessments and studies for use in strategic planning and defense policy planning within OSD/DOD.

C. BASIS FOR FY 1984 RDT&E REQUEST: Provide for research and studies to support the determination of the military balance of the U.S. relative to potential adversaries and to aid in formulating appropriate defense issues, decisions, and policies. This program also supports the development of new methods and approaches to Net Assessment within DOD. The estimate recognizes the increasing demand for net assessment by the Executive Branch and the Congress, provides for development of improved methodologies for OSD/JCS and Service net assessments, and responds to net assessment related issues. Four balance areas are focused upon currently to provide net assessments for the Secretary of Defense -- NATO/Warsaw Pact (European Balance), East Asia Balance, Strategic Balance and Investment Balance.

- -- NATO/Warsaw Pact Balance: Effort has recently focused on the Northern Flank and the Soviet Assessment of NATO/Warsaw Pact Balance. An earlier comprehensive balance focused on the Central Front.
- -- An East Asia Assessment is being developed to describe the complex military situation including the China, USSR, Korea, Japan, and the U.S. A Korean Balance was previously completed for the SecDef.
- -- The Investment Balance assesses the U.S./USSR capability to support future military capability. It focuses on the overall defense program, R&D, demographic aspects, industrial capability, etc.
- -- The Strategic Balance was previously prepared. Subsequent effort has focused on specific subject updates and the development of improved analytic capabilities.

Specific efforts will also be placed on assessments and studies to support defense policy planning and strategic planning throughout OSD and DOD.

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Program Element: #65108D
DOD Mission Area: _____

Title: General Support to Net Assessment (N/A)
Budget Activity: #6 Programwide Management and Support

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: This descriptive summary continues the basic 1983 research program. Emphasis continues on research which will input directly into military balance assessments as well as that which will improve net assessments and the methodology to do them. The focus of the FY 84 research program will continue to be on the Military Balance in Europe, East Asia Balance, Military Investment Balance, Strategic Balance and expansion into some regional balances. It also continues to recognize and is designed to satisfy some of the increasing demand for comparative analyses of particular balance areas within DOD, the Executive Branch and Congress. Emphasis has been given in paragraph I below to the explanation and description of *results of past research*. *However*, it is clear that the research in this program is often analagous to "basic research" and, therefore, is not ameanable to immediate evaluation but instead it is an aid to current and future decisions, actions, policies and management issues. In addition to the past focus, the FY 84 research program will also focus on studies and research to facilitate, enable and support the preparation of assessments and studies for policy planning and the strategic planning efforts within OSD and DOD.

E. OTHER APPROPRIATION FUNDS: Other organizations co-sponsor or participate in a variety of these research projects with OSD/NA.

F. DETAILED BACKGROUND AND DESCRIPTION: This program supports OSD/NA in providing systematic net assessments (N/A) of aspects of the military balance for the Secretary of Defense. Net assessment is an analytical approach which emphasizes comparison of relevant aspects of overall military, economic and political power/capabilities of different nations. Measures of force effectiveness which include qualitative factors such as training, maintenance and logistics practices, state and impact of technology, tactical doctrine, organizational flexibility, strategy, geography, etc., are required where possible. Likely outcomes of conflicts are investigated and trends over time analyzed. Net assessments are done at different levels of the U.S. Government for decisionmakers with different levels and scope of responsibility and, therefore, with unique perspectives. Within OSD, proprietary net assessments are conducted for the SecDef, so as to discover emerging problems or opportunities. Assessing the major trends that shed light on strengths, weaknesses and vulnerabilities of each side is a major output of net assessments. It is a natural adjunct to thoughtful, executive-level management. It is a diagnostic device tailored to assist the policy maker in dealing with problems which affect the character and success of the total enterprise. The OSD/NA analyses provide the Secretary of Defense with descriptions and diagnoses of problem areas or opportunities to assist him in developing plausible strategy alternatives, directing existing, and allocating new, DOD resources more effectively, and efficiently utilizing resources to better accomplish our national security goals. Additionally, deficiencies and uncertainties in intelligence or friendly forces information and analyses are documented for appropriate action.

Program Element: #65108D
DOD Mission Area: _____

Title: General Support to Net Assessment (N/A)
Budget Activity: #6 Programwide Management and Support

Improvements in net assessment methodology and analysis are supported by this program. These are needed because there are major topics which are not analyzed well now. In particular, we need better comparisons of the likely performance of military organizations as affected by strategy, quality of manning, leadership, training, logistics, C^3, tactical doctrine, and other behavioral factors. Readiness and personnel skill levels are not now incorporated very well. Assessments do not include the full range of likely contingencies and initial conditions of conflict. Better descriptions of the plausible scenarios (including ambiguous warning) against which we should test our policies and forces are required. Analytical capabilities do not allow appropriate and realistic testing of policy and force alternatives. Ways of integrating existing military judgements needs to be improved. A substantial and long-term effort is required to improve our capability to do first rate net assessments. Extensive studies are also required to support the related areas of near and longer term policy planning and strategic planning.

G. RELATED ACTIVITIES: Other programs contributing to this effort are net assessments and supporting studies being performed by the Services and other elements in OSD and DOD. There are supporting efforts by the intelligence community to provide quantitative and qualitative data concerning foreign military forces; economic, political and technical posture; and other related national resources. Elements of OSD and the Services provide comparable U.S. military posture data. Finally, complementary efforts by other executive branch agencies are used. All of these inputs and the results of this contractual support are integrated into the net assessments as appropriate and provided to the SecDef. Internal and external studies and analyses of other OSD and DOD elements provide synergistic results to support strategic planning and policy planning activities.

H. WORK PERFORMED BY: This research program is managed by the Director, Net Assessment, OSD. Current contractors include: Rand Corporation, BDM Corporation, Research and Development Associates (RDA), C&L Associates, Naval Postgraduate School, The Analytical Sciences Corporation, Analytical Assessments Corporation, Carnegie Melon University, Texas A&M University, Cortana Corporation, Jeffrey Cooper Associates, Georgetown University, Hudson Institute, MITRE, Advanced International Studies Institute, Brookings Institute, Harvard University and Science Applications, Inc. (SAI).

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1983 and Prior Accomplishments: OSD/NA research is selected and executed to support the net assessments being prepared for the Secretary of Defense. Sometimes the result of research for one particular fiscal year is integrated into military balances for the following several years. Once the research is used or considered in a net assessment, it completely pays for itself even though it may then also be used for other purposes and for several years. However, the total research budget also provides more general payoffs. Analyses initiated in FY 75 of the Middle East War of 1973 compared the performance of U.S. and Soviet weapons systems. Results of that research continue to impact DOD comparative analyses and inform decisions being made. Research started in FY 76 focused on U.S. and Soviet long-term competition (R&D and technology) and factors affecting the strategic balance. The findings concerning the competition were included in the

Program Element: #65108D
DOD Mission Area: _____

Title: General Support to Net Assessment (N/A)
Budget Activity: #6 Programwide Management and Support

1982 Defense Guidance. A multiyear assessment of the ability of the U.S. and USSR to project power was started in FY 77. Results were included in the Power Projection Balance prepared for the SecDef in October 1979. This net assessment had an affect upon the development of the Rapid Deployment Joint Task Force, agreements about overseas basing rights and R&D thrusts. Research was started in FY 78 which focused on estimating the size of the USSR defense program and comparing the economics of U.S. and USSR defense program. Significant results from this and follow-on research were provided in FY 80 through 83 to Congress during testimony by the SecDef, and various DOD witnesses. Research into long-term strategy development and defense policy guidance prompted and aided the creation of organizations in OSD, Navy and Air Force to specifically deal with strategic planning and policy development. Research to identify the basic and changed perceptions of the military balances over the past three years have had implications for U.S. defense policy. U.S. policies with other countries have, therefore, changed. Studies to analyze various aspects of the U.S./USSR and the NATO/Warsaw Pact military force balance in Europe were primary parts of the research program since 1974. Throughout most of this period the focus was on the Central Front. These resulted in valuable guidance for the LTDP, as well as meeting the primary objective of providing necessary inputs for the Military Balance in Europe. Other recent research and their spillover impact include:

- -- Ways to compare Command, Control Communications & Intelligence systems: USD(RE), DCA, and JCS have adopted some results in the C^3I assessments to Congress and those used to prepare the R&D programs.
- -- Technology absorption capability of military forces: ASD(ISA), USD(RE) and DSAA have made policy decisions based on this research.
- -- Assessment of alternative models of European security from a European perspective. USD(P) currently assessing implications of varying viewpoints of European security.
- -- Analysis of Soviet Style in War and Soviet approaches to conflict has had impact across DOD at all levels.
- -- Analysis of Soviet Style of Bureaucracy: OSD/NA and USD(P) have expressed interest in light of Soviet vulnerabilities.
- -- Impact of the changing ethnic composition of the 18 year old cohort on Soviet military: SecDef and others have focused on such Soviet vulnerabilities.
- -- Soviet perceptions of U.S. strategic force modernization (MX and Closely Spaced Basing): USD(R&E), DNA, AF(RD) have used this information in basing studies, as well as, informational support to START negotiations.
- -- Analysis of 'Quality of Life' in the Soviet Union as an indicator of deficiencies in the overall economic structure having direct impact on the efficiency of the military: USD(P) and others have used this data in vulnerability considerations.
- -- Studies undertaken in 1982 to assess and improve capabilities at developing alternative strategies such as cost imposing and counter offensive strategies were directed to provide future policy options for DOD decision makers.

Program Element: #65108D
DOD Mission Area: _____

Title: General Support to Net Assessment (N/A)
Budget Activity: #6 Programwide Management and Support

These assessments and studies have served as bases for better net assessments for the top DOD decisionmakers, improving net assessment methodology throughout DOD, as well as identifying the issues considered by and shaping the policies and decisions of the Secretary of Defense.

2. FY 1983 Program; Studies that address the relative efficiencies and effectiveness of the U.S. and USSR in military competition throughout the overall military balance continue as a high item of interest. This includes analysis of the historical trends, current factors projections and related implications. Research will continue into the long-term U.S./USSR competition, implications of the differences in U.S./USSR military doctrines, and the nature of the strategic, Asia, investment and NATO/Warsaw Pact balances. Specific topics to be researched include:

Military Balance in Europe $750,000
-- Continue updating of the U.S. conventional ground forces in comparison with evolving Soviet organizational and force structure changes.
-- Continue to investigate Soviet views of the military balance in Europe and alternative strategies available to Soviet planners.
-- Continue work to conceptualize how the Southern Flank can be integrated into the balance.
-- Continue to develop alternate views of alliance cohesion under a variety of scenarios.
-- Development of Land, Armor, Manpower, Methodology Model (LAMM) as a potential national level data base for both quantity and quality comparisons of force structure and application.

East Asia $400,000
-- Assess the impact of the evaluation of the North Korean economic ability to continue to sustain the current level of military effort.
-- Investigate Soviet vulnerabilities in the Far East.
-- Assess Soviet/Chinese relationship and vulnerabilities as regard one anothers nationality and demographic structure.
-- Understand the evolution and future direction of the Japanese military organization.
-- Evaluate views of East Asian countries on nuclear proliferation and its relative impact on the military and political policy of those nations.

Military Investment $775,000
-- Continue to describe the trends in Soviet military institutions, organizations and manpower issues.
-- Continue research on mobilization capabilities--Ability to Sustain or Surge Size of Military Efforts of U.S. and Soviet Union
-- Continue research in Soviet pricing, statistical accountability and production to develop realistic values of the military product and its impact on economic growth.

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Program Element: #65108D
DOD Mission Area: _____

Title: General Support to Net Assessment (N/A)
Budget Activity: #6 Programwide Management and Support

-- Assess Soviet capability of management and innovation and evaluate findings in the context of the overall productivity of Soviet economy, and as potential weakness and/or vulnerability.
-- Analyze the implications of the trends in Soviet economy.
-- Improve methodology to analyze Soviet economy and potential defense expenditures.
-- Continued analysis of Soviet Style Management and the relationship of management techniques between the military and civilian sector.

Strategic Balance $200,000
-- Improve capabilities to analyze contributions of strategic forces to the overall military balance.
-- Continue analysis of Soviet perceptions of strategic balance and implications of U.S. strategic force modernization.

Power Projection $150,000
-- Finalize comparative assessments of tactics, C^3I, training and logistics of light forces including our allies and those of the Soviets.
-- Continue evaluation of Soviet methodologies, objectives, strategies in power projection and investigation of strategies for countering Soviet initiatives.

Southern Flank/Middle East/Persian Gulf $157,000
-- Investigate plausible alternate U.S. actions to enhance usefulness of Third country contributions to help us attain our objectives.
-- Design alternative concepts for treating the Southern Flank countries and integrating them into the Military Balance in Europe.

Net Assessment Improvements $100,000
-- Continue to apply the implications of research on the organizational theory approach to assessment of C^3I capabilities and vulnerabilities.
-- Continue development and improvement of scenarios covering all levels of combat to provide for more realistic assessments of conflict situations.

Defense Policy Planning
-- Continue development of alternative policies to prevent Soviet advantages from technology transfer.
-- Address actions to exploit Soviet vulnerabilities throughout world in various scenarios.
-- Assess European role in arms transfer and arms control.

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Program Element: #65108D
DoD Mission Area: _____

Title: General Support to Net Assessment (S/A)
Budget Activity: #6 Programwide Management and Support

Long-Term Competition and Soviet Views $450,000

-- Soviet assessment of China and strategy with respect to it.
-- Cost of maintaining the Soviet empire.
-- Continue research on Soviet style bureaucracy - Soviet view on how government functions in theory and practice.
-- Conduct studies on Soviet Style Management; its structure and weaknesses. Assess military versus civilian management and their relationship.
-- Conduct analysis of the role of technology in combat and its relation to the techniques of war from historical and current perspective.

Strategic Planning Support $200,000

-- Develop methodology to expand alternate net assessments to support strategic planning
-- Continue studies on alternative strategy options available to policymakers (i.e., cost imposing strategies).

OTHER

3. FY 1984 and 1985 Planned Program: The future OSD/Net Assessment contract studies program objectives remain: (1) research leading to better assessments of the military balance, (2) research on improved net assessment methods. The analytic studies and comparisons will build on promising previous work and focus on the major balance areas and involving issues of interest to the SecDef. Studies will continue to assess the impact of the man/weapon combination, technology advances, technology transfer, and relevant doctrinal and strategy issues of the U.S./USSR competition. Other studies to improve balances and methods will focus on: Soviet views and assessments of various Military Balances, scenarios for improved assessments, doctrinal asymmetries, etc. Studies to support defense policy planning and strategic planning will continue to evolve and mature. To these ends, we would plan to fund such research as:

-- ongoing Balance Development Research: European net assessment study; further development of U.S./USSR studies on comparative doctrine/capabilities; identification of comparative abilities to absorb and exploit technology; description of maturing Soviet technology and technological management; integration of Southern Flank into the Military Balance of Europe; develop and continue to improve quantitative and qualitative models for force structure and strategy comparisons; alternative European security strategy studies.
-- Soviet Views of the Balances: Improve understanding of how the Soviets assess the balances, what scenarios, warning periods, etc., they think are important, and what criteria they may use in making their own assessments and decisions, and what strategy alternatives they feel are available in light of assessments. Continue to improve understanding of Soviet perceptions of strategic force requirement and application in response to U.S. initiatives. Continue to evaluate Soviet views of tactical battlefield and the requirements for C^3I.

Program Element: #65108D
DOD Mission Area: _____

Title: General Support to Net Assessment (N/A)
Budget Activity: #6 Programwide Management and Support

-- Improved Scenarios for Assessment: Develop a broader range of more realistic scenarios for strategic nuclear conflict, NATO/Warsaw Pact hostilities, and crisis and conflict in other regions of the world. Examine plausible crisis and conflict initiation scenarios. Consider changes in the world and the way crisis and conflict might evolve.

-- Doctrinal Asymmetries: Investigate comparative evolution and current status of doctrine, tactics and operations of ground/Air Forces, transition from peace to crisis, tactical nuclear weapons and CBR warfare doctrine/tactics; and the role of technology in warfare.

-- Manpower/Organization-related Issues: Compare relative force sizes, training and personnel practices, demographic constraints, leadership development, and organizational effectiveness over time. Detailed analysis of organizational behavior in relation to Soviet manpower, leadership and command.

-- Comparative Economics: Develop better methods for analyzing: U.S./USSR defense budgets, military burden impact, production capacity, mobilization/surge issues, force modernization, and additivity of Allied budgets. Continue efforts to derive realistic figures for Soviet defense product and impact on broad base of the economy.

-- General Net Assessment Improvement: Determine and study key components and essential characteristics of military competition and criteria for evaluating success; look into past assessments by military competitors; analyze military developments and trends; estimate future opportunities and risks in the military competition; appraise strengths, weaknesses, competences, advantages, and vulnerabilities of U.S./USSR and other forces against one another and in the changing competitive environment.

-- Defense Policy Planning:
  - o Explore alternative policies to operational concepts in the Defense Guidance and the SecDef Posture Statement.
  - o Identify ways of implementing official defense policy in a more effective and adaptive manner.
  - o Consider ways of changing the focus of the annual defense debate from program and budget to objective, goals and strategies.
  - o Develop policy alternatives in the face of Soviet action and propensities.

-- Strategic Planning:
  - o Focus on understanding geographic areas and functions where strategies need improving or do not exist and thus must be developed.
  - o Evaluate current strategies and applications to plausible scenarios.
  - o Insure a comprehensive strategic planning and doctrine.
  - o Develop long term adaptive strategies suited to meet the future needs of policymakers.

4. Program to Completion: This is a continuing analytic program to directly support the Secretary of Defense and improvement of Net Assessments in the Department of Defense.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

ement: #65109D
n Area: Management and Support

Title: General Support & Manpower, Reserve Affairs, and Logistics
Budget Activity: Defense-Wide Mission & Support

CES (PROJECT LISTING): ($ in thousands)

Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Authorization	Additional to Completion	Total Estimated Costs
tal for Program Element	2,600	1,835	2,688	3,141	Continuing	Continuing

DESCRIPTION OF ELEMENT AND MISSION NEED: Provides resources to support studies of a general nature in manpower, personogistics research.

FOR FY 1984 RDT&E REQUEST: Funds are required to provide independent studies used in addressing high priority problems of DOD military (Active and Reserve), civilian manpower requirements, management and utilization, and logistics manageitions to meet force effectiveness, combat readiness and sustainability goals.

ISON WITH FY 1983 DESCRIPTIVE SUMMARY: The over 35% reduction in required resources in FY 83 will cause MRA&L to subreduce its planned program and result in several important projects (i.e., improvements in manpower requirements determproductivity analyses, efforts to reduce manpower and logsitics support costs, and modeling to improve DOD's understandrelationship of resources to readiness and sustainability) being carried over or deferred into FY 84. Authorizing full request for FY 84 is essential if we are to meet program goals and objectives.

APPROPRIATION FUNDS: None.

ED BACKGROUND AND DESCRIPTION: These research studies for the Assistant Secretary (Manpower, Reserve Affairs, and are directed at high priority problem areas of DOD military and civilian personnel requirements, management utilizalogistics. The objective of these studies is to provide increased capability of personnel and logistics management to meet force effectiveness, combat readiness and sustainability goals. Inherent to this objective is the necessity data concepts in support of management policy development, to improve the determination of the requirements for manimprove the technological capability of personnel systems to acquire, distribute, train, and utilize qualified personall manpower sources, to develop analytical tools to better address MRA&L issues, to quantify the relationship between service related factors and job performance, and to provide improved logistics support. These studies, which are prilied to OSD policy formulation, also have direct utility to the four Military Services and are integrated with them so services and the OSD programs do not duplicate each other.

G. RELATED ACTIVITIES: Other programs contributing in part to this effort are: (1) Personnel Utilization Technology, P.E. 62703F; (2) Army Personnel and Manpower Technology, P.E. 62717A; (3) Naval Personnel Support Technology, P.E. 62763N; (4) Army Training Technology, P.E. 62722A; (5) Navy Manpower Control Systems Development, P.E. 63707N; (6) Military Personnel Performance Development, P.E. 63731A; and (7) Army Contemporary Issues, P.E. 63744A.

H. WORK PERFORMED BY: Work is performed by private non-profit and for profit contractors, federal contract research centers and in-house research centers. Current contractors include: General Research Corporation, ADTECH, Boeing Computer Services, MITRE, LaBrie Associates, Operations Research Incorporated, Human Resources Research Organization, PResearch, Incorporated, Institute for Defense Analyses, Center for Naval Analysis, Rand Corporation, Naval Post Graduate School, and the United States Military Academy.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: Previous efforts have had substantial impact and value by both producing better data and improving the methods for analyzing and evaluating the effects of existing as well as alternative programs and policies. Specific examples from the FY 82 program include: (1) Expansion of the DOD Wartime Manpower Planning System WARMAPS) to incorporate civilian planning guidelines into DODI 1100.19 and serve as a civilian workforce mobilization planning information system; (2) A civilian mobilization workforce study that provides a basis for DOD/DOL to establish policy and prepare plans and approaches to insure adequate availability of civilian workers within DOD and Defense-related industry during mobilization; (3) A series of projects to evaluate exercise PROUD SABER, a major mobilization exercise within DOD. Evaluation results provide numerous and valuable "lessons learned" in a realistic mobilization environment and identify for remedial action improvements to DOD's mobilization activities; (4) Completion of a comprehensive 2-year effort to resolve the underlying issues currently inhibiting significant progress in the improvement of demand forecasting for secondary items; (5) A study of enlisted career force management policies that indicates that non-monetary factors such as guaranteed locations and a choice of length of term--policies not now pursued--could significantly influence individual second term reenlistment decisions. These results have been shared with the Services and are being used to improve career force management; (6) A study of Reserve Forces retention that pointed out the effectiveness of bonus payments when coupled with longer terms of service, the importance of personnel policies directed toward civilian employer and family conflicts and the relatively weak effect of direct pay increases. Improved Reserve retention is a direct result of pursuing these policies identified through analysis; (7) An evaluation of educational standards for entry into the Armed Forces. Results are being used to recommend methods and procedures for using educational variables (credentials, grades, extra-curricular activities) in a revised screening system, and provides a cost-benefit analysis for changing the recruit screening systems to incorporate these variables; (8) An analysis of enlistment standards and job performance being used to develop an analytical computer model which will assist in determining the optimum enlistment standards for sets of occupational specialties in each Service; (9) A review of the moral standards process for entry into the Armed Forces to improve the collection and use of information currently collected for moral waivers, and to assess the validity of the data for predicting subsequent performance in the military and improve the moral waiver process; (10) An analysis of the marginal pipeline costs of enlisted personnel that provides a revised methodology using precise FY 82 baseline costs to consistently and accurately calculate accession alternatives for the PPBS, (11) Initial development of a cost/training effectiveness model to serve as a basis for justifying training equipment and systems; and (12) A study of the Reserve Forces pretrained individual manpower (PIM) management programs to improve all Services' PIM programs and to increase the size and better manage the pretrained force and Individual Ready Reserve.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element #01015D

Title: Technology Transfer and Control
Budget Activity: #6 Defense Wide Mission Support

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY1982 Actual	FY1983 Estimate	FY1984 Estimate	FY1985 Estimate	Additional to Completion	Total Estimated Costs
	Total for Program Element	--	2,000	2,200	1,968	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Funds policy studies related to international economic, trade and security policy as they pertain to the transfer and control of technology in support of the Office of the Under Secretary of Defense, Policy and the Office of the Assistant Secretary of Defense, International Security Policy. Studies are used to address the ever changing aspects of growing technology and its impact on national security in a dynamic international political arena. Under the statutory responsibilities of the Export Administration Act and the Arms Export Control Act key issues must be identified and processes developed to avoid the transfer of sensitive technology. This is accompolished through studies which provide independent, objective analysis and new ideas for achieving our primary goal of restraining the growth of the Soviet military capability. Tasks identified have been selected on the basis of resource optimization and the identification and prioritization of achievable tasks.

C. BASIS FOR FY 1984 REQUEST: Presently known and predicted technology transfer policy issues and their impact on defense strategy, long range planning, and future operational mission requirements; planning and management of international economic policy matters of Defense interest related to NATO, other European countries and Soviet affairs; all international trade and technology matters of Defense interest and their impact upon U.S. national security; analysis of the interaction of international economic and export control factors affecting U.S. national security; the need for a country by country examination of the gaps and loopholes in the export control process; to undertake a defense support industry by industry study to determine the key elements which are affected by export controls and economic sanctions; development of an economic impact model to assess the commercial and national impact of a transfer both to the recipient nation, to western allies, and to the U.S.; develop the methodology and test the ability to effect control of technology through transfer mechanisms or economic sanctions; the study of western energy alternatives

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element #01015D

Title: Technology Transfer and Control
Budget Activity: #6 Defense Wide Mission Support

and the Soviet Natural Gas Pipelines; assess the aggregate effect of transfers of technology, product, and munitions on the security of the United States regardless of the transfer mechanisms involved; in the transfer of technology assess a recipient nation's: ability to maintain the security of proposed transfers of technology, product, and munitions; reliability in maintaining the security of technology, product, and munitions that origionate in the United States and whose transfer to other nations may be against the best interests of the United States; reliability in securing U.S. Government approval before exporting technology, product, and munitions originating in the United States to other nations, reliability and promptness in reporting known or suspected transfers of U.S. technology, product, and munitions that were not approved by the U.S. Government; reliability in not transferring critical technology, products, and munitions harmful to the U.S. security. This program will provide direct support to key decision-making personnel and will expand the information and knowledge base available to them for carrying out their functions.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: This is a new start program.

E. OTHER APPROPRIATION FUNDS: Not applicable to this P.E.

F. DETAILED BACKGROUND AND DESCRIPTION: This program provides studies and analyzes support to meet the needs of the Under Secretary of Defense, Policy and the Assistant Secretary of Defense, International Security Policy. The key objective of the USDP program is to provide detailed analyzes, independent assessments and innovative ideas which assist planners and decisionmakers to use our appropriated resources more efficiently and with these resources avoid a negative impact on the effectiveness of our deployed military forces and our national security. These funds are used to support the USDP in the exercise of his responsibilities which include: provides the focal point within Defense for policy guidance to Defense components on overall economic policy matters related to international security policy affecting NATO, other European countries and the Soviet Union. Has primary responsibility for analyzing the interaction of policies affecting U.S. national security, and for developing, preparing, coordinating and recommending related Defense positions, policies, plans and procedures, in the field of international economic policy of interest to Defense affecting NATO, other European countries and the Soviet Union to include global defense expenditures, investment, trade, technology transfer, industrial mobilization, foreign investment in the U.S. and other international economic policy issues. Is the DoD contact point for U.S. Government policy toward East-West energy trade, the Soviet gas pipelines, and the Western European Energy Indepen-

2. FY 1983 Program: The FY 1983 program represents a priority based selection of the presently identified external research and study requirements for MRA&L. Work will be continued from promising FY 1982 efforts and initiated in the following areas: (1) Efforts to develop, analyze, and evaluate mobilization exercises (example: evaluation of major mobilization exercises such as Exercise PROUD SABER, DOD/Selective Service System exercises, mobilization issues affecting US readiness to reinforce (NATO)); (2) A major thrust to improve the determination of civilian and military manpower requirements processes (example: a review of the processes used to plan civilian and military manning mix for support activities, development of alternative techniques for deriving staffing standards, and a prototype planning model to identify the most efficient military manpower mix (number, grades, and skills) for selected units in each Service); (3) Efforts to analyze the military compensation system (examples: military pay and retirement reform studies, evaluation of compensation policy under the AVF, analytical and technical support to the 5th Quadrennial Review of Military Compensation); (4) Efforts to improve DOD total force modeling and management (examples: active and reserve force modeling, analysis and implementation of the Defense Officer Management Control System, DOD wartime civilian manpower requirements); (5) Efforts to quantify the influence of personnel policy and factors on military productivity, attrition and retention (examples: attrition information for the Reserve Components, prediction of military job performance, attrition reduction in the selected reserves, enlisted and officer attrition analyses, and analysis of the impact of personnel policies on job performance); (6) Efforts to increase total force supply (example: analysis of variable entrance standards for military service and alternative sources of manpower supply); (7) Efforts to improve civilian personnel management programs, policies, and procedures; (8) Efforts to reduce and project logistics and manpower support costs of new weapon systems (examples: development of policy guidelines supplemented by examples of analytical techniques for use in assessing alternative maintenance and support concepts in the DSARC review process, evaluation of commercial practices to reduce the acquisition cycle and improve R&M); and (9) Research to develop analytical tasks and models to project improvements in readiness due to changes in funding levels in response to both DOD and Congressional concerns.

3. FY 1984 Program: The research and studies planned for FY 1984 will continue promising FY 83 initiatives and begin projects deferred due to lack of available funding. The program's main thrusts will be concerned with the central issues of determination and evaluation of manpower requirements (military, civilian, and contract), total force analysis and planning, manpower modeling, military and civilian compensation analysis, improved personnel training, career development and retention, mobilization planning, development and testing and improved logistics support concepts. Proposed research projects also address Congressionally identified problems such as readiness levels, requirements determination, analysis of the recruiting market available to support the All Volunteer Force in the out years, and a series of long-range personnel policy issues and improved logistics support to new and fielded weapons systems. The FY 1984 research studies are deemed especially important in controlling manpower requirements and support costs while improving DOD's readiness and sustainability posture.

4. FY 1985 Planned Program: The FY 1985 program will be a continuation of the FY 1984 program.

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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element #01015D

Title: Technology Transfer and Control
Budget Activity: #6 Defense Wide Mission Support

dence Project. With significant statutory responsibilities under the Export Administration Act and the Arms Export Control Act reviews Strategic Trade and Munitions Export License Applications. Additionally, the transfer of certain case processing responsibilities from USDR&E to USDP and from the vastly increased emphasis placed by this administration upon controlling the transfer of militarily critical technologies to potential adversaries has caused the need for greatly increased initiatives. This emphasis carries with it greatly enhanced technology related data collection and analysis requirements as well as the assignment of broad administration and processing of strategic trade and munitions license case requirements.

G. RELATED ACTIVITIES: Other programs contributing to the effort are those studies, analyzes, tests and evaluations of policy and resource plans, and net assessments performed by the Army, Navy, Air Force, USDR&E, the Defense Intelligence Agency, other segments of OSD, and the CIA.

H. WORK PERFORMED BY: Data Solutions Corporation; McLean Research Center, Inc.; B-K Dynamics Corporation; Jeffery Cooper Associates, Inc..

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Program: New start in FY 1983. In preparation for this new start P.E. a complete manpower engineering study has been accomplished to determine and examine functional responsibilities, task identification, task frequency, and total manhour requirements. A study to determine resource requirements to include manpower, money, equipment, and space has been completed. Organizational support studies are underway to describe and document current technology transfer policy formulation and case processing procedures within OSD and among the Military Services; define data and assessment elements necessary for formulating technology transfer policy statements governing specific technologies or groupings of technologies; define the data and assessment elements necessary for effective DoD technology transfer case processing; define a process for formulating technology transfer policy; define a process for initial screening and subsequent working of technology transfer cases; define the content, utilization and data sources for an automated, word-processor-adaptable file of technology transfer "policy oriented rationales" for use in supporting the technology transfer decision process. Substantive studies have been done on developing a methodology to determine the key technical components of defense support industries and on

the energy resource reserves of the North Sea.

2. FY 1983, FY 1984, and FY 1985 Programs: Future studies will require a country by country examination of the gaps and loopholes in the export control process; a defense support industry by industry study to determine the key elements which are affected by export controls and economic sanctions; development of an economic impact model to assess the commercial and national impact of a transfer both to the recipient nation, to western allies, and to the U.S.; development of a methodology and to test our ability to effect control of technology through transfer mechanisms or economic sanctions; a study of western energy alternatives and Soviet natural gas pipelines; an assessment of the aggregate effect of transfers of technology, product, and munitions on the security of the United States regardless of the transfer mechanisms involved.

3. Program to Completion: The study program is a continuing program.

RESEARCH, DEVELOPMENT, TEST AND EVALUATION DEFENSE AGENCIES

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

FY 1984

JANUARY 1984

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
SUMMARY BY BUDGET ACTIVITY
($ in Thousands)

		FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
1.	Technology Base	$668,186	$721,500	$856,300	$985,100
6.	Defense-Wide Mission Support	7,276	8,100	11,400	11,600
	TOTAL RDT&E - DIRECT	$675,462	$729,600	$867,700	$996,700
	Reimbursements	12,974	8,500	10,000	10,000
	TOTAL PROGRAM	$688,436	$738,100	$877,700	$1,006,700

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
SUMMARY BY PROGRAM CATEGORY
($ in Thousands)

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
6.1 Research	$ 92,490	$101,000	$108,600	$125,300
6.2 Exploratory Development	575,696	620,500	747,700	859,800
6.3 Advanced Development	---	---	---	---
6.4 Engineering Development	---	---	---	---
6.5 Defense-Wide Mission Support	7,276	8,100	11,400	11,600
Total Research and Develpment (Program 6)	$675,462	$729,600	$867,700	$996,700
Total Operational Systems Program	---	---	---	---
Total RDT&E - Direct	675,462	729,600	867,700	996,700
Reimbursements	12,974	8,500	10,000	10,000
TOTAL PROGRAM	$688,436	$738,100	$877,700	1,006,700

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DEPARTMENT OF DEFENSE - MILITARY
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES
DETAIL BY BUDGET ACTIVITY
($ in Thousands)

Element Code	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Descriptive Summary Page Numbers
1.	Technology Base					
6.1	Research					
61101E	Defense Research Sciences	$ 92,490	$101,000	$108,600	$ 125,300	
6.2	Exploratory Development					
62101E	Technical Studies	3,300	1,000	1,200	1,500	
62301E	Strategic Technology	154,630	161,500	207,900	252,700	
62702E	Tactical Technology	76,700	93,500	120,800	148,500	
62707E	Particle Beam Technology	30,550	33,000	33,100	36,400	
62708E	Integrated Command and Control Technology	41,100	45,300	50,000	55,000	
62711E	Experimental Evaluation of Major Innovative Technologies	237,670	253,500	290,000	315,500	
62712E	Materials Processing Technology	14,830	15,400	25,700	29,200	
62714E	Nuclear Monitoring	16,916	17,300	19,000	21,000	
6.	Defensewide Mission Support					
6.5	Management and Support					
65898E	Mgt. Headquarters (R&D)	7,276	8,100	11,400	11,600	
	TOTAL DARPA	$675,462	$729,600	$867,700	$996,700	

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #61101E
USDR&E Mission Area: 530

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

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
FY 1983 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		$91,400	$112,100	$145,000	N/A	Continuing	N/A
FY 1984 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		$92,490	$101,000	$108,600	$125,300	Continuing	N/A
MS-1	Materials Sciences	12,081	16,612	13,752	18,540	Continuing	N/A
ES-1	Electronic Sciences	20,447	18,047	18,010	19,760	Continuing	N/A
DRH-1	Systems Sciences	14,394	12,715	14,800	19,200	Continuing	N/A
CCS	Computer and Communications Sciences						
CCS-1	Intelligent Systems	14,213	14,742	17,100	19,300	Continuing	N/A
CCS-2	Advanced Digital Structures and Network Concepts	15,677	17,888	20,500	23,000	Continuing	N/A
CCS-3	Modernization Technology	5,254	7,308	10,600	13,000	Continuing	N/A
UDR-1	Unconventional Detection Research	5,895	5,400	6,450	7,000	Continuing	N/A

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #61101E
USDR&E Mission Area: 530

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

DRT-1	Target Penetration Research	2,308	5,205	4,088	2,100	Continuing	N/A
DRG-1	Geophysical Research	2,221	3,083	3,300	3,400	Continuing	N/A

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:

Materials Sciences. This project explores new materials, processes, structures, and device concepts, and demonstrates innovative solutions for overcoming materials related limitations or barriers to advancements in: advanced bearings and lubricants; thermochromic and ultraviolet laser materials; new material technology concepts; rapid-solidification technology; improved propulsion engine materials; metal-matrix components; carbon-carbons; ceramics derived from polymers; dynamic synthesis and compaction of unusual materials; and laser countermeasure materials.

Electronic Sciences. This project explores new concepts in electronic and optical materials, devices, and device fabrication with the goal of demonstrating their feasibility to provide new technical options for implementing future electronic and optical systems. Strong emphasis is placed on pursuit of unique combinations of performance, survivability, and cost required of DoD systems. Technologies pursued include: monolithic microelectronic, microwave, millimeter wave and optoelectronic circuits of submicron feature size and made of compound semiconductors or silicon; electro-optical (especially infrared) sensors; fiber-optical sensors and ultralow-loss optical fibers; optical processing; monomolecular and electronically active polymer films; and special devices and materials of particular interest to DoD.

Systems Sciences. The goal of this project is to develop system sciences to aid defense decision makers through the development of improved man-machine systems and monitoring technology. These will lead to improved effectiveness of Armed Forces personnel in accomplishing their mission responsibilities under a full range of military conditions and operations. This project has been organized to focus on improved command and control capabilities; technology for the production of command and control and other software systems; systems for land-based travel; computer-based training technology; and ultra-sensitive chemical monitoring utilizing monoclonal antibodies.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #61101E
USDR&E Mission Area: 530

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

Computer and Communications Sciences. This program supports basic research in information processing and computer communication technology to provide a technological base for the development of future intelligent, network-based, military systems. The focus is on basic concept development, and includes the development and exploitation of intelligent systems, innovative computer and network architectures and Very Large Scale Integration (VLSI) architecture and design. A modernization technology effort is providing experimental computer resources to improve research productivity within Universities at the forefront of computer science and to increase defense productivity through the use of advanced automation techniques.

Unconventional Detection Research. Activities in the Unconventional Detection Research project are directed towards a determination of the operational potential of detecting submarines by a variety of non-acoustic technologies. The project involves analytic and experimental studies to investigate detection mechanisms based on hydrodynamic characteristics Motivation for the current efforts

Target Penetration Research. This program supports basic research in shock-wave chemistry, consolidation of advanced materials by dynamic techniques, and the formulation of Solutions to selected research issues are transferred to exploratory development.

Geophysical Research. This project is aimed at exploring advanced concepts and basic investigations of geophysical phenomena which have a wide ranging application to DoD problems, with particular emphasis on those topics which relate to verification of nuclear test ban treaties. These studies provide the broad technology base of studies and understanding upon which the DoD verification capability for nuclear test monitoring resides. These efforts also contribute in a significant way toward providing DoD policymakers with technical options and analyses upon which to establish realistic negotiating stances in talks aimed at limiting nuclear explosions. Other investigations within this project are aimed at improving the fundamental knowledge of the geophysical environment in which DoD systems must operate, and identification of particular geophysical parameters which might be exploited to enhance the effectiveness of DoD operations.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Element: #61101E
Mission Area: 530

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

SIS FOR FY 1984 RDT&E REQUEST:

terials Sciences. The exploitation of rapid solidification technology to obtain new, high performance alloys for ructure and propulsion system components will continue at an intense level. Research on carbon-carbon materials r use at 1975° C for more efficient engines will be increased. Other objectives include: exploration of new ystal growth processing; expansion of research efforts on non-conventional consolidation methods for rapidly lidified alloy powder; development of thermochromic materials for various applications; continued research in tal-matrix composites; a new initiative in strengthened polymers; dynamic synthesis and compaction; laser untermeasure materials development; and continued efforts on a coordinated theory to explain the enhanced operties for rapidly solidified alloys.

ectronic Sciences. New research efforts in use of monomolecular (Langmuir - Blodgett) films in electronic vices and chemical agent and infrared sensors, high power density batteries for space and tactical weapons plications, and opto-electronic circuits for interconnection of multigigabit/sec microelectronic circuits and mputational/communications systems will be initiated. Research in three dimensional integrated circuit ructures which might provide unique supercomputational capabilities, extremely high frequency (millimeter wave) vice structures for communications and weapon guidance concepts, and materials for optical signal processing ructures will expand. Continuing efforts will include: novel materials growth and device structure concepts, d submicron feature processing techniques for digital and microwave integrated circuits based on silicon and III-compound semiconductors; growth, processing, and characterization of infrared focal plane array and magnetic miconductor materials; electronic polymers; low-loss fibers and fiber-optic sensor and signal processing systems.

stem Sciences. Funds requested are for technology transfer of previous developments in this area, completion of rking prototypes scheduled for test and evaluation, and the development of new and required capabilities. These clude: transfer of the distributed, low bandwidth, virtual space teleconferencing technology to a command and ntrol application; completion of the design of a color, half-tone codec for teleconferencing; demonstration of alytic aids for high resolution synthetic aperture radar image analysis; completion of techniques for dynamic onic graphics and automatic typography to aid software production; completion of an adaptive suspension vehicle

including a storage energy unit, hydraulics, laser range finder, and hierarchical control algorithms; laboratory demonstration of an ultra-sensitive chemical detection system; enhancement of the bio-chemical technology base to allow development of novel polymeric materials with significant mechanical properties; extension of command and control training technology to large scale networks, including shaping algorithms and exercisers; and concept demonstration of technology for producing fractal-based displays.

Computer and Communications Sciences. The projects in machine intelligence and advanced digital structures and network concepts support basic research in areas that will have a major impact on future defense systems. These are long term projects, frequently carried out at universities, that continually provide new ideas which are further developed in other DARPA or Service programs. Computers and information processing continue to play an ever increasing role in supporting communication, command and control, intelligence and embedded computers in weapons systems. Massive amounts of data now overwhelm our ability to intelligently analyze it, particularly in time-critical circumstances. The intelligent systems research is developing automated techniques for understanding the content of various kinds of images, both photographic and radar. Techniques for fusing data from multiple sources into intelligible information are being developed. Basic research is continuing in signal interpretation, natural language understanding, knowledge representation and knowledge-based planning.

A technology base is being developed for dealing with complex and innovative architectures that will be needed in future military systems. Design methodologies, design tools and innovative architectures are being developed to exploit the advantages of Very Large Scale Integration (VLSI). If successful, this effort will lead to a major reduction in both time and cost of designing integrated electronics. Many DoD applications require processing capabilities far in excess of what is achieveable today. A major thrust of this program is to develop highly parallel architectures which could support tens of thousands of processors. If successful, this will lead to systems which have processing capabilities which are not achieveable with technological advances alone. New concepts are being pursued in which systems can be partitioned for survivability that use artificial intelligence techniques to make systems easier to use, and that use automation to help manage complex network resources.

A project in modernization is providing experimental computer resources to major universities in order to upgrade their resources to adequately support their DoD research programs. This portion of the program will continue through FY 1987. Other aspects of the modernization project will focus on productivity technology.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #61101E
USDR&E Mission Area: 530

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

Unconventional Detection Research. The goals and thrust of the Unconventional Detection Research project remain unaltered with continued priority being placed on detection mechanisms. Emphasis will be placed on the use of for the detection of submarine At-sea experimentation will focus on the nature of background interference signals Successful at-sea background measurement data will allow development of detection algorithms and a firm assessment as to whether signal detection is possible with state-of-the-art sensors.

Target Penetration Research. This project will and shock and combustion wave techniques to synthesize and consolidate materials for DoD application. The potential impact of these activities will be to create a scientific and engineering understanding of new technologies which will transition to exploratory development.

Geophysical Research. Fundamental studies into the nature of seismic wave propagation and the interaction of explosion sources with the surrounding geological media will be continued. Particular attention will be placed on developing the theoretical basis for understanding possible differences in seismic signals which are generated by earthquakes and explosions. This understanding is necessary in order to apply source identification techniques to events in geographical areas for which there is insufficient statistical information to form a basis for the source classification of such signals. Results of this work are directly applicable to the more applied efforts in PE62714E. In addition to these efforts, theoretical studies will be undertaken to examine the nature of the electrical conductivity conditions within the earth. Under certain circumstances, electrical waveguides may exist which may have implications for long range electromagnetic wave propagation. These efforts will be increased over the exploratory work done in FY 1983.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #61101E
USDR&E Mission Area: 530

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

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:

Materials Sciences. The decrease in the FY 1984 funds requested compared to the FY 1983 Descriptive Summary is due to the advanced materials efforts in bearings being terminated because of the successful demonstration of the original program objectives, the partial transfer of the ceramics from polymers program to the 62712E program element, and a de-emphasis in the efforts on thermochromics and ultraviolet-visible laser components. This allowed efforts in carbon-carbon for engine use and a new polymers initiative to be expanded.

Electronic Sciences. This project, ES-1, was previously reported under the Materials Sciences Project as Project MS-2. The reduction in the FY 1984 request compared with last year's Descriptive Summary is due to the transfer of portions of the gallium arsenide integrated circuit research into the 62712E program element, project MPT-2, and the earlier than anticipated completion of research of surface acoustic wave and related analog device structures, large optics, optical coatings, and laser materials. This reduction also allowed research on low power, radiation hard gallium arsenide (GaAs) integrated circuit (IC) materials processing and design to be increased in support of the new GaAs IC Pilot Line initiative planned in PE62301E Project ST-10, Strategic Computing and Survivability.

Systems Sciences. As a consequence of the FY 1984 funding being decreased by $6.6M from that reported in the FY 1983 Descriptive Summary, the following tasks will not be done in FY 1984: the teleconferencing technology will not be expanded to allow use by groups larger than a single person at each meeting site; no work will be done to develop new teleconferencing architectures for tactical applications, such as distributed command posts; and, a very large scale integrated circuit version of the new display processor technology for training applications will not be built and evaluated.

Computer and Communications Sciences. The CCS-2 project reduction of $5.1M will result in less Very Large Scale Integrated (VLSI) systems research and a deferral of network partition research. A reduction of $2.3M in CCS-1 for FY 1984 reduced the number of applications of artificial intelligence planned for Defense Systems.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #61101E
USDR&E Mission Area: 530

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

Unconventional Detection Research. The funding decrease for FY 1983 and FY 1984 has resulted in a scaling down and re-baselining of the Non-acoustic Anti-submarine Warfare program, and the termination of the Advanced Cannon Propellants, Seismic Surveillance and Phase Derived Range programs.

Target Penetration Research. No significant changes.

Geophysical Research. The funding for this project has been increased by $0.3M from that shown last year. This increased funding is to support basic research activities related to the military application of geophysics. These investigations include projects to estimate the electrical conductivity of the lithosphere, development of methods to analyze remotely-gathered observables in order to interpret the geophysical conditions at distant sites, and the detection and interpretation of infrasonic signals.

E. OTHER APPROPRIATION FUNDS: None

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #MS-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Materials Sciences
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objectives are to explore new materials concepts, and seek solutions to materials limitations which prevent further advances in materials for power sources, optical requirements, rapid solidification technology, metal matrix composites, carbon-carbons, polymers, dynamic synthesis and compaction, and in laser countermeasure materials development. The materials programs in support of power systems are concentrated in high-performance gas turbine engines. Solid-lubricated, roller element bearings offer the potential of maintenance-free operation in extreme environment where liquid, organic lubricants are limited by high or low temperatures, oxidation and corrosion (long storage times), and radiation-induced breakdown. Solid-lubricated main engine bearings for cruise missile engines would offer increased performance (by permitting higher operating temperatures), reduced engine weight and volume (through removal of the liquid lubrication system), and significantly reduced maintenance requirements. The full exploitation of rapid solidification powder technology will make possible a 300°C increase in operating temperature limits for turbine-blades, hence higher specific thrust and lower specific fuel consumption for advanced cruise missile and tactical aircraft engines. New aluminum alloys emerging from this technology will challenge higher-cost titanium alloys and composite materials for achieving weight, cost, and fuel reductions in advanced aircraft and missiles. Metal-matrix composite research is addressing particulate reinforcement for achieving high -stiffness and high-strength aluminum alloys, ion plating as a method for making wide tape composite precursor, and new methods for achieving ultra-high modulus graphite fibers (120 million psi) that could yield zero coefficient of thermal expansion composites at practical fiber contents. Materials programs in support of strategic systems are focused on advanced carbon-based composites for cruise missile engines having very high efficiency. New techniques in polymer and polymer composite processing will be exploited for development of organic materials designed for longer life at higher temperature. Potential DoD applications include structural members and coatings for high performance aircraft and composite structures for space. The laser countermeasures materials (LCMM) program will seek materials and/or combinations of materials to defend strategic systems from space-based laser radiation.

G. RELATED ACTIVITIES: Advanced bearing materials efforts are being coordinated by the Air Force Wright Aeronautical Laboratories. DARPA programs in metal matrix composites and Rapid Solidification Technology are coordinated with other service efforts through joint steering committees. The LCMM program is being coordinated with all three services.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #MS-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Advanced Systems Materials
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

H. WORK PERFORMED BY: Effort is distributed among performers as follows: 68% industry, 21% universities and 11% in-house government laboratories. The ten top performers are: Marko Materials, Incorporated, Watertown, Massachusetts; General Electric Company, Schenectady, New York; Westinghouse Electric Company, Pittsburgh, Pennsylvania; Rockwell Science Center, Thousand Oaks, California; University of Michigan, Ann Arbor, Michigan; Stanford University, Palo Alto, California; University of California, Davis, California; Carnegie-Mellon University, Pittsburgh, Pennsylvania, Raytheon Corporation, Waltham, Massachusetts and Rice University, Houston, Texas. In-house laboratory efforts are performed at the Naval Research Laboratory, Washington, D. C.; Air Force Wright Aeronautical Laboratories/Materials Laboratory, Dayton, Ohio; the National Bureau of Standards, Gaithersburg, Maryland; the Army Armament Reserch and Development Command, Dover, New Jersey; and Lawrence Livermore Laboratories, Livermore, California.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: A twenty foot long aluminum-graphite metal matrix composite furlable antenna rib was fabricated. This component has demonstrated the feasibility of using metal matrix composites for satellite antenna structures which are lighter than would be possible with other suitable materials, and will minimize antenna distortion caused by uneven component heating. The result of this will be a large increase in antenna signal-to-noise ratio. Effort was transferred to program element 62712E for fabrication and test of a representative spacecraft component. Development of a new aluminum alloy based on rapidly solidified powder technology has demonstrated that a 30% increase in specific stiffness (elastic modulus divided by density) can be achieved, while retaining acceptable levels of ductility. This achievement translates directly into corresponding weight savings for a wide-variety of stiffness critical defense weapon system components. A high temperature capability aluminum alloy prepared by rapid solidification rate powder processing demonstrated acceptable strength and ductility at temperatures up to 350°C. Part-weight savings of 31% compared to titanium and 61% compared to steel were achieved for gas turbine engine stator vane components. Rapid solidification processing of bearing steels has yielded material which should lead to longer life, more reliable bearings.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #MS-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Advanced Systems Materials
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

Other FY 1982 accomplishments includes the following: Successful 2 hr, 600°F test of solid lubricated, roller element bearings was accomplished demonstrating the possibility of reducing the cumbersome lubrication system in a cruise missile engine; a feasibility study indicated that the entire lubrication system in a cruise missile engine could be removed provided bearings which operate in the 700-1000°F range could be developed; new geometric approaches to high speed machining (high clearance angle, high negative rake angle) were found to yield significantly longer tool life; the use of fiber optics to provide increased beam positioning and improved access to workpiece was demonstrated as feasible in laser assisted machining processes; using feature extraction techniques, the separation of acoustic emission signals due to crack growth and crack rubbing has been demonstrated increasing the potential for in flight monitoring of crack growth; and significant advances in the development of a probabalistic basis for accept/reject criteria have been made. These should provide guideline for decisions pertaining to retirement-for-cause for the F-100 engine.

2. FY 1983 Program: Continuing efforts in the area of Rapid Solidification Technology include scale up of a new rapid solidification method for producing powder for the study of new steel compositions with high temperature capability, test the feasibility of plasma spraying to form new higher capability turbine engine components and study of dynamic and other unusual compaction methods for consolidating powders into useful, near-net shapes. Metal matrix composite efforts include continuation of plating research as a method for making composite tapes and investigation of basic corrosion mechanisms. New efforts are addressing the fundamentals of micro structure-property relationships in both continuous and discontinuous reinforced metal matrix composites. Solid lubricated rolling element bearings are being operated in cruise missile engine test stands to determine the technical feasibility of developing an all solid lubricated cruise missile engine. A carbon-carbon disk is being spun at 3500°F for 5 hours at a tipspeed of 2,000 fps; this effort will grow through FY 1984 in order to adequately explore the potential of this new technology. The Laser Countermeasure Materials program is examining materials which the Soviet Union could employ to protect their strategic systems from a defensive space-based laser weapon. Existing hardened materials approaches will be scrutinized in detail, in order to extend technology to practicable limits.

3. FY 1984 Planned Program: Novel approaches in the synthesis of normally stable, structural polymers will be examined. Superior polymeric composites and compositions will be developed. The program directed to the making of high performance ceramics from polymers will be transferred to 6.2 funding to reflect the applications for the

research which will be emerging over the next few years. Oxidation resistant coatings will be applied to carbon-carbon specimens for extending the survivability of high-temperature gas turbine engine components. First order hardening levels of Soviet liquid and solid fueled ballistic missile boosters to U.S. high energy laser weapons will be determined, based on hardened materials development. The bearings program will be terminated in FY 1984 when a decision will be made on its applicability to cruise missile engines.

4. Program to Completion: Efforts in Rapid Solidification will continue to grow through FY 1985 in order to adequately explore the potential of this new technology. Carbon-carbon materials will continue to be explored for next-generation cruise missile engines; ceramics-from-polymers will be fabricated into ceramic-ceramic composites having very high toughness.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
--	End FY 1984	Scale up of rapidly solidified iron base alloy powder process completed.
--	Early FY 1985	Demonstration of Plasma Spray Deposition Technology.

6. Explanation of Milestone Changes: Milestones listed in the FY 1983 Descriptive Summaries were accomplished.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ES-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Electronic Sciences
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: In last year's Descriptive Summary this project was reported as #MS-2, Electronic and Optical Devices and Materials. The objective of this project is to explore and demonstrate device, material, and material processing concepts which will provide: (1) new technical options for implementation of future electronic and optical systems and functions; and (2) substantial increases in performance, survivability, reliability, and availability of electronic and optical components and monolithic, high functional throughput circuits at reduced cost per function. Specific areas of electronic materials device and manufacturing research include revolutionary new approaches to produce large area infrared sensor materials and devices for strategic and tactical systems; innovative processes, device design concepts, and computer-based process design aids for submicron feature size integrated circuits; compound semiconductors for low power, radiation tolerant, high speed monolithic integrated circuits; magnetic semiconductors; electronic polymers; and monomolecular thin film structures. Specific areas of optical materials and components research include: ultra-low loss fiber-optic waveguides for long distance, repeaterless, secure communications; fiber-optic sensors which promise to revolutionize anti-submarine warfare and other detection technologies; and optical and fiber-optical signal processing.

G. RELATED ACTIVITIES: The Services have programs developing specific infrared sensor devices. The DARPA program is focused on demonstration of "silicon-like" materials growth, processing, and characterization of infrared sensor arrays. The Services have initiated, under a coordinated effort through the Under Secretary of Defense for Research and Engineering (USDR&E), exploratory and advanced development efforts in Very-High-Speed-Integrated-Circuits (VHSIC). The research effort in submicron device and materials technology complements the USDR&E program by addressing long range problems in design and fabrication of materials and devices that operate at or very near their physical limits. A number of efforts are funded jointly with the Air Force, Navy, and Army Offices of Research, Air Force Wright Aeronautical Laboratories Materials Division, and the Naval Electronic and Air Systems Commands. Cooperative efforts at universities in submicron structures and crystal growth research are in progress with the National Science Foundation.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ES-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Electronic Sciences
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

H. WORK PERFORMED BY: Approximately 48% of this work is performed by industry, 34% by universities, 10% by government laboratories, and 8% by FCRCs. The top industrial performers include: Rockwell International Science Center, Thousand Oaks, California; Honeywell Research Center, Bloomington, Minnesota; Texas Instruments, Dallas, Texas; McDonnell-Douglas, Huntington Beach, California; and Hughes Research Laboratories, Malibu, California. The top university performers are: Stanford University, PaloAlto, California; Massachusetts Institute of Technology, Cambridge, Massachusetts; Cornell University, Ithaca, New York; and University of California, Berkley, California. In-house performer is the Naval Research Laboratory, Washington, D.C. Lincoln Laboratory, Bedford, Massachusetts is the FCRC performer.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: New techniques to characterize mercury cadmium telluride (HgCdTe) detector crystals revealed major problems in defect introduction during processing of CdTe substrates used in growth of thin films of HgCdTe. Techniques to eliminate these defects were developed and demonstrated. Collaborative university - industry research programs re-established a viable academic involvement in infrared materials research. Non-linear optical polymer single crystals were synthesized which have second and third order susceptibilities more than ten times those of presently used materials. The third edition of the computer-based aid for silicon process and device modeling (SUPREM III) was issued to industrial and university R&D groups. New silicon-on-insulator materials systems demonstrated the potential for substantial improvements in radiation hardness compared to existing silicon technologies. Analytical models were developed which predict correctly the effects of protons and cosmic rays in causing temporary upset ("soft errors") in semiconductor memory circuits. Gallium arsenide (GaAs) IC's were demonstrated to be resistant to upset by transient radiation effects at radiation fluxes greater than $5x10^{10}$ rad/sec, well in excess of any demonstrated capability by silicon technologies. Technical possibility of microwatt per bit, radiation hard GaAs random access memories was demonstrated. The GaAs developments form the basis for a radiation tolerant, low power, GaAs large scale integrated circuit pilot line project to begin in FY 1983 in PE 62301E, Strategic Technology, project ST-10. Research on fiber-optic acoustic sensors was completed, and the sensors incorporated into brassboard demonstration programs by DARPA and several Navy systems commands.

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Title: Electronic Sciences
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Budget Activity: 1. Technology Base

2. FY 1983 Program: *In the FY 1983 program, increased* funding supports expansion of efforts in extremely high frequency (EHF) monolithic circuits. heterostructure devices and optical signal processing. The submicron feature-size technology program is beginning exploration of feasibility of three-dimensional integrated circuit structures utilizing previously developed beam processing technologies. Modelling and experimental assessment of radiation induced temporary upset ("soft errors") in silicon circuits are being completed, and initial studies of this phenomenon in GaAs circuits is beginning. The first fully operational GaAs 256 bit memories are being fabricated, as are the first prototype GaAs logic gate arrays.

New process technologies for large-area mercury cadmium telluride (HgCdTe) crystals is establishing feasibility of material larger than five centimeters in diameter, and incorporating advanced molecular beam epitaxy processing techniques in the sensor fabrication cycle. A one-half TV resolution Schottky Barrier Infrared sensor is being fabricated to determine the producibility of this silicon-based technology.

The program exploring new fiber-optic sensor concepts is demonstrating suitable fiber and coating fabrication technologies as needed for magnetic and temperature sensing applications. Effort on optical signal processing is beginning with research on growth of photorefractive materials and on two-dimensional spatial light modulators. Evidence is being gained which supports previous theoretical predictions that repeaterless links of 1000-3000 Km are feasible with ultra-low loss fibers.

3. FY 1984 Planned Program: In the FY 1984 planned program, research on growth and processing of large area mercury cadmium telluride (HgCdTe) infrared sensor material will continue its emphasis on the molecular beam epitaxy method and expand investigation of depositing device quality layers on dissimilar substrates. Research on the growth and infrared and magnetic properties of mercury manganese telluride (HgMnTe) and related compositions will be expanded. Exploration of new concepts for uncooled infrared sensors will be initiated. Research in concepts for fabrication and application of three-dimensional integrated circuits will expand. Radiation induced temporary upset ("soft errors") in Gallium Arsenide (GaAs) circuits will be assessed theoretically and experimentally, and preparation of silicon and GaAs test structures for FY 1986 on-board satellite experiments will begin. New concepts in compound semiconductor devices and fabrication will be explored, including innovative

monolithic uses for the unique electro-optical and microwave device properties of GaAs and closely related materials. Fiber optic sensor research will transfer to the Navy with the demonstration of technology suitable for applications. Monolithic integration of diverse technologies will be explored such as Surface Acoustic Wave (SAW), Charge Transfer Device (CTD), bipolar and Field Effect Transistor (FET) logic to permit each technology to perform those electronic functions for which it is optimum. Research in problems related to low-loss fibers, such as radiation sensitivity, will continue. In optical signal processing, efforts on development of photorefractive materials and spatial light modulators (SLM's) for applications such as synthetic aperture radar (SAR) processors will be explored, and experiments will begin on use of the photorefractive materials in phase conjugation and other non-linear optical applications. Initial efforts in fiber-optical signal processing structures will begin. Exploration of monomolecular film applications and ionic polymer conductors will begin as will research on new concepts for high power density batteries.

4. Program to Completion: Research efforts exploring the feasibility of specific new concepts in devices and materials within the Electronic Sciences Project generally have a duration of three to six years. New efforts will be expanded in technology applications of monomolecular films, electronic polymers, optical signal processing, and three dimensional circuit structures. Exploration of magnetic semiconductors will expand. The submicron materials and device physics effort will continue in FY 1985 and beyond due to the far-reaching operational significance which accompanies success, and the extreme technical challenge involved. Efforts in optical signal processing and extremely high frequency device and material structures will continue beyond FY 1985 due to their emerging importance in supercomputation, survivability, secure and other communications.

5. Milestones: The milestones reported in the FY 1983 Descriptive Summary have been completed or are expected to be completed on schedule except as noted below:

Last Year's Reported Plan	Current Plan	Milestones
Late FY 1982	Early FY 1983	Demonstrate fully operational 256 bit gallium arsenide random access memory.

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USDR&E Mission Area: 530

Title: Electronic Sciences
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Mid FY 1983	Mid FY 1983	Storage and correlation in electro-acoustic device structure suitable for anti-ship missile imaging radar system.
Late FY 1984	Late FY 1984	Feasibility of 2" diameter HgCdTe layers on high band gap substrate.
Late FY 1984	Late FY 1984	Demonstrate feasibility of solid state thermal neutron detectors.
Late FY 1984	Late FY 1984	4,096 gate array gallium arsenide digital integrated circuit.
Late FY 1984	Late FY 1984	Computer Aided Design for high speed GaAs Gate arrays.
--	Mid FY 1985	Demonstrate 4 Kilobit RAM in GaAs technology.
--	Early FY 1985	Demonstrate signal amplification at 100 Ghz in new transistor structures.
--	Mid FY 1985	Demonstrate advanced photorefractive materials in spatial light modulation and phase conjugation device configurations.

6. Explanation of Milestone Changes: The first milestone listed has been accomplished and the last three are new milestones. The milestones to demonstrate a 4096 gate array gallium arsenide digital integrated circuit has been transitioned to the 62712E program element under project MPT-2.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

ect: #DRH-1
gram Element: #61101E
DR&E Mission Area: 530

Title: System Sciences
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

DETAILED BACKGROUND AND DESCRIPTION: The goal of this project is to develop the system sciences that form the basis for technological aids to augment the performance of Department of Defense personnel. Command and control problems that have been addressed include: information overload, including redundant and ambiguous messages; difficult database searching; difficulties of group and complex decision making and group communication; poor acceptance of technological aids to decision making; excessive cost and high error rate in the construction and design of complex systems; control systems for adaptive suspension vehicles; related command and control training technology; and applications of advanced biotechnology to ultra-sensitive chemical monitoring and the development of novel polymeric materials.

One technical initiative is command and control information systems. This effort involves: developing a new technological approach for the presentation of geographic imagery to aid in tactical planning and tactical operations, using video disk technology and geometrically distorted oblique overhead imagery to present realistic, perspective, ground level views of terrain and cultural features; the development of a virtual space, low bandwidth, distributed teleconferencing technology to help overcome the problems of distributed decision making; [illegible] development of heuristic, analytic, and electronic techniques to aid in the increasing problem of high [illegible] synthetic aperture radar image analysis and tactical use.

[illegible] is specifically aimed at developing a new methodology for the specification, requirements [illegible] implementation, design, implementation, debugging, maintenance, and management of very large command and [illegible] under development is an interactive graphics system that makes visible to DoD personnel, for the [illegible] of such systems, displayed at varying levels of detail. Applications include the [illegible] software systems and very large-scale integrated circuits, the design of programs for the [illegible] surveillance data and the design of complex strategic and tactical systems. Although the [illegible] new technology will be in major cost savings, the major long-term Department of Defense [illegible] tness for complex command and control systems.

Project: #DRH-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: System Sciences
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

A third initiative is in the area of adaptive platforms. This effort will provide new controls and capabilities for land-based travel over previously inaccessible terrain using a new control system that anticipates the future path using a laser range-finder, relieves the operator of responding to the details of that terrain, and adapts the suspension of the land based vehicle to accommodate to the terrain. Preliminary data to date demonstrates major mobility improvements, e.g., a doubling of maximum speed of travel over rough terrain.

Fourth, an effort is underway to produce a low cost, portable, training simulator technology with associated displays for command and control applications. The technology can make use of newly developed fractal-based displays that have been shown in the laboratory to produce imagery 144 times faster than the best prior methods.

Fifth, an ultra-sensitive monitoring technology is being developed using monoclonal antibodies, with applications in both the tactical and strategic arenas, including anti-chemical warfare. Techniques of bio-chemical technology are being advanced to allow development of polymeric materials with useful rheological properties suitable for use in constrained operational environments.

G. RELATED ACTIVITIES: These efforts are coordinated with Army Research Institute, Battlefield Information Systems Program; Defense Mapping Agency; European/J2 and Department of Army; the Air Force Rome Air Development Center; and Command and Control research with the Marine Corps.

H. WORK PERFORMED BY: 60% industry and 40% universities. Major performers include: Science Applications, Inc., Tucson, Arizona; Advanced Information and Decision System, Mountain View, California; RCA Corporation, Camden, New Jersey; Computer Corporation of America, Cambridge, Massachusetts; Analytic Sciences Corporation, Reading, Massachusetts; Human Computing Resources Corporation, Canada; Ohio State University, Columbus, Ohio; and University of New Mexico, Albuquerque, New Mexico.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Program Accomplishments: In FY 1982 the low bandwidth virtual space teleconferencing system underwent initial test and evaluation and is expected to have major impact on the quality of decision making during

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Title: System Sciences
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national crises. Current teleconferencing systems are limited either by requiring very large bandwidth that will not be available during national nuclear crises or by so degrading the quality of distributed meetings that effective decision making is impossible. By using newly developed techniques for low bandwidth video, the new system will allow effectively distributed decision making in a realistically low bandwidth environment. The Air Force Personnel Command has selected this technology for their applications and developed a system in FY 1982.

Major developments continued on the anti-terrorist system, TARGET, with use by a Department of Defense customer. Geographic display systems were developed with several customers, including JCS, USN, RDJTF, USA, and SAC. The system for the production of ground level images by the geometric distortion of oblique overhead imagery was developed further to allow, for the first time, effective tactical map displays of denied areas. This was particularly economical since currently available overhead resources would be used. Further, this technology was expanded to allow essentially instantaneous updating using electronic materials to supplement video disks.

In the area of adaptive platforms for land-based travel, work began on the laser range-finder technology, hydraulic technology, and energy-storage technology required for successful prototype completion. In addition, dynamic balance heuristics were extended to three dimensions. In the area of command and control system software, efforts on dynamic graphics and typography were initiated.

As an aid to the analysis of high resolution synthetic aperture radar imagery, algorithms for relating image characteristics to scatterer characteristics, expert system heuristics, and feature extraction techniques were completed in FY 1982.

Using monoclonal antibodies for specificity and reporter biomolecules for sensitivity, monitoring technology applicable to anti-chemical warfare began development. These same technologies are applicable to a wide range of strategic and tactical detection problems. Command and control training technology included completion of small team training technology, refinement of the algorithms for reactive opponents, and initiation of new audio and visual techniques for improving the realism of presented displays. Algorithms were refined for fractal-based display presentation.

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2. FY 1983 Program: In FY 1983, work is being completed on the design of low bandwidth, color, halftone codec for virtual space teleconferencing applications, and this design will begin to be implemented. The current low bandwidth, virtual space distributed training technology is being transferred to a command and control application. The demonstration of the algorithm for high resolution synthetic aperture radar (SAR) image analysis is being completed, incorporating the FY 1982 results. SAR transponder work has begun. In the area of command and control systems software production, a graphics system for compiler and data base management system construction is being demonstrated. Late in the year, adaptive suspension vehicle components incorporating prior work in energy storage systems, hydraulics, laser rangefinders adaptive suspensions, and control algorithms will be demonstrated, making a major impact on land mobility.

Laboratory demonstration of the components of an ultra-sensitive chemical detection system is being completed. In the area of command and control training technology, work is being completed on reactive opponents and audio (binaural) and video display techniques. The major efforts will be in the expansion of the technology to large scale networking to supplement, for example, major international exercises such as Reforger; and the development of fundamental new algorithms based on learning theory for improving training, with associated exercisers. Further, a prototype fractal display technique is being demonstrated.

3. FY 1984 Planned Program: There are seven major components to the FY 1984 planned program. First, the effort in low bandwidth, command and control teleconferencing will end with the demonstration of the 50 kb color codec for high quality, low bandwidth video. In contrast to the best existing systems that require 1.2 mb, the new codec will use economical communication lines, the communications will be easily encrypted, and, perhaps most importantly, will function in times of crisis where bandwidth will be limited.

Second, the first fielded concept demonstration adaptive suspension platform will be completed and evaluated. The expected increased mobility and versatility of this platform is so great that the evaluation is scheduled to take place at three different ranges. This approach makes possible new tactics and all weather operation now precluded and is designed to ease inventory problems and operation problems experienced by military personnel.

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Third, the first laboratory demonstration of an ultra-sensitive chemical detector will take place. This capability will represent an increase in sensitivity of between ten million and a billion over currently available technology, and thus can be used for strategic and tactical applications now impossible. The technique is to use a naturally occurring biological mechanism - antibodies - to achieve the specificity and sensitivity desired, and to couple that mechanism to sohpisticated counting schemes to provide an actual device. Another biotechnology effort will address platform efficiency and noise issues, and is directly relevant to system survivability.

Fourth, the learning strategies effort is concerned with inclusion in low cost, portable training simulators of algorithms for guiding the student in the most efficient use of his practice time. Such algorithms derive from laboratory studies in experimental psychology that indicate that major reductions in practice time, for equal performance, are possible. These algorithms may also incarnate the heuristics used by expert instructors who guide the use of student practice time, in person, at multi-million dollar simulators that DARPA's low cost simulators are meant to supplement or replace.

Fifth, basic research in large scale electronic gaming will concentrate on the communications, display processor, data base synchrony, and fidelity issues of developing a technology base for a new multi-echelon, multi-service command and control training capability, that will also be used to aid in R&D and procurement decision making, and evaluating new tactics and doctrine. When completed, the capability will make possible continuous training that is now only intermittently available at great cost. The focus is both on lower level troops and commanders, and includes both hand-eye coordination and decision making practice.

Sixth, prior work in developing aids, heuristics and algorithms to aid in the analysis of high resolution SAR imagery will be combined in a concept demonstration capability for image analysis. The impact will be to remove a major bottleneck in new imagery collection systems, namely that our technology for the collection of imagery far outstrips our capability for the manual analysis of those images due to limitations in the number and capability of military personnel.

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Seventh, in the area of command and control software graphics, a typographic system and a graphic icon system for software production will be demonstrated. Both approaches will concentrate on the maintenance of large scale command and control software, an area of major DoD expenditure.

4. Program to Completion: There is a continuing requirement for improving the effectiveness of Armed Forces personnel in mission responsibilities. Future program content will be determined by research results, technology options and operational problems arising in this critical area.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Late FY 1983	Late FY 1983	Design of 50KB color codec.
Late FY 1983	Late FY 1983	Demonstration of high resolution SAR image analysis algorithm.
--	Mid FY 1984	Demonstration of 50 kb color codec for low bandwidth video
--	Late FY 1984	Adaptive suspension platform in field test.

6. Explanation of Milestone Changes: Previously reported milestones are unchanged.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #CCS-1 Title: Intelligent Systems
Program Element: #61101E Title: Defense Research Sciences
USDR&E Mission Area: 530 Budget Activity: 1, Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The Intelligent Systems project combines fundamental investigations into the limits of the digital computer's capability for intelligent processing with concept demonstrations in selected areas of military relevance. The goal is to make it possible for computers to assist and/or relieve military personnel in complex as well as routine decision-making tasks which are information or personnel intensive, tedious, dangerous, or in situations which are rapidly changing. Research in artificial intelligence is exploring new ways of representing and using knowledge in computers in order to perform tasks that require symbolic reasoning of sufficient complexity that one would ascribe intelligence to a human who performed them. Continuing research efforts include common-sense reasoning processes, learning, knowledge acquisition and representation, natural language understanding, cooperative problem solving in a distributed computer environment, and development of expert system tools. These efforts form the necessary foundation of technology which can be utilized to solve DoD problems. Continuing applications of this technology include the development of intelligent aids for tactical air battle management, intelligent database access mechanisms, image understanding for photointerpretation and autonomous navigation, intelligent sensor architectures, synthesis of computer algorithms from high level specifications, intelligent assistance for carrier air operations, and specialized memory architectures for extremely fast knowledge retrieval. New efforts have been undertaken in the areas of fusion of information from various sources for intelligence assessment and exploitation of expert system technology for threat evaluation of anti-aircraft carrier air strikes.

G. RELATED ACTIVITIES: The National Science Foundation, the National Institute of Health, the National Aeronautics and Space Administration, the Office of Naval Research, the Air Force Office of Scientific Research, the Naval Research Laboratory, the Naval Electronic Systems Command, the Defense Mapping Agency, Rome Air Development Center, and the Air Force Avionics Laboratory also support artificial intelligence research. These efforts address image understanding, expert systems technology, industrial automation, analytical chemistry, immunology, natural language understanding, deep-space and undersea probes, information fusion, and management decision aids. Techniques developed in this program have widespread applicability throughout the Defense Department. Close coordination with prospective users is maintained through workshops, site visits, the choice of contracting agents, and joint programs. Examples of joint programs include the Image Understanding Testbed and Natural Language Database Interface work being performed in conjunction with the Defense Mapping Agency.

H. WORK PERFORMED BY: 31% Industry, 62% University, 7% In-house. Major performers are Massachusetts Institute of Technology, Cambridge, MA; Stanford University, Stanford, CA; Carnegie Mellon University, Pittsburgh, PA; Bolt Beranek and Newman, Cambridge, MA; University of Rochester, Rochester, NY; SRI International, Menlo Park, CA; Rand Corporation, Santa Monica, CA; Yale University, New Haven, CT; Kestrel Institute, Palo Alto, CA; U. of California, Berkeley, CA; and DCADECCO, Scott AFB, IL.

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Project: #CCS-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Intelligent Systems
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Image understanding research encompasses integration of data from optical images as well as forward looking infared radar (FLIR) and text in order to exploit additional sources of information. Applications of image understanding techniques to land-based autonomous navigation was begun, and the ACRONYM vision system was transferred to a testbed (Cartographic Workstation) which is designed to exploit the best image understanding technology for cartographic analyses. The implementation of a distributed vehicle simulation testbed allowed the study of computation/communication tradeoff strategies, development of methods for dealing with incomplete and/or inaccurate information, and allocation of tasks without centralized control. Advanced knowledge acquisition techniques were successfully explored in the context of natural language interfaces and the creation and modification of databases. An expert system (AIRPLAN) has been developed to assist in the planning of aircraft launch and recovery operations from a carrier, and demonstrated in a laboratory with simulated data. In conjunction with the Very Large Scale Integration research effort, the framework for a knowledge-based expert system for VLSI design was substantially completed with the development of graphics and programming packages and the initiation of a significant portion of the knowledge bases. A communications chip for implementation of advanced semantic network memory technologies has been developed. The Rule Oriented System for Implementing Expertise (ROSIE) language has been extended to allow its application in distributed computational environments. A prototype expert assistant for tactical air targeting has been designed and an initial version implemented which selects airfields and specifies targets for attack. A prototype of the the data intensive planning system has been designed and implemented on a large-scale computer.

2. FY 1983 Program: Fundamental research on image understanding is continuing with emphasis on photointerpretation and application to autonomous navigation. Algorithms for symbolic image representation, 3-D mapping, and feature identification are being added to the Cartographic Workstation. Exploration of expert systems to demonstrate the feasibility of automating the photointerpretation task is also being undertaken with development of port monitoring and stereo reconstruction tasks. AIRPLAN is being refined, extended as experience is gained from actual air operations, and demonstrated in an operational environment. New techniques are being developed that permit users to specify what task they wish a computer system to accomplish rather than how the task is to be performed. The acquisition, representation and utilization of large bodies of knowledge for expert systems is being explored at several research institutions.

ROSIE is being utilized to implement a distributed processing application in the area of control of remotely piloted vehicles (RPV). AI applications are continuing to focus on development and demonstration of high performance systems for easy retrieval and manipulation of tactical information, for producing correct and efficient programs from their specifications, for interfacing users to computer systems via natural language, for fusing of information, and for tactical

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targeting. A significant effort is being initiated to develop an expert system for support of a command action team (CAT) that will perform threat assessment in an anti-aircraft carrier air strike situation. A system called Transportable English-Access Media (TEAM) is being improved to handle a wider range of dialogue and is being interfaced to one new database to test its portability. Prototype distributed systems for Remotely Piloted Vehicle control and vehicle location and tracking are being developed. Research in architectures for rapid retrieval of knowledge is continuing with the development of processor chips that constitute the primitive nodes of a semantic memory network. The VLSI expert system design assistant is continuing to evolve and is expected to provide the capability of creating and modifying simple integrated circuit designs. The data intensive planning system is being implemented on one or more types of personal computers and being applied to laboratory and research planning tasks.

3. FY 1984 Planned Program: Basic research in machine representation and utilization of knowledge will focus on the requirements of distributed, cooperative problem solving systems, where each processor must maintain a model of the data and knowledge bases known to the other processors. Applications of knowledge engineering techniques will be demonstrated in prototype expert systems which emphasize intelligent user interfaces and multiple uses of a single knowledge base, e.g. for problem solving, explanation of its reasoning, tutoring, and acquiring new knowledge by analogy. Research in knowledge-based programming will address the rapid prototyping of programs from high-level specifications. Applicability of image understanding techniques to vision-based robotics will be explored for potential impact on manufacturing productivity. Distributed problem solving will be applied to represent uncertainty and propagate its effects in control of RPV's. Evaluation of the intelligence photointerpreter system will commence, and natural language understanding will be incorporated into the system. The CAT program will expand to incorporate additional command and control functions in a distributed command action team environment. The data intensive planning effort will continue the applications in laboratory and research planning and explore the use of constraints to detect deviations from plans. The increased funding in FY 1984 over FY 1983 supports the development of an expert system for use by a command action team and also an adjustment for inflation in the existing efforts.

4. Program to Completion: This is a continuing program. Developments in image understanding will continue to concentrate on areas of autonomous navigation and tracking of mobile targets. Research will continue on techniques for acquiring knowledge, for representing knowledge efficiently in intelligent computer systems,on development of understanding context of discourse, on the conceptual development of expert systems and on new computer reasoning tools. Advanced techniques for mapping data from dissimilar sources into a common knowledge model will be developed, as will mechanisms for situation monitoring and alerting in command, control environments. Applications of artificial intelligence in command and control, signal processing and intelligent planning systems will be pursued.

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Project: #CCS-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Intelligent Systems
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestone
Mid FY 1983	Mid FY 1983	Demonstrate a system that can acquire a knowledge base through an interactive dialogue in English and use that knowledge for cartographic problem solving (TEAM).
Mid FY 1983	Mid FY 1983	Demonstrate the Cartographic Workstation.
Late FY 1983	Late FY 1983	A very high level language for implementing expert systems will be demonstrated on distributed processors (ROSIE).
Late FY 1982	Early FY 1984	Demonstration of a prototype memory to perform concurrent knowledge retrieval from a semantic inheritance network (called a connection machine).
Mid FY 1984	Mid FY 1984	Initial evaluation of an intelligent assistant for photo interpretation.
----	Late FY 1984	Demonstrate a knowledge engineering system for Expert System development.
----	Early FY 1985	Demonstrate an expert system for threat assessment in an operational environment.

6. Explanation of Milestone Changes:

A simulator for the connection machine has demonstrated the concept, and two custom VLSI chips have been designed and fabricated. Chip testing and final assembly of the system have not been completed, delaying this milestone to early FY 1984.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #CCS-2 Title: Advanced Digital Structures & Network Concepts
Program Element: #61101E Title: Defense Research Sciences
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to build the technology base in the areas of advanced digital structures and system and network concepts as the base for future distributed military information processing systems. Design methodologies and computer aided design tools are being developed for Very Large Scale Integration (VLSI) technology which will reduce projected design time and cost over present trends and produce designs of the quality and robustness required for DoD applications. Design systems are being developed which permit the designer to start with a high-level description of the desired chip architecture, and interact with a computer to refine his design, develop test procedures and finally rely on the computer to create a suitable layout on the material substrate. Chips will be designed and fabricated to explore innovative architectures, including highly parallel structures, restructurable logic, signal processing applications and real-time symbolic processing.

Fundamental concepts are being explored for future C3 system architectures which will lead to systems which are easier to use and which are able to survive in hostile environments. User interface techniques are being developed which rely on intelligent systems to simplify access to distributed resources. Partitionable system concepts are being developed whereby a system can continue to function as multiple separate pieces after being split or prior to merging into an integrated system. Techniques are being developed to facilitate resource sharing among computers; diagnostic tools and methodologies are being developed to allow for the rapid isolation of and recovery from network and host failures, and to provide dynamic reconfiguration of resources in response to hostile environmental conditions or overload situations.

G. RELATED ACTIVITIES: The multi-Service effort on Very High Speed Integrated Circuits (VHSIC) is focused on very high speed technology and complements the DARPA program which is addressing the architecture and design concepts for very large scale systems. NSF has a basic research program in submicron structures which is being coordinated with the DARPA program. DARPA maintains close technical liaison with DCA on new computer communications protocols and advanced network concepts.

H. WORK PERFORMED BY: 83% University, 13% Industry and 4% In-house. The major performers are Massachusetts Institute of Technology, Cambridge, MA; Columbia University, New York City, NY; Stanford University, Stanford, CA; University of California, Berkeley, CA; California Institute of Technology, Pasadena, CA; Carnegie Mellon University, Pittsburgh, PA; MIT Lincoln Laboratory, Lexington, MA; University of California, Los Angeles, CA; University of Southern California, Information Sciences Institute, Marina del Rey, CA; Bolt Beranek and Newman, Cambridge, MA.; DCADECCO, Scott AFB, IL.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #CCS-2
Program Element: #61101E
USDR&E Mission Area: 530

Title: Advanced Digital Structures & Network Concepts
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: VLSI design tools were developed for layout, placement and routing. Emphasis was placed on developing tools to handle larger designs with increased efficiency and greater flexibility. A 6,000 transistor signal processing chip was designed using a silicon compiler. Tools were developed to verify the physical integrity of VLSI circuit designs including hierarchical design rule checkers, circuit extractors and circuit simulators. Chips were developed and tested for several innovative architectures including a reduced instruction set computer and a high-performance graphics system. Analog circuits were successfully demonstrated using a scaled CMOS process that is compatible with digital logic.

An internet fault detection and isolation system was designed to localize hard failures and to automatically assess the source of performance degradations. Protocols for automatic recovery from network partitioning using alternate internet routes were investigated along with concepts for internetwork resource allocation. A cooperative interactive system for use on a personal workstation which uses form based interaction was designed. A prototype user interface for a message system was developed which uses natural language input, a knowledge-based model of the system and inferencing capabilities. A prototype multi-media message capability was developed and demonstrated with messages consisting of voice, facsimile and text.

2. FY1983 Program: VLSI design tools are being developed for automated parameter extraction, timing analysis, and logic simulation; design tool capabilities are being expanded to include CMOS at VLSI complexities. Languages and methodologies for testing of VLSI designs are being developed. Wafer scale integration of restructurable logic is under development. A programmable systolic chip, a homogeneous machine, a tree machine, and a lisp machine interpreter are being fabricated; the minimum feature size is being decreased as technology permits. Theoretical research includes efforts in modeling VLSI computation complexity and in the theory of systolic computation. Innovative architectures are being investigated, with an emphasis on the exploitation of intrinsic parallelism.

Experiments are being conducted to assess the effectiveness of internet fault detection, isolation and recovery mechanisms. Analytical models of the reliability and performance of multi-net systems are under investigation. Research on cooperative interactive systems is addressing issues of robust communication, cooperative error correction, explanation of system capability and personalization of the system for individual users. A voice annotation capability is being added to the multi-media document editing, and a feature-based voice capability for large vocabularies is being explored. Experiments are being conducted to dynamically migrate distributed processes across hosts, and experimentation with dynamic resource

Project: #CCS-2 Title: Advanced Digital Structures & Network Concepts
Program Element: #61101E Title: Defense Research Sciences
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

reservation techniques are being conducted. An automated network management strategy is being designed, and the concept of partitionable software systems is being explored.

3. FY1984 Planned Program: The CMOS design capability will be completed and tested. Advanced system design tools will be integrated for use in a low-cost workstation and improvements that allow in excess of one hundred thousand transitors per chip will be incorporated. Languages and design methodologies to achieve functional correctness will be developed. A tagged token data flow architecture using an applicative language will be completed, an object oriented machine architecture and a pipelined architecture will be explored. The development of systolic arrays and homogeneous machines will continue. Low cost, high performance VLSI design workstations will be developed. A new effort to design a multi-processor system that can emulate highly parallel special purpose and programmable machine architectures will begin. Components for a multi-processor connection machine will be developed and tested. Theoretical efforts will emphasize design algorithms that operate in linear time and chip area.

The various components of the cooperative interactive system will be integrated; research in the use of voice to support user interfaces will continue with the use of both feature-based and template-based approaches. A distributed kernel for partitioned software systems will be developed and partitioned system operation will be demonstrated. Special programs called Agents will be developed to assist the user in using partitioned systems and in dealing with unfamiliar operating systems. Efforts will continue in developing effective use of multiple hosts to support distributed applications. Network partition recovery will be demonstrated; experiments with dynamic resource reservation will continue and resource reservation concepts will be extended to the internet systems. Automated network management techniques for performance tracking, fault detection and isolation, and degradation detection will be integrated into an experimental internet monitoring and control system. Design of an initial automated resource management system will begin. The increased funding in FY 1984 over FY 1983 is for implementation of the automated network management techniques and adjustments for inflation in the existing efforts.

4. Program to Completion: This is a continuing program. VLSI architecture and design effort aims to develop an integrated capability for the design, fabrication, and test of integrated circuits containing in excess of a million gates. Efficient design systems for NMOS, CMOS and GaAs will be demonstrated. Designs will be scaled to submicron dimensions. Innovative architectures and testing procedures for use with VLSI will be developed. Research in cooperative interactive systems will provide a methodology for building services which share a natural, easy-to-use interface that is consistent across different services. Capabilities will be developed to incorporate continuous speech as an integral component of user interfaces. The use of automated techniques for monitoring, control and operation of the internetwork environment will be demonstrated. Network partition recovery techniques will be made more robust and evaluated. Partitionable

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #CCS-2 Title: Advanced Digital Structures & Network Concepts
Program Element: #61101E Title: Defense Research Sciences
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

software systems will be developed which permit portable operation as well as surviving unscheduled network disruptions. The automated resource management system will be completed and tested under real-time dynamic load conditions. Network based system concepts and techniques will be developed and investigated in the context of advanced C3 system architectures.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Late FY 1982	Mid FY 1983	Demonstrate Working Tree Machine
Mid FY 1982	Early FY 1983	Demonstrate restructurable logic with 100,000 transistor circuit.
Mid FY 1983	Mid FY 1983	Incorporate standard CMOS rules in VLSI design tools.
Mid FY 1983	Mid FY 1983	Demonstrate prototype cooperative interactive system in context of a multi-media message system.
Late FY 1983	Late FY 1983	Demonstrate multi-processor containing 1000 processors.
Mid FY 1982	Mid FY 1984	Demonstrate network partition recovery capability.
----	Mid FY 1984	Automated Network Management System Designed.
Late FY 1984	Late FY 1984	Demonstrate cooperative interactive system which supports multiple application domains.
----	Late FY 1984	Demonstrate low cost, high performance VLSI design workstations.
Mid FY 1985	Mid FY 1985	Demonstrate VLSI circuit containing 1 million transistors.
----	Late FY 1985	Demonstrate automated resource management techniques.

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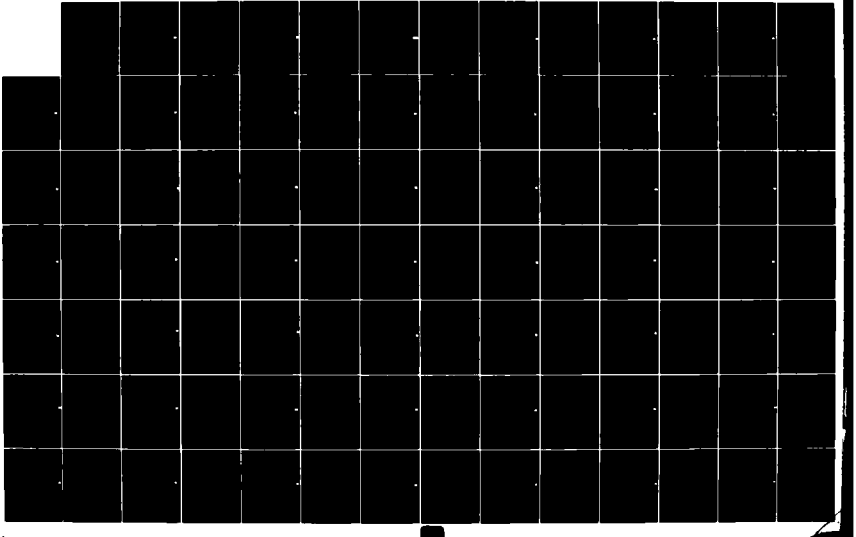

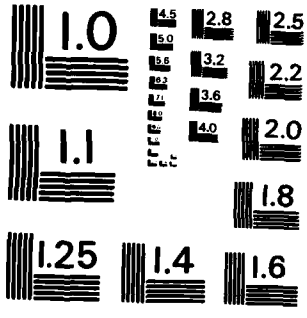

MICROCOPY RESOLUTION TEST CHART
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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #CCS-2
Program Element: #61101E
USDR&E Mission Area: 530

Title: Advanced Digital Structures & Network Concepts
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

6. Explanation of Milestone Changes:

The tree machine required extensive modification to the design tools as well as major redesign of the chip to increase the processor performance.

A small scale restructurable logic application was successfully demonstrated, but process development difficulties delayed the 100,000 transistor application.

The network partition recovery capability was deferred to FY 1984 due to lack of sufficient address space in the internet gateways.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #CCS-3 Title: Modernization Technology
Program Element: #61101E Title: Defense Research Sciences
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: This project is aimed at providing a base of modern computing resources in U.S. Universities which is needed to carry out state-of-the-art research in information processing, and developing a technology base to increase defense productivity. This area was highlighted by the Defense Science Board as a critical area for investment if the U.S. technology leadership in information processing is to be maintained. Existing equipment, which in some cases is almost twenty years old, is being upgraded from large time-sharing systems to powerful single-user systems on local networks. Experimental computer resources such as symbolic processors with large address space and high resolution graphics displays are being provided to U.S. Universities performing DoD research to stimulate innovation in the fields of artificial intelligence, VLSI architecture, software technology, design systems, robotics and automated manufacturing.

Efforts are being initiated to explore ways in which information processing can close the gap between the generation of ideas and their concrete realization in the form of visual models, physical objects, or mechanical systems. This will include the design of systems for describing and transforming shape and motion information, the synthesis of complex mechanical structures and the recognition and representation by computers of 3-dimensional scenes which can be derived from sensor information. High-resolution graphics systems will be used to aid in the description of complex objects and to provide a graphical representation of objects described by information structures. Design of a highly capable real-time controller for the intelligent manipulation of physical objects is being initiated. Techniques will be explored to improve the productivity of scientific researchers by providing automated assistance for manual tasks which are tedious, time-consuming and error-prone.

H. WORK PERFORMED BY: 3% Industry, 84% University, 13% In-house. Work being carried out by University of California, Berkeley, CA; University of Maryland, College Park, MD; Carnegie Mellon University, Pittsburgh, PA; Massachusetts Institute of Technology, Cambridge, MA; Stanford University, Stanford, CA; University of Southern California, Information Sciences Institute, Marina del Rey, CA; Kestrel Institute, Palo Alto, CA; University of Rochester, Rochester, NY; Yale University, New Haven, CT; DCADECCO, Scott AFB, IL.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Initial experimental computer resources were provided to five university research laboratories at the forefront of computer science research in the U.S. Equipment included lisp machines, large address space processors with interactive displays, local network technology and file servers. This was the initial phase of a planned 5 year effort to modernize the computer science base in these laboratories. Exploratory work on the design of a real-time controller for advanced manipulations was begun.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #CCS-3
Program Element: #61101E
USDR&E Mission Area: 530

Title: Modernization Technology
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

2. FY 1983 Program: The computer resource modernization effort is being continued. State of the art resources plus maintenance are being provided to a total of seven laboratories in FY 1983. Various research efforts are being initiated on vision and control for robotics including work on autonomous navigation, spatial reasoning and 3-D sensing. The development of a prototype controller for an advanced manipulator is being carried out. Theoretical and experimental research is being conducted on the use of Beta-splines in computer graphics to represent and modify geometric shapes.

3. FY 1984 Planned Program: The experimental computer resource modernization effort will continue; state of the art equipment will be provided to a total of ten laboratories. A system for geometric modelling of complex physical structures will be designed. The results of research in describing shape will be applied to the prototyping of single objects based on their mathematical description. The prototype real-time controller will be demonstrated in conjunction with the advanced manipulator. Three dimensional scene understanding involving motion will be demonstrated for simple tasks. The increased funding in FY 1984 over FY 1983 is for additional experimental computer resources at major universities and laboratories.

4. Program to Completion: State-of-the-art computing resources will be established and maintained in critical research laboratories. A technology base will be developed to improve defense productivity through the application of advanced information processing techniques to rapid design and prototyping, robotics, and by providing software tools and programming support to enable more productive use of advanced computer resources.

5. Milestones:

Last year's Reported Plan	Current Plan	Milestones
----	Mid FY 1983	Continue Computer Resource Modernization at 7-8 sites.
Late FY 1983	Late FY 1983	Demonstrate the use of Beta-splines to graphically describe geometric shapes.
----	Late FY 1984	Initial 3-D scene intepretation involving motion.
Late FY 1984	Late FY 1984	Demonstrate prototype controller with advanced manipulators.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #CCS-3 Title: Modernization Technology
Program Element: #61101E Title: Defense Research Sciences
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

----	Late FY 1984	Demonstrate Spatial Reasoning techniques.

6. Explanation of Milestone Changes:

No changes.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #UDR-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Unconventional Detection Program
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: This activity is evaluating the feasibility of detecting submarines using non-acoustic techniques,

For these types of detection methods, operational feasibility is being analyzed
The effort is being pursued in three broad areas: (1) Characterization and understanding of the properties of both the signal signature and background interference noise sources; (2) development of experimental sensors that can be used to detect signals of interest; and (3) development of signal processing methods on the sensor output in order to achieve target detection.

Efforts in this area are concentrating on the displacement of the optical scattering layer

The detection of is a new effort beginning in FY 1983. Work is centered on developing a capability for fast and accurate digital processing of SAR images and on investigating previously unstudied hydrodynamic effects such as diffraction and resonance of long surface waves and estimating surface wave relaxation rates.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #UDR-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Unconventional Detection Program
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

Experimental sensor development is directed towards establishing feasibility of a new class of

G. RELATED ACTIVITIES: This program is complementary to the Navy's exploratory development program on non-acoustic ASW. The development of an experimental is a component of the Fiber Optic Sensor System program jointly sponsored by DARPA and the Navy.

The study of optical properties of the ocean medium is connected to DARPA's Strategic Laser Communications program. Coordination mechanisms include participation in the Office of Under Secretary of Defense for Research and Engineering (OUSDR&E) reviews of the the Navy Non-acoustic ASW Advanced Development Coordinating Committee and briefings to CNO's Working Group and Defense Science Board task forces.

H. WORK PERFORMED BY: 55% of the efforts are funded to industry which include: Poseidon Research, Los Angeles, California; Arete Associates, Encino, California; Physical Dynamics, Incorporated, Arlington, Virginia; Pacific-Sierra Research Corporation, Santa Monica, California; SRI International, Menlo Park, California; and R&D Associates, Marina del Rey, California. DoD laboratories performing 35% of the efforts are: the Naval Research Laboratory; the Naval Post-Graduate School; the Naval Air Development Center; the Naval Ocean Systems Center; the Naval Underwater Systems Center; and the Naval Ocean Research and Development Activity. Universities, encompassing 10% of the effort, are: Lawrence Berkeley Laboratory, Berkeley, California and the Johns Hopkins Applied Physics Laboratory, Laurel, Maryland.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: The major accomplishment in this fiscal year was the conduct of an at-sea test during which a laser radar operating in the blue-green regime detected perturbations of the optical scattering layer caused by

The test was conducted off the coast of Florida and

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #UDR-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Unconventional Detection Program
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

ground truth was established by a thermistor chain and a variety of ocean optical instrumentation developed under this program. Preliminary data analysis had indicated high correlation between the ground truth data and the laser radar data

In the fiber optic sensor work, accomplishments in FY 1982 were the design of a gradient magnetometer configuration, the start of construction and evaluation of the sensor, the completion of environmental testing for pressure and temperature effects and the extension of the frequency measurement capability

2. FY 1983 Program: In the optics area, the efforts in FY 1983 are to analyze the data from the FY 1982 experiment, to plan for an experiment in FY 1983, to incorporate a new laser and to improve the capability to detect small changes in the backscattered signal over a large signal amplitude range.

The terminated effort in MHP is being replaced in FY 1983 by examining the detectability of surface effects using a Synthetic Aperture Radar (SAR). Primary to this effort is the development of a software capability to rapidly and accurately process SAR images.

In the is being tested and evaluated, the response to dc magnetic fields, is being measured and the effects of hysterisis and thermal fluctuations on device performance in low fields and over a wide frequency range are being assessed and measured.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #UDR-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Unconventional Detection Program
Title: Defense Research Sciences
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3. FY 1984 Planned Program: The efforts in optics will concentrate on a complete analysis of the FY 1983 at-sea test.
Such a test will provide a combination for the first time with correlation to ground truth instrumentation. These tests will likely not employ an airborne sensor platform as previously planned but will retain the surface platform concept for testing, because the same type of results can be obtained at a lower experimental cost.

The Synthetic Aperture Radar (SAR) work will receive increased emphasis in FY 1984 when the digital processing capability becomes operational. Intensive analysis of SAR images coupled with hydrodynamic analyses and experimental planning will be the main elements of this effort.

In FY 1984 the continuing development of Sensor is expected to transition to the Navy (NAVAIR 510).

4. Program to Completion: This is a continuing level-of-effort program.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Mid FY 1983	Mid FY 1983	Testing of Fiber Optic Magnetic Sensor Gradiometer.
Late FY 1983	Late FY 1983	Advanced Blue-Green Laser Experiment.
Late FY 1984	Late FY 1984	Sensor transition to Navy.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #UDR-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Unconventional Detection Program
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

6. Explanation of Milestone Changes:

The milestones cited in the FY 1983 Descriptive Summary with completion dates through early FY 1983 have been completed on schedule except as stated in Section 5.

The elimination of the milestone regarding magnetohydrodynamic (MHP) experiments has resulted from a series of analytical studies

For this reason, the MHP portion of the program has been deleted and resources allocated elsewhere.

FY 1984 RDT&E Descriptive Summary

Project: #DRT-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Target Penetration Research
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The technical objectives of the Target Penetration Research project are to investigate the

and shock and combustion wave techniques to synthesize and consolidate materials for DoD application. The potential technical impact of these activities will be to allow to enter exploratory development. Advancement in scientific understanding

systems. The development of a scientific understanding of dynamic synthesis and consolidation techniques will allow for the use of advanced materials with enhanced properties for applications which involve a high pressure or high temperature environment. Furthermore, this activity will create a scientific base to avoid potential technological surprise by the Soviet Union in the use of dynamic processing techniques for advanced materials. Over the last two decades,

G. RELATED ACTIVITIES: The Target Penetration Research project was established in FY 1981. This project addresses critical research issues in support of the DARPA exploratory developmental program in Advanced Armor Technology. Coordination of current activities is maintained with the Office of the Undersecretary of Defense Research and Engineering and appropriate Service laboratories. In particular, coordination is maintained with the Army Armament Research and Development Command, Research Office, and Missile Command, the Naval Surface Weapons Center, and the Air Force Armament Test Laboratory.

FY 1984 RDT&E Descriptive Summary

Project: #DRT-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Target Penetration Research
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

H. WORK PERFORMED BY: About 45% of this program is contracted to industry; the remaining 55% is contracted to universities. The principal industrial contractors are: Battelle Columbus Laboratories, Columbus, Ohio; Physics International, San Leandro, California; Science Applications Incorporated, Palo Alto, California; System Planning Corporation, Arlington, Virginia; and System Science and Software, Inc., La Jolla, California. The universities are University of California, Berkeley, California; University of Denver - Denver Research Institute, Denver, Colorado; Drexel University, Philadelphia, Pennsylvania; University of California - Los Alamos National Laboratory, Los Alamos, New Mexico; Massachusetts Institute of Technology, Boston, Massachusetts; and North Carolina State University, Raleigh, North Carolina.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (S) FY 1982 Accomplishments: Basic research in the use of was initiated. In addition, new analytical and experimental efforts were introduced to augment the technical options for the It is clear that the existence of the Research on the critical technical issues associated with was initiated --

Experiments in the use of explosive consolidation techniques to form continued. were launched at to study their behavior under dynamic conditions. Experiments and analyses continued in Emphasis was placed on understanding Hydro-code models were rewritten which allow greater use of these techniques for the design of studies. experiments were conducted to study the behavior of selected materials under conditions of high strain and high strain rates. Correlation between the results of the

FY 1984 RDT&E Descriptive Summary

Project: #DRT-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Target Penetration Research
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

were made. New efforts were initiated to conduct detailed research on shock activation techniques, self-propagating high-temperature synthesis, plasma-arc synthesis, and dynamic consolidation of non-oxide ceramics and ceramic-metals. A new technique was discovered for synthesis of ceramic nitrides. If successful, these techniques will provide materials with enhanced properties of direct interest to the DoD.

2. FY 1983 Program: Research is contining at an accelerated rate on warhead technology applicable to the Research initated in FY 1982 on dynamic synthesis and consolidation techniques for ceramics and has expanded. shaped-charge liners are being fabricated and evaluated against standard armor targets. Research into phenomena continues. penetrators are being evaluated against a variety of standard targets. Research is being initiated in armor systems which provide Research is being initiated into the use of As solutions to technical issues posed in FY 1982 and FY 1983 are provided, new efforts will be incorporated into the program.

3. FY 1984 Planned Program: Research on advanced warhead technology will be transferred to exploratory development. The effort in the dynamic synthesis and consolidation of non-oxide ceramics and ceramic-metals will bifurcate into two activities. The first will continue with basic research of a general nature addressing the many technical issues associated with the selected dynamic techniques. The second will conduct research on advanced materials designed for specific DoD applications. will be transferred to exploratory development. The study of will continue. Basic research in armor technology will be accelerated.

4. Program to Completion: The Target Penetration Research project is a continuing effort. New initatives are evaluated continually as research issues are solved and advanced concepts transfer to exploratory development. The dynamic synthesis and consolidation effort will continue through FY 1986. In FY 1986, programmed basic and applied research in this technical area will be completed and all developed technology will be transferred to the Services.

FY 1984 RDT&E Descriptive Summary

Project: #DRT-1
Program Element: #61101E
USDR&E Mission Area: 530

Title: Target Penetration Research
Title: Defense Research Sciences
Budget Activity: 1. Technology Base

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestone
Late FY 1983	Late FY 1983	First demonstration of dynamically synthesized/consolidated material.
--	Early FY 1984	Transfer warhead research to exploratory development.
--	Early FY 1984	Transfer warhead liner research to exploratory development.

6. Explanation of Milestone Changes: Milestones reported in the FY 1983 summary have not changed.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62301E
USDR&E Mission Area: 530

Title: Strategic Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional To Completion	Total Estimated Costs
FY 1983 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		$148,631	$151,900	$160,000	N/A	Continuing	N/A
FY 1984 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		$154,630	$161,500	$207,900	$252,700	Continuing	N/A
ST-1	Advanced Strategic Concepts & Strategic Technical Analysis	3,129	2,638	3,900	4,325	Continuing	N/A
ST-2	Space Surveillance & Advanced Optics	15,733	13,300	29,500	33,000	Continuing	N/A
ST-3	High Energy Laser Technology	45,029	54,720	45,000	45,000	Continuing	N/A
ST-4	Strategic Deterrent	7,687	12,350	7,770	9,000	Continuing	N/A
ST-5	Strategic Delivery Vehicles	33,069	27,179	27,055	26,400	Continuing	N/A
ST-6	Warning Technology	9,097	8,134	10,050	11,625	Continuing	N/A
ST-7	Special Applications Technology	5,936	12,479	12,825	12,250	Continuing	N/A
ST-8	Space Object Identification	4,806	3,800	1,800	-0-	-0-	109,401
ST-9	Submarine Laser Communication	30,144	20,900	20,000	16,100	Continuing	N/A
ST-10	Strategic Computing and Survivability	---	6,000	50,000	95,000	Continuing	N/A

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62301E
USDR&E Mission Area: 530

Title: Strategic Technology
Budget Activity: 1. Technology Base

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element funds a comprehensive research and development program directed toward the development and application of advanced technologies associated with advanced strategic system concepts; electroptical sensors; laser devices; ballistic missile defense; strategic delivery vehicles; space surveillance systems and multimission radar concepts; post attack communication system; multi-application spaceborne signal processor; space object identification; submarine communication; and strategic computing and survivability.

C. BASIS FOR FY 1984 RDT&E REQUEST: The Advanced Strategic Concepts Technology and Strategic Technical Analysis project provides the initial theoretical analysis needed to define advanced strategic concepts, to assess their general utility, and to establish criteria to judge the impact of technology advances on strategic options. The Space Surveillance and Advanced Optics, and the Warning Technology projects are providing the technologies for new space surveillance systems that decrease warning time, and permit new options for strategic defensive and offensive force management. The High Energy Laser Project is developing the technology base for laser weapons having space applications Efforts are underway for both

The Strategic Deterrent project develops technology for a range of defense techniques that could nullify the massive Soviet offensive weapons inventory. Areas of concern include options, survivability applications for space systems, technology for non-nuclear weapons, and a weapon at long ranges using ballistic weapons technology. The Strategic Delivery Vehicles project is developing and demonstrating the technologies necessary to maintain and improve the survivability and effectiveness of strategic and tactical manned and unmanned airborne delivery systems. The Special Applications Technology project is developing advanced signal processing capabilities and options for strategic communications. The Space Object Identification project is demonstrating optics technique that will space objects from a ground based telescope and based on the optics and detector array technologies being developed in the Space

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62301E
USDR&E Mission Area: 530

Title: Strategic Technology
Budget Activity: 1. Technology Base

Surveillance and Advanced Optics project. The Submarine Laser Communications project is investigating systems concepts and advancing device and optics technology for communication to submarines at operating depths using laser beams from a satellite in the blue/green spectrum. The Strategic Computing and Survivability project is a new effort which provides for the development and demonstration of extremely high performance computers (more recently referred to as Super-Computers) and their strategic application within the Department of Defense.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: The Space Surveillance and Advanced Optics funding decrease of $7.2 million in FY 1983 is due to decreased emphasis on optics technology now under DARPA's Large Optics Demonstration Experiment (LODE). The FY 1984 increase of $8.5 million is due to the descoping of the Advanced Sensor Demonstration program from a flight demonstration to a technology based effort which will be funded under this project in FY 1984. The FY 1983 increase in the High Energy Laser Technology program is due to additional efforts in short wavelength laser technology directed by Congress. The Strategic Deterrent project funding increase in FY 1983 is a result of accelerated efforts within the Ballistic Intercept Missile and Unconventional Defense Technology programs to determine earlier feasibility. The FY 1984 decrease reflects the transition of the Unconventional Defense Technology program to the USAF. Decreased funding within the Strategic Delivery Vehicles project is due to convergence on a single engine concept, increased Air Force participation in the Autonomous Terminal Homing program and revised schedules for undertaking the Advanced Cruise missile technology. The Warning Technology program reflectes only minor program perturbation. The Special Applications Technology increases in both FY 1983 and FY 1984 are due to increased emphasis on the Advanced Onboard Signal Processor. The Submarine Laser Communication program decreases $10.3 million in FY 1983 and $20.5 million in FY 1984 due to early program success and the associated funding requirements of other DARPA programs. The Strategic Computing Survivability program is a new effort.

E. OTHER APPROPRIATION FUNDS: None.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-2
Program Element: #62301E
USDR&E Mission Area: 530

Title: Space Surveillance and Advanced Optics
Title: Strategic Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: This project is concerned with the development and demonstration of the critical elements of electo-optical sensor technology necessary to maintain the current advantageous strategic surveillance position held by the U.S. in the face of an evolving Soviet threat. In particular, the objectives are: (1) to maintain launch warning and spacetrack capability against the potential and (2) to provide the ability for spaceborne surveillance encompassing For this purpose advanced infrared sensor technology must provide

A high sensitivity mosaic staring sensor, which is able to background, is being developed and demonstrated to achieve these objectives. This is being accomplished through the Infrared Surveillance Technology Programs, which include the High Altitude Large Optics (HALO) Program and the Advanced Sensor Demonstration (ASD) Program (funded thru FY 1983 in PE62711E, Project EE-06). The technology base developed will support decisions on advanced infrared surveillance systems.

G. RELATED ACTIVITIES: The project is directly related to strategic efforts of the Army, the Air Force and the Navy. DARPA has the responsibility for technical data interchange with the Services and the Defense Agencies involved with strategic infrared technology developments. Within DoD, there are interrelations with the Air Force Systems Command, Aerospace Defense Command, and Strategic Air Command; the Army Ballistic Missile Defense Program Office; the Naval Research Laboratory, the Naval Ocean Systems Center; the Naval Air Development Center; and the Office of the Under Secretary of Defense for Research and Engineering. A transfer of the IR surveillance technology (HALO and ASD) to the USAF for Advanced Warning System (AWS) surveillance and to the U.S. Navy for advanced ocean surveillance applications is anticipated in the early 1990's. This will provide these services a package of technology options for future systems. This project is related to the Advanced Sensor Demonstration Program (PE62711E, Project EE-06).

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USDR&E Mission Area: 530

Title: Space Surveillance and Advanced Optics
Title: Strategic Technology
Budget Activity: 1. Technology Base

H. WORK PERFORMED BY: Ninety-eight percent of the efforts under this project are performed by industry. Approximately one percent is performed by Federal Contract Research Centers (FCRCs). Less than one percent is performed by universities. Primary contractors are: Rockwell International, Seal Beach, California; Lockheed Missiles and Space Company, Sunnyvale, California; Hughes Aircraft Company, El Segundo, California; Irvine Sensors Corporation, Costa Mesa, California; Charles Stark Draper Laboratory, Cambridge, Massachusetts; Honeywell, Inc., Minneapolis, Minnesota; Magnavox Government Industrial Electronics Company, Mahwah, New Jersey; Eastman Kodak Corporation, Rochester, New York; and ITEK Corporation, Lexington, Massachusetts. The FCRC effort is performed by Aerospace Corporation, El Segundo, California. The University of California, Berkeley, California is the university contractor.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: A unique 3-dimensional silicon detector array readout device with gain and frequency bandpass control has been successfully demonstrated under the High Altitude, Large Optics (HALO) Program. The silicon chip, was the largest such chip ever manufactured at a commercial silicon facility. Techniques to fabricate a high density element infrared mosaic focal plane module using a stacked silicon sandwich of these chips have also been developed. The advantage of this approach is that it provides several times the circuit area per channel over that of the conventional planar detector array because the readout chips are arranged in an edgewise stacked position behind the mosaic detector array. The better use of space gives the focal plane more capability and flexibility in operation. A high accuracy, high speed laser profilometer was also built and demonstrated. This instrument will permit precise cost effective surface figure measurement of off-axis aspheric optical surfaces and will result in an order of magnitude improvement in cost and time required to perform the measurement. Two actively controlled fused silica mirror panels were edge and figure matched under ambient conditions. This was a first time demonstration of such a capability and is an enabling technology for large composite mirror development. Critical engineering design issues for high performance applications were resolved so that fabrication could begin on an engineering model.

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Project: #ST-2
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2. FY 1983 Program: A complete three-dimensional mosaic focal plane module is being fabricated. Integration of the silicon readout stack with an infrared detector array is also being accomplished. Tests and evaluation of function and performance are being started. A reverse-Brayton Cycle Turbo-Refrigerator is undergoing endurance testing and development of an alternative high-efficiency turbo-expander is being initiated. The Linear Stirling Cycle Cryo-Refrigerator is being fabricated. Composite mirror phasing tests are being conducted with aspheric panels under cryogenic conditions. Alternative high-performance spectral filter concepts are being investigated. An effort to develop the active control technology needed for advanced space structures has been established this fiscal year.

3. FY 1984 Planned Program: The long-wavelength demonstration focal plane array in a modular configuration will be completed. All of the necessary support electronics will also be completed. The brassboard signal processor will be completed and integration of the demonstration focal plane assembly with the brassboard processor will begin. The fabrication and testing of the active mirror segments will be initiated. Final engineering evaluation of the linear Stirling and turbo alternator cryo-refrigerators will be made in order to select an approach to be developed and demonstrated.

4. Program to Completion: This is a continuing program. The focal plane and signal processor integrated demonstration will be performed to support a decision about whether to develop an advanced IR surveillance system

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestone
Mid FY 1982	Late FY 1984	Demonstrate long-wavelength intrinsic focal plane arrays with background limited sensitivity at

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Budget Activity: 1. Technology Base

Mid FY 1983	Deleted	Demonstrate focal plane modules
Late FY 1983	Mid FY 1984	Demonstrate high throughput spectral filter.
--	Late FY 1984	Select multiplexer for advanced demonstration.
Early FY 1984	Late FY 1984	Achieve successful demonstration by deployment of a scale model of the lightweight, adaptively controlled optical system technology
Mid FY 1985	Mid FY 1986	Complete producibility demonstration of technology program.
Early FY 1984	Early FY 1984	Demonstrate prototype Stirling cycle high-efficiency, long-life cryogenic refrigerator.
--	Late FY 1984	Select turbo or Stirling cooler for design and fabrication of demonstrator.
--	Late FY 1985	Integrated focal plane array and signal processor demonstration

6. Explanation of Milestone Changes: Technical issues in mercury cadmium telluride material have forced a delay in the planned major detector technology milestones. Suitable solutions were not forthcoming for the intrinsic focal plane modules with filter and signal processor. Although this milestone was deleted, work will continue at lower funding levels to demonstrate a high throughput filter later in mid FY 1984. The planned integration of the Advanced Sensor Demonstration Program (PE62711E, Project #EE-6) with this project in FY 1984 and the attendant restructuring of the entire IR surveillance technology effort in the out years has resulted in some new milestones being added.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-3
Program Element: #62301E
USDR&E Mission Area: 530

Title: High Energy Laser Technology
Title: Strategic Technology
Budget Activity: I. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The High Energy Laser Technology project is comprised of the following programs: High Power Short Wavelength Lasers; Acquisition, Tracking and Pointing; and Laser Optics. The objectives of this project are to develop basic technologies for improving laser device efficiency and to develop laser optical components and ultra-precise beam pointing and tracking. The laser device efforts are now concentrated on scalable, efficient short wavelength lasers.

The program tasks in high power optical components and ultra-precise acquisition, tracking and pointing are developing technology for space based laser applications

G. RELATED ACTIVITIES: This project provides the supporting technology for the major demonstration experiments in PE #62711E (Experimental Evaluation of Major Innovative Technologies), Project Numbers EE-7, EE-8, and EE-12. These three efforts form the DARPA space laser TRIAD and constitute the major DoD effort in developing key elements of space based laser systems. Coordination of this DARPA project with on-going High Energy Laser activities in the Departments of the Army, Navy and Air Force is maintained through periodic reviews with the Assistant for Directed Energy Programs, Office of the Under Secretary of Defense for Research and Engineering.

H. WORK PERFORMED BY: 69% of the program is performed by industrial contractors, 13% by National Laboratories, 12% by Federal Contract Research Centers, 4% by Government in-house laboratories, and 2% by universities. The major industrial contractors are AVCO Everett Research Laboratories, Everett, Massachusetts; BDM Corporation, McLean, Virginia; Charles S. Draper Labs, Cambridge, Massachusetts; General Research Corporation, McLean, Virginia; Aerodyne Research, Inc., Billerica, Massachusetts; Martin Marietta Aerospace, Denver, Colorado; Rand Corporation, Santa Monica, California; Riverside Research Inc, Arlington, Virginia; TRW, Los Angeles, California; W. J. Schafer Associates, Arlington, Virginia. The national laboratory is Lawrence Livermore National Laboratory, Livermore, California. The contractual efforts are managed with the assistance of the following DARPA agents: Air Force Space Division, Los Angeles, California; Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, Ohio; Naval Weapons Center, China Lake, California; and U.S. Army Missile Command, Redstone Arsenal, Alabama. Federal

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Title: High Energy Laser Technology
Title: Strategic Technology
Budget Activity: 1. Technology Base

Contract Research Centers include the Aerospace Corporation, Los Angeles, California; and MIT Lincoln Laboratory, Lexington, Massachusetts. Government in-house activities are being funded at the Naval Research Laboratory, Washington, D.C.; and the Naval Surface Weapons Center, Silver Spring, Maryland. Universities contributing to the program include Stanford University, the University of Arizona and the University of Oregon.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Short Wavelength Lasers. The single pulse Xenon Fluoride (XeF) laser which demonstrated scalability of excimer lasers to large single pulse energies in FY 1981 was used to produce in the blue-green spectral region via Raman shifting of its ultraviolet output beam. This pulse energy exceeds the single pulse energy required for the blue-green laser communications experiment (SLCSAT).

Free electron laser amplifier experiments demonstrated the potential for high efficiency operation. Approximately 4% single pass extraction efficiency was achieved in subscale amplifier experiments which verified free electron laser models that project overall efficiencies of approximately in a high power device. Laboratory and field experiments were initiated to develop the required for applications of ground based short wavelength lasers. If successful, these experiments will demonstrate the feasibility of in the near term with potential for growth to a capability at in the mid

High Power Chemical Lasers: In FY 1982 detailed performance models for cylindrical chemical laser resonator concepts were completed by two different contractors. These models, which have been anchored to the existing small-scale laser data base, enhance our confidence in scaling to

Laser Optics: In FY 1982, a set of state-of-the-art optical coatings for hydrogen fluoride lasers was successfully tested at power levels representative of system use. Prototypes of new high performance laser mirrors

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were in the final stages of fabrication and analyses of beam control optics were extended. The Large Optics Diamond Turning Machine (LODTM) building was completed and occupied; the machine base was installed and assembly started. Efforts to support the LODTM (metrology, metal coatings and post-cut polishing techniques) were initiated. A new effort was initiated to investigate the application of carbon-carbon materials to large space laser mirrors.

Acquisition Tracking and Pointing: Significant technical advances have been made in the area of Acquisition, Tracking and Pointing during FY 1982. Algorithms have been developed to acquire missiles under powered flight and to identify the missile type. The feasibility to determine the missile position and velocity vectors to sufficient accuracy for the operation was examined. An investigation of other potential tracking observables, spanning the range from vacuum ultraviolet to visible wavelengths, was initiated to determine a reliable means for selecting and maintaining a precise hard body laser aimpoint in the presence of the large missile plume signature. Other completed studies have

A new family of more robust target features has been identified that yielded extensive advantages in terms of flight computer memory (80% reduction) and throughput (86% reduction). Probability of correct identification was improved for low signal thresholds and distant targets. System requirements for a dynamic pointing simulator were established and a conceptual design for a simulator with the required performance has been developed. When completed in FY 1984, this hybrid simulator will be used to investigate precision, rapid retargeting techniques in the presence of a large, deformable beam expander structure.

2. FY 1983 Program: Short Wavelength Lasers: Experiments will continue in the Xenon Fluoride (XeF) laser program to demonstrate the repetitive pulse technologies required for closed cycle XeF lasers operating These technologies include high power switches, electron guns, high damage threshold optics for ultraviolet wavelengths, and diffraction limited beam quality improvements These results will be combined into the design of a XeF laser Free electron laser oscillator experiments at 10.6 microns will also be conducted. These experiments should resolve all remaining physics issues

associated with developing high efficiency free electron lasers. This experiment is expected to operate with approximately electrical efficiency and demonstrate near diffraction limited optical beam quality. The laboratory and field experiments that will demonstrate the fundamental feasibility for short wavelength lasers against will be completed. Planning will be initiated for experiments to be conducted over the next 3 years.

Laser Optics: Prototypes of two high performance silicon mirrors are being completed in FY 1983. Each will be comprehensively tested to determine its vibration characteristics and its thermal distortion performance. Completion of the Large Optics Diamond Turning Machine (LODTM) will be followed by a thorough validation and test program to be conducted by the National Bureau of Standards. LODTM is scheduled to be operational by the end of FY 1983. Additional supporting activities will carry the development of an interferometer for conical optics through design into fabrication and will define optimum metal coatings for diamond turning. The program exploring the use of carbon-carbon will be continued to completion of the major technical milestones related to material coating and joining. Analytical studies of systems applications of the technology will also be completed. Finally, a new program to develop improved optical coatings for hydrogen fluoride (HF) chemical laser systems is being initiated. Activities to develop improved coating deposition techniques will be underway.

Acquisition, Tracking and Pointing: During FY 1983 acquisition, tracking, and pointing activities will be directed toward the development of techniques for quickly and accurately estimating a missile's state vector, efficient missile identification algorithms, sensor designs, and on-board data processing subsystem requirements. Realistic missile tracking scenes will be generated and used to evaluate conceptual tracking system designs to determine the feasibility laser aimpoint designation. The preliminary and detailed design of the dynamic advanced retargeting and tracking simulator will be completed with fabrication beginning in the last quarter of FY 1983.

3. FY 1984 Planned Program: Short Wavelength Lasers: The objectives of the Excimer Laser Program in FY 1984 will be to combine repetitive pulse excimer laser technology developments in the final design of a Xenon Fluoride laser. Work will be initiated in the laboratory to demonstrate the engineering feasibility of the

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most critical components. The objective of the FY 1984 free electron laser program wil be to demonstrate the very high efficiencies that are projected for these lasers. A beam energy recovery experiment will be concluded which should demonstrate the feasibility of obtaining electrical efficiencies Radio frequency accelerator technology experiments will be initiated to demonstrate capability for scaling rf accelerators required by high power free electron lasers.

Technology efforts will be underway to build

Laser Optics: The carbon-carbon materials program will be completed and will demonstrate the validity of applying these new materials to advanced, large space optics for high energy laser applications. The LODTM will be operational and engaged primarily in manufacturing optics to support the ALPHA chemical laser program. A small sustaining effort will remain to upgrade and improve the LODTM and to complete the supporting conic metrology. The HF coatings program will continue with efforts in improved coating deposition, studies of damage mechanisms, characterization of coating samples, and extensive laser tests of representative coating samples. Activities will continue to develop advanced cooled mirrors and to provide extensive tests of prototype hardware.

Acquisition, Tracking and Pointing: Integration of the retargeting and precision tracking simulator will occur during FY 1984. Current plans call for a phasing down of other ATP activities.

4. Program to Completion: Short Wavelength Lasers:

All of the technology components will have been demonstrated as well as the fabrication and testing a subscale electron gun module. The free electron laser program will continue to develop the necessary accelerator technologies for achieving the high quality electron beams at the high average currents necessary for scaling to short wavelengths. Also a low power short wavelength free electron laser experiment will be initiated in FY 1985.

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The experiments will be completed in thereby demonstrating the feasibility of utilizing short wavelength lasers The technology required for will be completed in

Laser Optics: Mirror development will continue with efforts to achieve significant advances in improved manufacturability and reliability, and test data to support an engineering data base for a wide variety of system applications. The HF coating program will proceed to completion in FY 1987 supporting advances in coating deposition technology and innovative coating designs to fulfill space-based chemical laser system requirements. Results will be confirmed with medium and high power laser tests. The diamond turning of optics (LODTM) will continue to be supported on a sustaining basis.

Acquisition, Tracking and Pointing: Test operations will commence on the dynamic pointing simulator to investigate various retargeting methods, fire control algorithms and bending mode behavior.

5. Milestones: The milestones cited in the FY 1983 Descriptive Summaries with completion dates through Mid FY 1983 have been completed or are expected to be completed on schedule, except as noted below:

Last Year's Reported Plan	Current Plan	Milestones
Mid FY 1983	Mid FY 1983	Complete Fabrication/Validation of 1.5m Diamond Turning Machine for Resonator Optics.

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Program Element: #62301E
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Title: High Energy Laser Technology
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Budget Activity: 1. Technology Base

Mid FY 1983	Deleted	Validated estimates of vulnerability of liquid-propellant boosters to CW laser radiation.
Late FY 1983	Deleted	
Early FY 1984	Early FY 1984	Demonstrate High Efficiency Free Electron Laser
---	Mid FY 1985	Commence testing on the retargeting and pointing simulator.
Mid FY 1986	Deleted	

6. Explanation of Milestone Changes:

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Project: #ST-4 Title: Strategic Deterrent
Program Element: #62301E Title: Strategic Technology
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: Emphasis in the Strategic Deterrent Project has been on new technical approaches to offensive and defensive weapons and weapons platforms. In addition, there have been relatively short term efforts investigating the potential contribution of certain high payoff surveillance techniques in defending against tactical ballistic missiles; the feasibility of increasing the survivability of US satellites; and the feasibility of a manned, highly maneuverable space cruiser. In Unconventional Defense Technology our efforts were focused on Impactor Technology, which utilizes techniques having the potential to destroy hard targets The Impactor effort is jointly funded with the USAF. Effort in the Ballistic Intercept Missile Program has been on development of technology for a ballistic weapon that could kill The weapon would be a system with a goal for An to the target. The baseline reentry vehicle was developed by the Department of Energy. The Strategic Weapons Technology task was initiated in FY 1981 to concentrate on two areas: (1) Options that could provide for of strategic weapons after they were launched; and (2) A technique for suppression so that strategic aircraft could achieve in shorter time and could increase their unrefueled range.

G. RELATED ACTIVITIES: This work is related to programs of the Army Ballistic Missile Defense Office, the Air Force Space Division, the Air Force Aeronautical Systems Division, the Air Force Ballistic Missile Office, the Naval Surface Weapons Center, the Naval Undersea Systems Center and the Defense Communications Agency.

H. WORK PERFORMED BY: About ninety percent of the effort is conducted by private industry. The major contractors are: General Dynamics, San Diego, California; General Research Corporation, Santa Barbara, California; Rand Corporation, Santa Monica, California; Analytic Services Company, Arlington, Virginia; Hughes, Fullerton, California; Raytheon, Lexington, Massachusetts; Stanford Research Institute, Menlo Park, California; Lockheed Missiles and Space Company, Palo Alto, California; Rockwell International, Downey, California; and Vehicle Research Corporation, South Pasadena, California. The remaining ten percent is conducted by the Department of Energy Sandia National Laboratories, Albuquerque, New Mexico, and the Naval Surface Weapons Center, Dahlgren, Virginia.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-4
Program Element: #62301E
USDR&E Mission Area: 530

Title: Strategic Deterrent
Title: Strategic Technology
Budget Activity: 1. Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Unconventional Defense Technology. The research under the Impactor Technology Program verified that penetration are valid. Phenomonology was determined by test Testing at other L/Ds verified scaling laws and established confidence that full sized rods (four feet long) would behave similarily. Evaluation of the contribution of advanced, infrared surveillance platforms to defense showed that queuing could enhance the ability of ground defense to engage the threat. The survivability concepts developed for US satellites were folded into USAF planning for advanced missile surveillance and warning systems. The fundamental feasibility of a manned space cruiser was shown and the USAF is examining use of such a concept. Under the Ballistic Intercept Missile Program, the effort was focused to emphasize ways to resolve the demanding issues Feasibility of a strategic missile was also shown; however, the penalities incurred and the difficulty in assuring positive control are sufficiently serious that further consideration of this concept has been dropped. Under a new effort, Grasshopper, we examined the applications of advanced technologies that might be feasible in the mid to late 1990s.

2. FY 1983 Program: Under the Impactor Technology Program, tests continue constructed of various materials and in various configurations. Additionally, efforts continue in: total impactor weapon system definition; target vulnerability; and impactor survivability and accuracy. Results of the defense evaluations are being made available to appropriate DoD agencies; meanwhile, relevant and valuable infrared surveillance technologies continue in Project ST-02. The competitive designs of for the Ballistic Interceptor Missile are being evaluated. The best of these designs will be further developed in FY 1983 in order to better understand the viability of this concept. Finally, assessments are being made in addition to the missions envisioned for Grasshopper.

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3. FY 1984 Planned Program: The ground test/integrated *analysis phase* of the Impactor Technology Program Solutions to key technology issues will be in hand. Preliminary impactor designs will be available and preliminary test planning will be completed. The overall findings will be made available to the USAF so that the latter can determine whether to continue the program to testing. Advanced designs for the Ballistic Intercept Missile will be available for ground simulation, test and evaluation.

4. Program to Completion: This is a continuing program. New technologies for advanced strategic defensive/offensive applications will be explored under the Unconventional Defense Technology Program. The evaluation of techniques will be continued under the Ballistic Intercept Missile (BIM) Program. A series of BIM test demonstrations will be considered for the FY 1987 - FY 1988 time frame.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestone
Mid FY 1983	Mid FY 1983	Preliminary design for BIM concept.
Mid FY 1984	Mid FY 1984	Transition Impactor Technology to Air Force.
Early FY 1985	Late FY 1985	Complete BIM integration.
Late FY 1985	Mid FY 1986	BIM demonstration completed.

6. Explanation of Milestone Changes: The BIM guidance integration and demonstration milestones are slipped to reflect the need for further refinement in design in order to solve the critical performance issues.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-5
Program Element: #62301E
USDR&E Mission Area: 530

Title: Strategic Delivery Vechicles
Title: Strategic Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to develop technologies appropriate to improved strategic delivery vehicles. There are three major areas currently under investigation. The Advanced Cruise Missile Technology Program is investigating unconventional design and launch modes along with a variety of synergistic subsystem technologies in order to provide a substantial increase in the range-payload product simultaneously with an improved penetration capability. Additionally, the Advanced Cruise Missile Technology Program is developing a high payoff engine concept which promises a potential to use new high energy fuels, increased thrust and a reduction in fuel consumption compared to the current cruise missile (CM) engine (F-107). This will permit smaller vehicles to be developed (more per CM carrier) or increase the payload-range combination for advanced mission options. The Autonomous Terminal Homing Program is developing precise guidance techniques which will enable the effective destruction of broad classes of fixed, high value targets with non-nuclear munitions thereby providing the National Command Authority with response options which are alternatives to massive nuclear destruction. Included in this effort is an optimal flight path project for allowing the vehicles to avoid known and unknown radar threats and to proceed to the target with the greatest possible chance of survival. Finally, the Air Vehicle Survivability Evaluation Program, formerly named the Cruise Missile Detection Technology Program, is investigating the observables phenomenology and characterizing and assessing potential defense technologies in order to provide advanced air vehicle technology development programs with insight into methods of defeating defenses, and to provide a capability to realistically evaluate and demonstrate the survivability of such advanced vehicles.

G. RELATED ACTIVITIES: The Advanced Cruise Missile Technology Program is directly related to programs managed by the Joint Cruise Missile Project Office, and by the Air Force Aeronautical Systems Division, Deputy for Strategic Systems and Deputy for Development Planning (the latter serving as DARPA's agent). The Autonomous Terminal Homing effort is related to the Army's Pershing II developments and the Air Force's Advanced Ballistic Reentry Systems (ABRES). The engine development activities are related to small engine activities of the Army Tank and Automotive R&D Command, the Air Force Aero Propulsion Laboratory at (Wright-Patterson AFB serving as DARPA's agent) and the Naval Air Propulsion Center (NAPC Trenton, NJ, serving as a DARPA agent). The Air Vehicle Survivability Evaluation Program (AVSE) interfaces with the Joint Cruise Missile Project Office, the Air Force Test and Evaluation Center, the Strategic Air Command, the air defense and detection activities at the Army Missile R&D Command, the Air Force Avionics Laboratory, Rome Air Development Center, and Electronic Systems Division (which serves as the DARPA agent for the AVSE Program).

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Program Element: #62301E
USDR&E Mission Area: 530

Title: Strategic Delivery Vechicles
Title: Strategic Technology
Budget Activity: 1. Technology Base

H. WORK PERFORMED BY: Industry provides 98% and government in-house 2% of this project effort. The industrial contractors are: Vought Corporation, Dallas, Texas; Convair Division of General Dynamics, San Diego, California; the Boeing Corporation, Seattle, Washington; Honeywell Electro-Optics Center, Lexington, Massachusetts; Raytheon Corporation, Sudbury, Massachusetts; SCIPAR Corporation, Buffalo, New York; Systems Control Technology, Palo Alto, California; the Analytic Sciences Corporation, Reading, Massachusetts; Control Data Corporation, Minneapolis, Minnesota; Technology Services Corporation, Santa Monica, California; Northrop Corporation, Ventura California; Teledyne Continental Engine, Toledo, Ohio; Williams International, Walled Lake, Michigan; Garrett Turbine Engine Company, Phoenix, Arizona; Suntech Corporation, Philadelphia, Pennsylvania; UOP, Chicago, Illinois; SPC Corporation, Arlington, Virginia; Stanford Research Institute, Menlo Park, California; Calspan Corporation, Buffalo, New York; Systems Control Technology, Palo Alto, California; Goodyear Aerospace Corporation, Akron, Ohio; Grumman Aerospace, Bethpage, New York; Rockwell International, Anaheim, California; BDM Corporation, McLean, Virginia; and the MIT Lincoln Laboratory, Lexington, Massachusetts. The government in-house work is performed by USAF Space Division, El Segundo, California and the Naval Surface Weapons Center, Dahlgren, Virginia.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: The Advanced Cruise Missile Technology Program completed a technical evaluation of the mid range (2500NM - 3000NM) vehicle requested by the U.S. Air Force (USAF) to be used in comparison with other candidate systems for a follow-on to the current USAF Air Launched Cruise Missile (ALCM). After completion of the technical evaluation, the mid range vehicle program was transitioned to the USAF and was continued as an USAF vehicle technology demonstration program. The long range vehicle concept design studies begun in FY 1982 were completed. Efforts in stealthy terrain following terrain/obstacle avoidance continued and bomb damage assessment system developements were evaluated. Candidate concepts and configurations were formulated by defining an applicable technology base including propulsion, observables, structures, guidance and control, and other critical technologies. Configurations include design approaches suggested in other DARPA studies in addition to those identified by the contractors. Qualitative assessment of configuration characteristics and basing concepts provided a basis from which the contractors will select range and payload weight combinations and associated designs. After evaluation of competing concepts this program proceeded into the design and development of the critical technologies required for the long range mission. In FY 1982, the Advanced

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Cruise Missile Technology Program also narrowed the field of candidate cruise missile engine concepts. The recuperative carbon-carbon turbine engine was chosen over the previously investigated Compound Cycle Turbofan Engine (CCTE), the excentric engine and the wave rotor engine. Development studies showed the high temperatue coated carbon-carbon materials will allow increased turbine and nozzle temperatures increased thermal efficiency reduced cooling related loses and reduced reliance on strategic materials. These improved parameters will produce favorable effects on advanced engines by reducing size and weight of engine components, increasing specific thrust and reducing specific fuel consumption The improved advance engines in turn will produce favorable effects on the advanced flight vehicles by increasing the range increasing the payload, and reducing fuel usage Development studies also showed that the higher internal engine temperatures will allow the burning of higher energy fuels such as boron slurry. For a baseline range vehicle, boron slurry can reduce the overall vehicle weight and volume producing a range increase Within the Autonomous Terminal Homing Program, both sensors were fabricated and completed laboratory testing. The scene matching laboratory was completed with the successful correlation of synthetic scenes and images. The two competitive scene match algorithms used in the scene matching laboratory worked extremely well. Detailed flight test plans were completed and included testing in various weather conditions and terrain backgrounds. The Air Vehicle Survivability Evaluation Program (AVSEP) continued acquiring and employing the necessary field instrumentation equipment and experimental programs required to perform fundamental measurements. A multi-frequency (VHF, UHF, L-, S- and X-Band) radar system began visiting many of the over 70 sites visited by the X-band radar to quantify the Moving Target Indicator (MTI) requirements necessary to cope with clutter. As data were collected and analyzed in the AVSEP, continuing feedback to the advanced delivery vehicle contractors provided for the earliest possible design improvements to be made in order to maximize air vehicle survivability.

were performed. The output of this effort was parameterized for such effects as vehicle radar cross section (RCS), altitude, offset, etc. Detailed systems studies were performed to evaluate in detail the viable air defense systems.

were begun. Activities on three specific new instrumentation systems began in FY 1982 and will continue through the out years (a low frequency (VHF) ground-based surveillance radar, an X-band medium/high PRF ground-based radar,

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Title: Strategic Technology
Budget Activity: 1. Technology Base

2. FY 1983 Program: The Advanced Cruise Missile Technology Program, long range vehicle technology demonstration will begin. Refinement in the development of the critical technologies will include measurements, wind tunnel tests, unique engine installations, improved control concepts and critical subsystem development, such as tests of the structural characteristics of Supporting engineering and effectiveness analyses will include tradeoffs between aero and propulsion performance and survivability in the basing, cruise and penetration phases of the flight profile. Additionally, the carbon-carbon material strength and endurance will be characterized through component demonstration tests. The higher temperature oxidation protection coating will be validated. The fiber architecture for the turbine rotor will be designed and fabricated. The turbine rotor will be demonstrated in a high-speed, cold spin test. The boron fuel formulation, rheology and preliminary specification will be completed.

The Autonomous Terminal Homing (ATH) Program will complete flight evaluation of two imaging sensors designed to demonstate The testing will demonstrate guidance capabilities over a variety of terrain and weather conditions found at Patuxent, MD and Rome Air Development Center, NY. The data from the two airborne sensor will be collected simultaneously in a dual pod configured A-6 aircraft and will be processed in the scene matching laboratory using two competing scene matching algorithms with synthetically derived scenes. Limited flight test evaluation will be obtained in the terrain following/obstacle avoidance (TF/OA) capabilities and the data will be compared with data from the simulation facilities.

The Air Vehicle Survivability Evaluation Program is continuing the collection and analysis of multifrequency radar clutter at selected sites under various weather and seasonal conditions. Both radar and IR propagation phenomenology are being collected and analyzed. Delivery of as a part of the flight test verification equipment will take place. Initial testing of this equipment was begun in FY 1983 against appropriate flight test vehicles.

3. FY 1984 Planned Program: In the Advanced Cruise Missile Technology Program a Critical Design Review (CDR) will occur in which the carbon-carbon material and its associated oxidation coating technology will be assessed. High-speed, cold turbine rotor spin tests along with static, high temperature test of oxidation coating material

will demonstrate the feasibility of the use of carbon-carbon material in the recuperational turbine engine. The boron slurry fuel formulation and rheology will be evaluated at the CDR to ensure compatibility with the recuperative engine. In the vehicle technology area, reactive threat analysis, basing options, launch options, system integration and survivability will be evaluated upon successful completion of the CDR. The program will proceed into a 24 month phase to demonstrate and validate the critical engine components, boron slurry fuel compatibility and critical vehicle technologies. Discussions with the Joint Cruise Missile Program Office and the Air Force Strategic Program Office indicate the possibility of a jointly funded effort with DARPA on the self-contained flight test demonstration of the Autonomous Terminal Homing Technology.

In the Air Vehicle Survivability Evaluation Program, the five frequency radar phenomenological data collection will be concluded by the end of the fiscal year. It will culminate in a final phenomenological model that will be demonstrated in the out years. Construction of both the surveillance radar and the equipment will begin. The tests, measurements, and analyses needed to develop verified engineering models of the key phenomena affecting the survivability/penetrativity of air vehicles will be performed. These results are critical to the confident determination of future missile force missions, structure and effectiveness air defense.

4. Program to Completion: In the Advanced Cruise Missile Technology Program, following the Critical Design Review in 1st quarter FY 1984, a 24 month phase will be commenced. During this phase, high temperature tests of heavyweight and flight combustor, engine static parts (turbine nozzle, case and ducts) and turbine rotor will be conducted for a carbon-carbon engineering qualification. The recuperative engine design concept will be validated. The boron slurry fuel and its associated fuel system will be demonstrated for compatibility. Critical vehicle technologies (radar cross section, aero and inlet performance) and the vehicle design concept will be validated. Additionally, study of potential benefits with existing cruise missiles and other applications will be evaluated during this phase. In early 1986 this program, following successful completion of the previously mentioned test and demonstrations, is scheduled to enter an Advanced Development Phase in which the propulsion technologies and vehicle technologies will be integrated to demonstrate the system feasibility of the long range cruise missile. In FY 1986, it is anticipated the program will be transitioned to the services for continuation of the advanced development phase and entry into a full scale development phase.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-5
Program Element: #62301E
USDR&E Mission Area: 530

Title: Strategic Delivery Vechicles
Title: Strategic Technology
Budget Activity: 1. Technology Base

The Air Vehicle Survivability Evaluation Program will perform the analyses, measurements and tests needed to develop verified engineering models of the key issues affecting survivability/penetration capability of air vehicles. These results are critical to the confident determination of future force missions, structure, and effectiveness in air defense. Further, the resulting understanding of potential will provide essential direction to our development of second generation missiles. State-of-the-art transportable instrumentation to demonstrate survivability rates of U.S. cruise missiles and other U.S. air vehicles. Extremely well instrumented data will allow designers and operational planners to assess current and future capabilities against our delivery vehicles. It will greatly assist these planners in maximizing our weapons-systems effectiveness in the face of Continual feedback to our designers will help assure maximum response to potential defensive threats as well as maximum use of phenomena that assist penetrativity. The equipment used to collect the basic phenomenological data At the end of FY 1985 the effort should transition to the U.S. Air Force.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Advanced Cruise Missile Technology Program		
Mid FY 1982	Early FY 1983	Initiation of propulsion, materials, avionics, structural and radar cross section (RCS) technology feasibility demonstration and test program Extended, Long-Range Integrated Technology Evaluation (ELITE).
--	Mid FY 1984	Critical Design Review of coated carbon-carbon material characterization, rotor spin test, boron fuel formulation. Decision to enter next phase.

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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-5
Program Element: #62301E
USDR&E Mission Area: 530

Title: Strategic Delivery Vechicles
Title: Strategic Technology
Budget Activity: 1. Technology Base

--	Mid FY 1986	Critical Design Review of critical engine components (combustor, turbine stator and rotor, ducting) boron fuel system, aero and inlet performance; decision to enter advanced development.

Air Vehicle Survivability Evaluation
(Previously Cruise Missile Detection Technology)

Mid FY 1983	Mid FY 1983	Specification of (VHF surveillance radar.
Mid FY 1983	Mid FY 1983	Initiate construction of
Late FY 1984	Late FY 1984	Produce final five frequency models.
Thru FY 1985	Thru FY 1985	Flight test
Late FY 1985	Late FY 1986	Transition program to U.S. Air Force.

Autonomous Terminal Homing (ATH) Program

Mid FY 1983	Mid FY 1983	Complete brassboard sensor flight testing.
Late FY 1983	Late FY 1983	Select single sensor/scene matcher combination.
Late FY 1983	Late FY 1983	Select TF/OA and damage assessment design approaches.
Mid FY 1984	Mid FY 1984	Complete integrated guidance unit design.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-5
Program Element: #62301E
USDR&E Mission Area: 530

Title: Strategic Delivery Vechicles
Title: Strategic Technology
Budget Activity: 1. Technology Base

Mid FY 1985	Mid FY 1985	Complete integrated guidance unit fabrication.
Early FY 1986	Early FY 1986	Complete IGU/Cruise Missile Integration.
Late FY 1986	Late FY 1986	Complete captive flight test.
End FY 1987	End FY 1987	Complete free flight demonstration.

6. Explanation of Milestone Changes: The Advanced Cruise Missile Technology Program previously reported Advanced Delivery Systems Program and Advanced Cruise Missile Engine Program have been combined into a single Advanced Cruise Missile Technology Program named the Extended, Long-Range Integrated Technology Evaluation (ELITE) program. The initiation of the ELITE program was delayed from mid FY 1982 to Early FY 1983 pending completion of concept design studies and the review of competing engine concepts. The field of engine concepts was narrowed in FY 1982 to the carbon-carbon recuperative engine.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-6 Title: Warning Technology
Program Element: #62301E Title: Strategic Technology
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The Warning Technology Project consists of Detection of Aircraft TEAL EMERALD and Detection from Space. Detection of Aircraft includes the determination of the Infra-red (IR) signatures of: (1) intercontinental and submarine launched ballistic missiles; (2) strategic aircraft and cruise missiles; (3) and (4) the natural and perturbed backgrounds against which these targets are observed from a spaceborne IR surveillance sensor. This project will provide the data base for the design of advanced space surveillance systems and will guide the development of the technology base. The HI-CAMP (Highly Calibrated Airborne Measurements Program) effort was initiated in FY 1981 to support the mission planning and flight operations of the TEAL RUBY Experiment (PE 62711E Project EE-02). HI-CAMP II includes the development, fabrication and flight test of a new, improved version of the highly successful HI-CAMP I infrared sensor system. The program will provide an IR data base through airborne measurements In TEAL EMERALD, a next-generation stabilized platform is being developed.

Detection from Space consists of the development of the core technology for space-based, radar concepts

Mission applications analogous to those for IR sensors will be assessed.

G. RELATED ACTIVITIES: These efforts are directly related to other programs under the cognizance of the Under Secretary of Defense for Research and Engineering as well as those of the following service units: Air Force: Directorates of Space Systems and Command, Control, Communications; Aeronautical Systems Division; Rome Air Development Center; Space Division; Rocket Propulsion Laboratory; and Geophysics and Avionics Laboratories; Army: Missile Research and Development Command and Harry Diamond Laboratories; and Naval: Weapons Center, Research Laboratory, Ocean Systems Center, Electronics Systems Command, and Postgraduate School. Service funding supports approximately twenty-five percent of this effort. DARPA sponsored task objectives are intentionally scoped well beyond the current specific Service goals and are coordinated through DARPA's Agents.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-6
Program Element: #62301E
USDR&E Mission Area: 530

Title: Warning Technology
Title: Strategic Technology
Budget Activity: 1. Technology Base

H. WORK PERFORMED BY: Ninety-five percent of this work is performed by industry and five percent by government laboratories. Major industrial contractors are: Lockheed Missile and Space Company, Palo Alto, California; Grumman Aerospace Corporation, Bethpage, New York; Raytheon Corporation, Bedford, Massachusetts; Texas Instruments Company, Dallas, Texas; General Electric Company, Syracuse, New York; SRI International, Menlo Park, California; Westinghouse Corporation, Baltimore, Maryland; Pacific-Sierra Research Corporation, Santa Monica, California; SAI Corporation, McLean, Virginia; and the McDonnell-Douglas Aircraft Company, Huntington Beach, California. Participating Universities include: the University of Southern California, Los Angeles, California; and the University of Arizona, Tuscon, Arizona. Government laboratories include: Air Force Geophysics Laboratory, Hanscom Air Force Base, Massachusetts; Rome Air Development Center, Griffiss Air Force Base, New York; Air Force Rocket Propulsion Laboratory, Edwards Air Force Base, California; Naval Research Laboratory, Washington, DC; Naval Ocean Systems Center, San Diego, California; and the Naval Postgraduate School, Monterey, California. Federal Contract Research Center support includes that of the Aerospace Corporation, El Segundo, California and the Institute for Defense Analyses, Arlington, Virginia.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Within the Detection of Aircraft project, the HI-CAMP II sensor sensitivity was improved by a factor of 10 through use of a redesigned focal plane array

Cryogenic dewar and focal plane drive electronics were completed and the focal plane subsystem development was nearly completed. New capabilities incorporated into HI-CAMP II included correlation tracking for lower contrast targets, night operation and the ability to measure dimmer targets than was previously possible. The line-of-sight stability of the stabilized gimbal platform was improved The improved gimbal system permits observations and pointing. In Detection from Space, fabrication of both the space-fed array and the array test fixture was begun. At years end, fabrication and test of prototype controllable phase-shifters were underway. Design and breadboard tests of the digital command and control section of the phase shift modules were completed. Achievements in the transceiver module effort included development of a monolithic microwave integrated circuit technology in both Silicon (Si) and

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-6
Program Element: #62301E
USDR&E Mission Area: 530

Title: Warning Technology
Title: Strategic Technology
Budget Activity: 1. Technology Base

Gallium Arsenide (GaAs)-based technologies. Final circuit designs were successfully completed and tested. All critical performance goals were achieved and fabrication of a mask set for the first monolithic transceiver chip was began. Because of the success of the GaAs device development, further work on the silicon technology was stopped in favor of GaAs in all of the frequency bands of interest. Preliminary design for the TEAL EMERALD was completed and critical design review work initiated.

2. FY 1983 Program: The HI-CAMP II subsystems hardware is being completed. The sensor and the gimbal platform are integrated and initial engineering tests are being conducted. The is being completed, including the installation of modules. Mechanical, pattern tests will commence. The first fully monolithic, single chip version is in fabrication and evaluation. Work continues on TEAL EMERALD

3. FY 1984 Planned Program: The HI-CAMP II equipment will be transitioned to a measurement program which will be closely coordinated with TEAL RUBY experiment mission planning. Testing and evaluation of the membrane will be completed. The monolithic module technology will be transitioned to a scaled demonstration program. A critical design review will be held on the TEAL EMERALD

4. Program to Completion: It is anticipated that elements of the IR measurement effort will continue to support the TEAL RUBY flight experiment. Certain aspects of the module technology will be adapted and improved for specialized applications. The TEAL EMERALD will be completed in FY and will undergo a series of tests.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Late FY 1983	Late FY 1983	Complete test of HI-CAMP II sensor

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-6
Program Element: #62301E
USDR&E Mission Area: 530

Title: Warning Technology
Title: Strategic Technology
Budget Activity: 1. Technology Base

--	Mid FY 1984	TEAL EMERALD
Late FY 1984	Late FY 1984	Complete HI-CAMP measurements
Early FY 1985	Late FY 1986	Complete HI-CAMP II Support
--	Early FY 1986	TEAL EMERALD testing.
Late FY 1983	Early FY 1984	Complete follow-on phase of space-based radar antenna membrane tests.
Late FY 1983	Early FY 1984	Complete gallium arsenide transceiver module.

6. Explanation of Milestone Changes: Completion of HI-CAMP II support of TEAL RUBY is delayed The follow-on portion of the phased array radar membrane tests will be completed later than anticipated because of delays in producing controllable (active) modules. Completion of the silicon module was deleted because all efforts were shifted to gallium arsenide technology. The completion date for development of the latter technology was slipped in order to maintain a comparable development schedule for the competing contractors. The TEAL EMERALD milestones are new

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-7
Program Element: #62301E
USDR&E Mission Area: 530

Title: Special Application Technology
Title: Strategic Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: This project consists of two major thrusts: Strategic Communications and Space Signal Processing. Strategic Communications is composed of several elements, the primary one being a vertical Very Low Frequency (VLF)/Extra Low Frequency (ELF) transportable communication system. This is a balloon supported vertical dipole antenna

A second component, called AM Internetting, is a program designed to form the AM radio broadcast stations into a network capable of surviving an Electro Magnetic Pulse attack Also included in this component is the development of monolithic array module technology aimed at frequencies in the region of the RF spectrum. This will eventually provide low cost satellite terminals in a frequency band most desirable for strategic satellite communications. Development of a programmable Electro-Optical (E-O) "mask" is underway. This unique device offers the potential for performing one billion multiplications per second and will have application to radar, E-O and communication systems.
Space Signal Processing consists of several elements, the primary one being the Advanced On-board Signal Processor (AOSP). The AOSP program will develop a multi-application, spaceborne signal processor using advanced architecture and high speed/low power micro-electronic technology. Its capabilities are aimed toward support of all projected military space missions to the year 2000. AOSP has a parallel processing architecture with a single building block called an array computing element. Each array computing element consists of a data processor for network control and a signal processor for task computation. This architecture is optimum for long life at minimum cost. In addition to silicon devices, gallium arsenide digital devices will be developed as a radiation-hard technology for the AOSP. The multi-dimensional processing element of this project addresses

Another thrust within this project is Autonomous Space Navigation using the Stellar Horizon Atmospheric Dispersion (SHAD) approach. By measuring the dispersion of light from known stars as viewed through the earth's atmospheric limb, a satellite or booster can uniquely determine its position in space. would provide routine economies of operation by reducing ground station workload and would greatly enhance survivability under hostile conditions. Incorporation of SHAD could provide improved capability against

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-7
Program Element: #62301E
USDR&E Mission Area: 530

Title: Special Application Technology
Title: Strategic Technology
Budget Activity: 1. Technology Base

G. RELATED ACTIVITIES: This project is related to programs of the Directorate of Space Systems and Command, Control Communications (jointly funded) at Headquarters Air Force, the Air Force Rome Air Development Center (jointly funded), the Defense Communications Agency, the Minimum Essential Emergency Communications Program (MEECN), the Naval Electronic Systems Command, the Office of Naval Research (jointly funded), and the Naval Research Laboratory.

H. WORK PERFORMED BY: Industry (88%), Government In-house Laboratories (2%), and Federal Contract Research Centers (FCRC) (10%). Contractors include: Raytheon Company, Sudbury, Massachusetts; Culler Harrison Inc., Santa Barbara, California; Hughes Aircraft Company, Culver City, California; Pacific Sierra Company, Santa Monica, California; Trans-Spectrum Corporation; Manhattan Beach, California; Grumman Aircraft Company, Beth Page, New York, Texas Instruments, Dallas, Texas; TRW, Los Angeles, California; General Electric Company, New York; McDonnell Douglas, Huntington Beach, California; and Charles Stark Draper Laboratories (CSDL). Government In-house Laboratories are: Rome Air Development Center, Rome, New York; and the Naval Ocean Systems Center, San Diego, California. The RAND Corporation, Santa Monica, California and the Institute for Defense Analyses, Arlington, Virginia are the FCRC's providing supporting analyses to the program. The Naval Research Laboratory, Washington, D.C.; and AF Geophysics Laboratory, Hanscom Airforce Base, Massachusetts.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: In FY 1982 the Passive Communications Satellite program was concluded. It was shown, technically, that a large passive reflecting structure could be constructed in space which could offer
In the Advanced On-board Signal Process (AOSP) program, eight array computing elements were constructed including both the data processor and the signal processor. These array computing elements were exercised with the software simulator to verify the performance of the operating system. The monolithic RF module technology initiated on the Space-Based Radar program was extended to higher frequencies in support of strategic space communications. Development of a three terminal device operating from was started. Both the Vertical Very Low Frequency/Extra Low Frequency (VLF/ELF) and the AM Internetting programs were shown to be viable concepts offering The radiation-hardened gallium arsenide Very Large Scale Integration (VLSI) development includes the demonstration of

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-7
Program Element: #62301E
USDR&E Mission Area: 530

Title: Special Application Technology
Title: Strategic Technology
Budget Activity: 1. Technology Base

random access memory. It is intended that this effort will be directed at the construction of an Advanced On-board Signal Processor (AOSP). A joint program with the Office of Naval Research (ONR) was initated to build a space flight experiment to validate the Stellar Horizon Atmospheric Dispersion (SHAD) approach to

2. FY 1983 Program: Development of three terminal devices operating in the range continues and efforts will begin on monolithic circuits. Under Space Signal Processing, the breadboard AOSP demonstration (consisting of eight array computing elements) is scheduled. A program to construct a brassboard AOSP will begin together with the necessary application software to demonstrate a specific satellite signal processing application. A demonstration of the Vertical Very Low Freequency/Extra Low Frequency (VLF/ELF) is being initiated as a joint program with the Navy. The effort to determine the feasibility of the AM Internetting concept continues with engineering design issues being addressed and the capability of such a process to provide is being assessed. There will be a preliminary design review for SHAD.

3. FY 1984 Planned Program: In FY 1984, final assembly of the brassboard AOSP will begin. Design will begin on an advanced AOSP design that employs the gallium arsenide digital technology. A small scale demonstration of the AM Internetting concept will be defined in order to evaluate the data and voice transmission capabilities of the system. Initial testing of the vertical VLF/ELF communication system will begin. This will be conducted with a fixed antenna before work begins on the mobile portion of this system. A critical design review and subsystem fabrication will be completed for SHAD.

4. Program to Completion: When the AOSP brassboard has been assembled, an application of the processor to the Defense Support Program (DSP) will be demonstrated using real time data. Also, a small area network of broadcast stations will be linked together to demonstrate the AM internetting concept. In addition, upon completion of the VLF/ELF testing, the mobile capability of this system will be demonstrated.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-7
Program Element: #62301E
USDR&E Mission Area: 530

Title: Special Application Technology
Title: Strategic Technology
Budget Activity: 1. Technology Base

5. Milestones: Milestones appearing in the FY 1983 Descriptive Summary for completion in FY 1982 have been completed except as indicated below:

Last Year's Reported Plan	Current Plan	Milestones
Mid FY 1982	Delete	Initiate design of transmit/receive terminals for Passive Communications Satellite.
Late FY 1982	Delete	Complete preliminary design of transmit/receive terminals for Passive Communications Satellite.
--	Early FY 1983	Conduct SHAD PDR.
Mid FY 1983	Mid FY 1983	Complete breadboard (eight array computing element) AOSP and test with simulation.
--	Early FY 1984	Conduct SHAD CDR.
--	Mid FY 1985	Initiate Testing of Vertical VLF/ELF Communication System.
--	Mid FY 1985	Conduct SHAD system integration and test.
--	Early FY 1986	Complete brassboard AOSP and test with application program.
--	Early FY 1986	Conduct SHAD on-orbit test and evaluation.
--	Mid FY 1987	Demonstrate operation of Transportable Vertical VLF/ELF Communication System.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-7
Program Element: #62301E
USDR&E Mission Area: 530

Title: Special Application Technology
Title: Strategic Technology
Budget Activity: 1. Technology Base

6. Explanation of Milestone Changes: Although the Passive Communications Satellite was shown to be technically feasible, practical limitations, resulted in the decision to conclude that program. Interest has shifted toward a survivable VLF/ELF concept and

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-8
Program Element: #62301E
USDR&E Mission Area: 530

Title: Space Object Identification
Title: Strategic Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The goal of this project is to develop and demonstrate advanced techniques for high payoff capabilities in space object identification. The Compensated Imaging System is designed to obtain near real time resolution satellites to assist in determining their function and evaluating any posed threat. With no compensation, only gross features can be observed with ground-based telescopes due to atmospheric turbulence distortion. The Compensated Imaging System not only provides useful images of satellites, but also is a convincing demonstration that optics is a viable technology. This optical technology will permit the development of several radically new strategic defense concepts, including space-based communication systems. The Compensated Imaging System will be operated on a routine basis with the USAF Strategic Air Command/Aerospace Defense Command This will end a productive, thirteen year development effort by DARPA in new technology for Space Object Identification. Historically, this effort has produced a sensor and two systems which are now providing uniquely The Compensated Imaging System complements these systems by providing visual images of a quality that was generally believed to be impossible prior to 1975.

G. RELATED ACTIVITIES: A USAF Program Management Directive has been generated for planning the transition of compensated imaging technology into Ground Electro-Optical Deep Space Surveillance (GEODSS) sites. Operational procedures and interface relationships have been established between USAF and DARPA for joint operations at the combined ARPA Maui Optical Station (AMOS)/Maui Optical Tracking and Identification Facility (MOTIF).

H. WORK PERFORMED BY: Ninety-eight percent of the effort is performed by private industry. The primary performers are: AVCO Everett Research Laboratory, Everett, Massachusetts; ITEK Corporation, Lexington, Massachusetts; Analytic Decisions, Inc., Arlington, Virginia; Optical Science Consultants, Yorba Linda, California; and Scripps Institute of Oceanography, San Diego, California. In addition, two percent of the effort is provided by Government in-house activities at the Rome Air Development Center, Griffiss Air Force Base, New York.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-8
Program Element: #62301E
USDR&E Mission Area: 530

Title: Space Object Identification
Title: Strategic Technology
Budget Activity: 1. Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: The key accomplishment was integration and successful test of the Compensated Imaging (CI) field unit on the large 1.6 meter telescope at the ARPA Maui Optical Station (AMOS)/Maui Optical Tracking and Identification Facility (MOTIF). This was a first time demonstration of large aperture real-time adaptive optics and serves to greatly increase confidence in the technology required by future adaptive optics laser systems. In addition, several space objects have been imaged

2. FY 1983 Program: The Laser Beam Director facility at AMOS is being used for laser ranging and illumination tests by other government agencies. Laser beam experiments are being performed in support of DARPA Directed Energy Office programs. A capability for the 1.6 meter telescope utility assessment is being completed. Infrared signature measurements are being made for the USAF Anti-Satellite (ASAT) program. DARPA performance evaluation and USAF operational evaluation of the CI field unit on the 1.6 meter telescope at AMOS is being completed.

3. FY 1984 Planned Program: Compensated Imaging System (CIS) operating procedures will be finalized with USAF Strategic Air Command/Aerospace Defense Command (SAC/ADCOM). This facility will provide the USAF, with real-time high quality optical imagery Together with the previously capability at AMOS/MOTIF, this will provide significantly improved characterization of near earth orbit satellites in fullfillment of the Space Object Identification function of ADCOM. The CIS, Laser Beam Director, and capabilities at AMOS will be transitioned to USAF for use as a national facility for experimentation in areas such as: space surveillance, laser beam measurements.

4. Program to Completion: Transition of project to USAF

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-8
Program Element: #62301E
USDR&E Mission Area: 530

Title: Space Object Identification
Title: Strategic Technology
Budget Activity: 1. Technology Base

5. Milestones:

Last Year's Report Plan	Current Plan	Milestones
Uncertain	Late FY 1982	Completed acceptance testing of Compensated Imaging (CI) Charge Coupled Device (CCD) camera.
Early FY 1982	No Change	Completed integration of CI Field unit with ARPA Maui Optical Station (AMOS) telescope.
Mid FY 1982	No Change	Completed feasibility demonstration of CI field unit.
--		Complete transition of AMOS/CI to USAF.

6. Explanation of Milestone Changes: Resolution of problems delayed in definitizing the milestone for completing acceptance testing of the Compensated Imaging (CI) CCD camera.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-9
Program Element: #62301E
USDR&E Mission Area: 530

Title: Submarine Laser Communications
Title: Strategic Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The DARPA/Navy Submarine Laser Communications (SLC) Program is developing th technology necessary for providing critical underwater communications using blue-green lasers. The specific payoffs of this technology would be: (1) providing critical messages to SSBN's at depth without compromising the submarine's natural covertness, thus helping to ensure the SSBN force's continued high level of survivability; (2) increased robustness and survivability of the C^3 system well into the post-attack period; (3) allowing the SSN to work most effectively in its own environment while providing it threat and target intelligence information in real-time; and (4) controlling a broad variety of pre-placed underwater assets, such as minefields and acoustic arrays.

The specific objectives of the DARPA/Navy SLC program are: (1) Develop technology for potential space-to-submarine communications with blue-green lasers (2) Exploit airborne tactical SLC as rapidly as is feasible; (3) Achieve an effective transition to the Navy for both SLC Airborne (SLCAIR) and SLC Satellite (SLCSAT) programs.

SLC System Concepts. In the near term blue-green laser communications could be used in operations involving aircraft and submarines, such as direct support or barrier operations. In this case the laser transmitter would be installed in a variety of aircraft; both carrier and land based. Threat and target data, as well as control orders, would be radioed from the battlegroup to the aircraft and converted into laser pulses. There would be no attempt or need to localize the submarine.

Equipment available for tests under realistic conditions in should be able to provide communications to depths of of the time.

In order to support operations where we do not control the air, use of satellites would be essential. There are two basic satellite approaches being pursued, but the technology is not yet advanced sufficiently to make a decision between the two based on cost, risk, and utility.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-9
Program Element: #62301E
USDR&E Mission Area: 530

Title: Submarine Laser Communications
Title: Strategic Technology
Budget Activity: 1. Technology Base

Whichever approach is used, mirror satellite (MS) or laser satellite (LS), the downlink beam would be expected to travel from the satellite through clouds to a diameter spot on the water. Data rates transmitted to submarines in this spot could be high, perhaps The message would be transmitted to a spot, then the beam is stepped to a new spot, and the message is retransmitted. The process could continue until the entire operating area is covered, and this procedure reduces the average data rate accordingly. The wide coverage area eliminates any possibility of the enemy's localizing the submarine.

SLC may permit radically new and effective ways of controlling the sea and projecting power using our stealthiest asset, the submarine.

G. RELATED ACTIVITIES: There are several supporting Navy programs in areas such as blue-green laser technology and optical oceanography. Other major technology areas, such as space optical systems and atmospheric compensation, are coordinated with ongoing Air Force, Navy, and DARPA programs through a variety of formal and informal mechanisms including joint use of facilities, personnel, and contracting agents.

H. WORK PERFORMED BY: Industry (85%), university (5%), and government in-house laboratories (10%). Contractors include: TRW, Los Angeles, CA; Hughes Aircraft Company, Los Angeles, CA; McDonnell Douglas Astronautics Company, St. Louis, MO; GTE Sylvania, Mountain View, CA; Lockheed Missiles and Space Company, Palo Alto, CA; AVCO, Everett, MA; Mathematical Sciences Northwest, Bellevue, WA; Itek Corporation, Lexington, MA; Northrop Corporation, Palos Verdes Peninsula, CA; Rockwell International, Canoga Park and Thousand Oaks, CA; Adaptive Optics Associates, Cambridge, MA; Eastman Kodak, Rochester, NY; Sanders Associates, Nashua, New Hampshire; a· Lincoln Laboratory, Lexington, MA. The university work is being done by the University of California's Scripps nstitute of Oceanography and the University of Arizona's Optical Science Center. In-house effort is being funded at the Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, D. C.; and Rome Air Development Center, Rome, New York.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-9
Program Element: #62301E
USDR&E Mission Area: 530

Title: Submarine Laser Communications
Title: Strategic Technology
Budget Activity: 1. Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: In support of SLC program objectives and the major decision points of 1984/5 (described in the following sections), technology development, experiments, and designs for major tests have been conducted in three areas: tactical airborne SLC and both laser satellite and mirror satellite approaches. For SLCAIR, final designs for the two SLC receivers to be used in the SLCAIR experiments were completed and the first receiver modules underwent initial laboratory testing. A laser module cavity for the transmitter has undergone and has demonstrated power output at

For the laser approach to SLCSAT, the principal risk area is the laser itself, and a major effort identified the spacecraft engineering issues associated with each of the candidate space laser technologies. This information has been used to restructure the laser technology development program; increased emphasis on new solid-state laser candidates at the expense of electric-discharge-driven gas lasers may provide a technology which is more compatible with the expensive and time-consuming space engineering and qualification process. HgBr lasers demonstrated lifetimes in excess of 100,000,000 shots at low power and efficiencies greater than 2%. Two XeCl lasers demonstrated greater than 4% efficiency in the ultraviolet with potential efficiencies of as much as 2% after conversion into the blue-green. HgBr and XeCl have a potential performance of greater than 1% overall system efficiency. A densely-packed array of diodes has been constructed as a first step in a diode-pumped solid state laser development effort which has potential of achieving system efficiencies in a very rugged and reliable package. Moreover, a novel concept in which CdS is pumped with a low voltage electron beam has shown efficiencies at very low power levels.

For the mirror satellite approach the greatest risk in a first SLCSAT experiment is the integration of the many complex technologies required for successful operation. Therefore, this effort focused on a preliminary design effort and associated technology development activities in several areas -- including adaptive optics, pointing and tracking, mirror panel fabrication and control, coatings, and lasers. The Lincoln Laboratory atmospheric compensation experiment demonstrated transmission of a low-power laser beam on a horizontal path through the atmosphere with a turbulence equivalent to that expected on the full vertical path through the entire atmosphere. A novel wavefront sensor device which consists of a fusion of the leading edge of sophisticated

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-9
Program Element: #62301E
USDR&E Mission Area: 530

Title: Submarine Laser Communications
Title: Strategic Technology
Budget Activity: 1. Technology Base

optics and self-reconfiguring microprocessors demonstrated performance as predicted in first tests; this sensor concept offers a factor of 10 to 100 reduction in complexity, weight, size, and cost when compared with current techniques. Two methods of correcting the previously uncorrectable "uncommon path" portion of optical systems were demonstrated. Conceptual and preliminary design efforts were completed on the space and ground components of a potential SLCSAT experiment which scales from the 70 channels of the Lincoln Atmospheric compensation experiment to the required for an operational system. An experiment in converting high energy pulses of ultraviolet light into the blue-green resulted in more than of blue-green laser light in a single pulse of approximately 2 microseconds duration; this is several times the value required for a first SLCSAT experiment with residual operational capability.

2. FY 1983 Planned Program: For SLCAIR the two receivers will be delivered to the government for laboratory testing. The transmitter will be undergoing final phases of fabrication. For SLCSAT technology, by the end of FY 1983 the first experimental
Raman conversion experiments will demonstrate highly efficient, stable operation with XeCl lasers, and HgBr devices will undergo additional life and efficiency developments. The
The atmospheric compensation field experiments will commence testing transmission of a beam to a high-altitude aircraft, and technology for a deformable mirror will be demonstrated.

3. FY 1984 Planned Program: At sea tactical airborne SLC tests will be conducted in local operating areas and under the more severe cloud and water conditions characteristic of northern latitudes. The objective of the 1984 tests will be to extend the 1981 propagation results to full performance depths under daylight and stressing cloud and water conditions. It is anticipated that it will be possible to communicate to the test submarine to depths in excess of

Laser atmospheric compensation tests through the
Technology development activities for adaptive optics, ground lasers, space mirrors, and space-based lasers will terminate by the end of the year. At that time the approach to be taken into further technology development for use in an eventual SLCSAT experiment, if warranted, will be determined.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-9
Program Element: #62301E
USDR&E Mission Area: 530

Title: Submarine Laser Communications
Title: Strategic Technology
Budget Activity: 1. Technology Base

4. Program to Completion: The overall program strategy is to achieve early (1984/1985) tests under realistic conditions of technology supporting airborne tactical SLC and to transition that part of the program to the Navy for engineering development and exploitation. In the far term, the program is structured to support an informed deployment decision in for a SLC satellite system. The SLCAIR portion is defined by SLCAIR-84/5 experiments and operational-like tests. The eventual deployment decision will be based on technology development and demonstration, subsystem-level experiments, Navy operational utility and survivability assessments, and a potential first end-to-end SLC satellite experiment (SLCSAT-1). In the near term, the technology efforts are geared toward supporting a FY 1984 decision on what, if any, SLCSAT-1 technology is to be continued leading to an eventual SLCSAT experiment. SLCSAT-1, if launched, will have a residual operational utility, will be capable of resolving remaining experimental issues and will be based on completely scalable technology.

5. Milestones: The milestones cited in the FY 1983 Descriptive Summaries have been completed or are expected to be completed on schedule. There are no changes.

Last Year's Reported Plan	Current Plan	Milestones
Late FY 1982	Complete	
Mid FY 1983	Mid FY 1983	30 cm aperture, submarine compatible receiver complete.
Mid FY 1983	Complete	Mirror satellite preliminary design.
Late FY 1983	Late FY 1983	
Mid FY 1984	Mid FY 1984	
Late FY 1984	Late FY 1984	

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #ST-9
Program Element: #62301E
USDR&E Mission Area: 530

Title: Submarine Laser Communications
Title: Strategic Technology
Budget Activity: 1. Technology Base

Late FY 1984	Late FY 1984	Continued technology development and detailed design initiation *decision point for first* end-to-end Submarine Laser Communication Satellite Experiment (SLCSAT-1).
Mid FY 1985	Mid FY 1985	

6. Explanation of Milestone Changes: Milestones remain the same as reported in last year's Descriptive Summary.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: ST-10 Title: Strategic Computing and Survivability (New Start)
Program Element: 62301E Title: Strategic Technology
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: This program will develop advanced supercomputers and associated device technology, and demonstrate their application to specific Defense problems. Several experimental high performance computing machines will be developed; low power, radiation hard Gallium Arsenide microcircuit technology will be developed and one or more pilot fabrication lines established for Defense use. A Very Large Scale Integrated (VLSI) systems technology will be developed to enable rapid prototyping of state-of-the-art multi-processor systems including new ceramic and optoelectronic systems for packaging and interconnection. Large scale design and automated assembly and testing will be pursued. Emulation systems will be explored and developed, if appropriate, to enable alternate system architectures to be investigated and evaluated. Machine architectures will be explored which are efficient for both symbolic and large scale numeric applications. System support software such as multi-processor operating systems, microprogramming tools and software aids will be developed. Innovative computer architectures will be prototyped and a new generation of hyperspeed computer applications will be developed and demonstrated, including speech understanding, vision systems, robotics, knowledge base applications, natural language man-machine interfaces, high performance graphics and defense applications of artificial intelligence. Specific defense AI applications will include such important military problems as photo interpretation, aircraft carrier command and control, logistics scheduling, data fusion, and a pilot's assistant. Other computationally intensive applications such as signal interpretation, strategic target planning, aerodynamic simulation, and cryptographic analysis will also be explored.

G. RELATED ACTIVITIES: The Defense software technology initiative will augment this effort by providing a methodology for life cycle maintenance of complex state-of-the-art software systems. The Defense supported Josephson Junction research is addressing high performance device technology. The VHSIC program is addressing special purpose VLSI chips for military signal processing applications. The S-1 multiprocessor system under development in the Navy is exploring one approach to multiprocessor architecture potentially useful for super speed computer applications.

H. WORK PERFORMED BY: It is expected that this effort will be carried out by industry and university teams working together. Approximately 5% of the work will be done by FCRC's or in-house.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplisments: This is a new program being initiated in FY 1983.

2. FY 1983 Program: Construction of a 64-node high performance emulation facility is being initiated along with assembly of a Gallium Arsenide pilot fabrication line. Gallium Arsenide random access memories are being designed and architectural requirements for defense AI applications are being developed.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: ST-10 Title: Strategic Computing and Survivability (New Start)
Program Element: 62301E Title: Strategic Technology
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

3. FY 1984 Planned Program: The Gallium Arsenide pilot fabrication line will be activated and designs for random access memories and gate arrays completed. VLSI systems technology will focus on the development of automated printed circuit board and interconnect technology integrated into existing VLSI design systems. Circuit and system level simulation software will be developed for multi-board systems of VLSI components. Techniques will be developed for integration of wafer scale VLSI systems including the associated process, device and packaging concepts. Development of a high performance emulator will be continued and the software will be designed to emulate a tagged token data flow architecture. Small-scale versions of the ultracomputer and connection machine architecture will be initiated. Software support system and languages for microprogrammable multi-processors will be developed. Generic hyperspeed computer applications development will be initiated including speech understanding, knowledge representation systems, natural language and high performance graphics. Defense AI applications will be initiated in such diverse areas as photo interpretation and aircraft carrier command and control.

4. Program to Completion: One or more advanced supercomputers and their applications will be developed and demonstrated. The Gallium Arsenide process technology will be developed along with the corresponding interconnect and packaging techniques; design systems for high performance computing will be developed and several prototype high performance multi-processor systems will be developed and demonstrated. The emulation facility will be completed and used to emulate various multi-processor architectures. A low cost symbolic micro processor system will be developed and demonstrated. The supporting system software design and simulation capabilities will be completed. Defense specific applications in areas such as photo intepretation, target detection and tracking, language translation, command and control automation, robotics, pilots assistance and logistics scheduling will be demonstrated. One or more advanced applications requiring high speed vector processing will be explored.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
---	Late FY 1984	Gallium Arsenide (GaAs) Pilot fabrication line in operation.
---	Late FY 1984	Speech Understanding system design completed.
---	Mid FY 1985	Initial Emulation Facility operational.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: ST-10 Title: Strategic Computing and Survivability (New Start)
Program Element: 62301E Title: Strategic Technology
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---	Mid FY 1985	Design of low cost symbolic processing system completed.
---	Late FY 1985	Printed circuit board automation over the Arpanet.
---	Early FY 1986	Initial automated computer assembly and testing.
---	Late FY 1986	Initial data flow emulator completed.
---	Early FY 1987	GaAs random access memories and gate arrays fabricated for space systems demonstration.
---	Early FY 1987	Innovative multi-processor architectures demonstrated with speed potential to 1000 times current supercomputer speeds.

6. Explanation of Milestone Changes: Not applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62702E
USDR&E Mission Area: 530

Title: Tactical Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
FY 1983 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		$84,715	$103,900	$139,700	N/A	Continuing	N/A
FY 1984 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		$76,700	$93,500*	$120,800*	$148,500*	Continuing	N/A
TT-1	Target Acquisition and Engagement	26,497	22.225	17,412	20,200	Continuing	N/A
TT-2	Weapons Technology and Concepts	21,717	21,635	24,738	29,050	Continuing	N/A
TT-3	Naval Warfare	23,438	31,675	34,850	28,650	Continuing	N/A
TT-4	Advanced Armor Technology	5,048	7,900	6,900	5,700	Continuing	N/A

*Total includes classified project not identified herein.

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is dedicated to the development of advanced technologies and concepts that will serve as the basis for development of the next generation, tactical systems. The overall program goal is to substantively advance non-nuclear, tactical, combat capabilities with careful consideration to both realistic cost and Service manpower constraints. The program technology development objectives are grouped into four major categories: (1) improving target acquisition and engagement capabilities; (2) advancing fire control, seeker, command and control and weapon technology; (3) improving tactical naval warfare capabilities; and (4) improving armor technology, all to counter the expanding tactical threats.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62702E
DoD Mission Area: 530

Title: Tactical Technology
Budget Activity: 1. Technology Base

C. BASIS FOR FY 1984 RDT&E REQUEST: Overall project objectives are to develop advanced technology for the following applications: (1) detection, acquisition and engagement of enemy ground and airborne targets with bistatic radar sensors and weapons that, if successfully developed, will form the basis for a new generation of survivable battlefield systems with expanded performance capabilities; (2) the development of surveillance and targeting concepts against next generation, low radar cross section, stealth vehicles; and (3) advanced imaging infrared and millimeter wave radar seekers which may be applied to both gun-fired projectiles and missiles. Major emphasis has been placed on developing the technology for (4) a concept to target critical battlefield control nodes, (5) new indirect fire cannon concepts, (6) an all digital radar capable of multi-mode, adaptive operation in an Electronic Countermeasure (ECM) environment, and (7) use of electro-magnetic propulsion for gun applications. Additionally, (8) a major exploratory effort is under way to develop means to integrate and correlate the outputs of a spectrum of wide area surveillance sensors to provide Over-the-Horizon (OTH) targeting information to commanders at sea. Similiarly, (9) work is also underway on the development of a array with a satellite data read-out, (10) long haul fiber optic cables and acoustic array sensors for ocean surveillance and (11) small, long endurance, unmanned undersea vehicles for a variety of mission applications. In the tactical ASW area, efforts will begin, (12) the development of drag reduction and energy storage technologies critical to advanced torpedo designs, (13) and the development of a new class of advanced submarine conformal sonar arrays embodying a newly developed technology base in hydrophones, platform noise reduction, and array beamforming. The objective of the armor technology effort (14) is to explore and demonstrate the technical feasibility of advanced armor systems to provide ballistic protection against large and small caliber munitions.

D. COMPARISION WITH FY 1983 DESCRIPTIVE SUMMARY: The FY 1983 budget reflects a reduction of $10.0 million from the FY 1983 Descriptive Summary request. The Descriptive Summary portion of the FY 1983 Congressional Budget submission requested $103.9 million for PE 62702E in FY 1983. However, the accompanying R-1, "RDT&E Programs" exhibit contained an administrative error which identified the FY 1983 request as $93.9 million. Despite requests to correct this discrepancy, the Appropriation Bill contained the incorrect total for this PE. This unrectified error has necessitated a reduction and re-baselining of the Electromagnetic Force (EMF) Gun program and the postponement of the initiation of a classified program. These actions taken to absorb the FY 1983 reduction also resulted in program delays which reduced the FY 1984 requirements for the EMF Gun program and the classified program.

E. OTHER APPROPRIATION FUNDS: None

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-1
Program Element: #62702E
!SDR&E Mission Area: 530

Title: Target Acquisition and Engagement
Title: Tactical Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The major goal of this project is to significantly increase the U.S. forces' capability to acquire and engage tactical targets. A significant problem on the battlefield of the future is to locate, identify, and attack the enemy in both first and second echelon formations in weather, at night, and while encountering defensive weapons, electronic countermeasures, and deception tactics. This project includes sensor and weapons programs, each of which is designed to meet a current mission shortfall with advanced technology. To meet this project goal, five ongoing elements are included: (1) bistatic radar techniques to increase radar survivability by separating the vulnerable transmitter from the radar receiver; this element includes the Tactical Bistatic Radar Development (TBIRD) program and the Bistatic Alerting and Cueing (BAC) program which use existing transmitters, such as AWACS, operating with separate receivers for short range air defense; (2) a closed loop, deception electronic countermeasures concept, called Surgical Countermeasures, to operate against advanced radars and missile seekers; (3) advanced detection and engagement concepts for defense against next generation cruise missiles and low cross section air vehicles, called Cruise Missile Defense; (4) integrated active and passive location techniques called Critical Node Targeting, for engaging second echelon force elements such as command posts and staging areas; and (5) the All Digital Radar, which will use a digital signal processor to form array radar antenna beams as well as process their output signals, providing enhanced detection and tracking capabilities.

G. RELATED ACTIVITIES: Project interaction with the Services include early information exchanges, with transition to joint developments when common program objectives and technology issues are identified. The Tactical Bistatic Radar Development (TBIRD) is jointly funded with the Air Force and forms the basis for the USAF's Covert Strike program, PE #63103F. The Surgical Countermeasures program is jointly funded with the Navy, under a Memorandum of Agreement, and exploits technology developed earlier by the Navy, under Program Element 62712N. Both the Cruise Missile Defense and Critical Node Targeting programs are being developed and funded jointly with the U.S. Air Force. The All Digital Radar is being developed and funded jointly with the U.S. Army Missile Command and the USAF Rome Air Development Center.

H. WORK PERFORMED BY: All the efforts are funded with industry, which include: MIT/Lincoln Laboratory, Lexington, Massachusetts; International Business Machines, Gaithersburg, Maryland and Owego, New York; Technology Service Corp., Santa Monica, California; Hughes Aircraft Company, El Segundo, California; General Electric, Utica,

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-1
Program Element: #62702E
USDR&E Mission Area: 530

Title: Target Acquisition and Engagement
Title: Tactical Technology
Budget Activity: 1. Technology Base

New York; TRW, Redondo Beach, California; Norden Systems, Melville, LI, New York; Raytheon Corporation, Lexington, Massachusetts; Advanced Information and Decision Systems, Inc., Mountain View, California; E-Systems, Garland, Texas; Stanford Research International, Menlo Park, California; and Systems Control Technology, Palo Alto, California.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: The Surgical Countermeasures (SCM) program completed analytical studies for angle deception. The studies used the experiences gained from previous anechoic chamber tests. Added to the scope of the studies was the use of multiple deception emitters to introduce spatial separation for angle deception. Static field tests were begun as planned in mid FY 1982 with measurements of radar observables and vulnerabilities against a fixed threat radar simulator.

The Tactical Bistatic Radar Development (TBIRD) program performed preliminary flight testing of the airborne bistatic SAR (synthetic aperture radar) mode. The test demonstrated ability of two airborne platforms to maintain coherence to one part in 10^9 and produced a low quality SAR image. Flight testing was terminated prior to the completion of the flight test program due to higher priority commitments of the test aircraft.

Fabrication of the Bistatic Alerting and Cueing (BAC) testbed was started. The Cruise Missile Defense program continued to analyze new sensor and signal processing concepts for detecting, tracking and engaging very low cross section air vehicles flying at low altitudes. Concepts include forward scatter and multistatic radars, specialized signal processing, low cost proliferated sensors, and over the horizon radars.

The Critical Node Targeting program completed the physical, electronic and operational description of the twenty combat nodes. The definition of the electronic environment, which is used to define sensor capabilities, is nearing completion. The acquisition strategy, groups of exploitable signatures, have been completed for all targets. The integration of the acquisition strategy and the environment was initiated to define the sensor requirements: moving target indication and track, signal intercept, and imaging. The All Digital Radar design studies were postponed to FY 1983 for budgetary reasons.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-1
Program Element: #62702E
USDR&E Mission Area: 530

Title: Target Acquisition and Engagement
Title: Tactical Technology
Budget Activity: 1. Technology Base

2. FY 1983 Program: In the Surgical Countermeasures program the static tests are being completed at the Naval Weapons Center, China Lake, California. Added to the field test program are dynamic tests against an airborne threat radar simulator over water later in the FY. The tests demonstrate the effectiveness of the SCM method against anti-ship missiles in a realistic variable-range environment with reflections from the water surface. The program is completed with these final tests and transitions to the Navy by the end of the FY.

The Tactical Bistatic Radar Development effort, jointly funded with the Air Force (62204F) flight demonstrates: Wide bistatic angle SAR (synthetic aperture radar) mode; SAR imaging of the velocity vector of the attacking aircraft; and limited electronic countermeasures resistance. The flight testing will be completed in FY 1983 and the technology will be transitioned to the Air Forces Covert Strike program, 63103F. The system design analysis for the Critical Node Targeting program will define the sensor and integration technology issues for the initial systems construct. Multiple contracts will be issued to perform competitive system designs concentrating on the technology issues identified in the MITRE Corp system design analysis. The system design will define the sensor suite and support systems to acquire, classify and target the combat nodes already identified.

The Tactical Bistatic Radar Development testbed fabrication of the Bistatic Alerting and Cueing system is completed and an extensive field test program will be initiated as a prelude to turning the system over to the Army for incorporation as a sensor in their distributed battle field surveillance and SHORAD (Short Range Air Defense) concepts. The Cruise Missile Defense program is conducting laboratory and limited field testing of several sensors and is initiating a new thrust in airborne intercept and engagement sensors for low cross-section targets. The All Digital Radar program is conducting multiple parallel design and analysis studies to address operational and application questions, as well as resolving critical technical issues, prior to embarking on a validation experiment.

3. FY 1984 Planned Program: For FY 1984, the Bistatic Alerting and Cueing and Tactical Bistatic Radar Development program will have completed a joint field demonstration and, if successful, transitioned, to the U.S. Army for advanced development. In the Cruise Missile Defense program, operational requirements and technical interfaces will have been identified and design/fabrication of testbeds for the selected approaches begun. The systems will be transferred to the Critical Node Targeting effort. The All Digital Radar testbed will be initiated with the incorporation of several promising approaches in a common testbed processor.

Project: #TT-1
Program Element: #62702E
USDR&E Mission Area: 530

Title: Target Acquisition and Engagement
Title: Tactical Technology
Budget Activity: 1. Technology Base

The multiple design solutions to the Critical Node Targeting effort will be evaluated and down-selected to a single approach using both active and passive sensors. A final design review will be completed and hardware fabrication will be initiated.

4. Program to Completion: This is a continuing program. New initiatives will be evaluated as technology options permit. The bistatic hybrid radar technology will have been transferred for both retrofit and new radar development by the Services, starting in FY 1984. Field demonstrations of new Cruise Missile Defense technologies will be continuing through FY 1985; Service transition is anticipated in late FY 1985. Field demonstration of the Critical Node Targeting testbed will commence in the United States in FY 1986, continuing into FY 1987 with a European demonstration; Service transition is anticipated in FY 1987. The All Digital Radar feasibility demonstration will be completed, and the program transferred to the U.S. Army for further development in several radar applications. Surgical Counter Measures (SCM) field tests, which were begun as planned in mid FY 1982, continued into early FY 1983 as a result of required further adjustments Added to these static tests are now field tests over water, to investigate SCM effectiveness against anti-ship missiles. These dynamic tests are a new milestone for late FY 1983 and also signify the transition of this program to the Navy.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Mid FY 1982	Late FY 1983	The Tactical Bistatic Radar transitions to advanced development.
Early FY 1983	Mid FY 1983	Testing of the Bistatic Alerting and Cueing (BAC) testbed will be initiated.
--	Late FY 1983	Dynamic tests for Surgical Countermeasure program. Transition to Navy.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-1
Program Element: #62702E
USDR&E Mission Area: 530

Title: Target Acquisition and Engagement
Title: Tactical Technology
Budget Activity: 1. Technology Base

Last Year's Reported Plan	Current Plan	Milestones
Mid FY 1984	Late FY 1983	METASCAN receiver transitioned to Critical Node Targeting Program.
Mid FY 1985	Late FY 1986	Demonstration on Critical Node Targeting Testbed in Europe.
--	Early FY 1984	The conceptual design studies for the new Digital Radar program will be completed.

6. Explanation of Milestone Changes: Tactical Bistatic Radar flight test results were not sufficient to warrant transition to advanced development in mid FY 1982 as planned. Bistatic Alerting and Cueing (BAC) testbed completion was slipped 3 months to permit adequate time for system integration and checkout. The METASCAN receiver effort will be transitioned to the Critical Node Targeting Program at the completion of the currently scheduled test and evaluation period which is currently projected to be late FY 1983. The Critical Node Targeting Testbed demonstration had slipped 18 months due to funding limitations in the program definition stages of the effort.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-2
Program Element: #62702E
USDR&E Mission Area: 530

Title: Weapons Technology and Concepts
Title: Tactical Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The overall objective of Weapons Technology and Concepts is to offset the greater number of enemy weapon systems on the modern battlefield with the increased effectiveness of our weapon systems. This project includes the development of advanced seeker technologies for precision guided munitions and the demonstration of those technologies in both direct and indirect fire weapon systems; the development of new propulsion technologies for direct and indirect fire weapon systems; and investigation of new concepts for enhancing battlefield command and control. The Advanced Indirect Fire System (AIFS) program has absorbed the Advanced Seeker Signal Processing (ASSP) program. Two subprograms have been established in AIFS, the Advanced Autonomous Seeker Technology (AAST) subprogram and the Advanced Technology Ramjet (ATR) subprogram. The AIFS (AAST) subprogram concentrates on developing advanced lock-on-after-launch millimeter wave and infrared seeker technologies with tri-service applicability to artillery, missiles, rockets and terminally guided submunitions (TGSM) against a wide class of ground targets. The program addresses the following technical issues: alogrithm development, signal processing speed and capacity, countermeasures (CM), counter-countermeasures (CCM), and data bases applicable to MMW and infrared technologies. Promising components and packaging concepts are being pursued to insure practical realization of program goals. Means for incorporating artifical intelligence and knowledge-based systems concepts will be investigated to determine possible performance improvements and feasibility of hardware implementation. The AIFS(ATR) subprogram concentrates on developing advanced ramjet propulsion technology for a variety of applications. A major effort is the development of the Ramrod concept, a solid fueled, Mach 5, ramjet powered, rod penetrator which is fully compatible with the 105mm tank gun and is adaptable to the 120mm gun system. A second ramjet development is a highly accurate long range (over 60 KM) 8" Howitzer Solid Fueled, Variable Thrust (Thrust=Drag) Ramjet projectile. A third ramjet project centers on development of a metal-boron solid fuel integral rocket ramjet propulsion system which may be used in fleet surface to air missiles (SAM) and surface strike weapon (SSM) systems. Other ramjet technology issues being examined include dual mode combustion scramjets (subsonic combustion and supersonic combustion), inlet design requirements and aerodynamic controls.

The Electro-Magnetic Gun (EMG) program explores the utilization of electro-magnetic energy instead of chemical energy to provide propulsion for gun and launcher applications. The primary purpose of this program is to demonstrate the feasibility of this technology for military application by developing an EMG laboratory launcher system and ultimately technology demonstration systems for air defense, armor, artillery or strategic applications.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-2
Program Element: #62702E
USDR&E Mission Area: 530

Title: Weapons Technology and Concepts
Title: Tactical Technology
Budget Activity: 1. Technology Base

The EMG hypervelocity laboratory launcher will provide a unique capability for basic and applied research in electromagnetic propulsion and terminal ballistics by providing a capability to accelerate projectiles to hypervelocities (3000 meters per second). A new program entitled Special Operations Technology (SOT) is being established to revitalize and expand the capabilities of the nation's special operations communities. Army Special Forces, Navy SEAL and UDT Teams and various Air Force personnel conduct similar missions requiring unique and specialized equipment which are not needed by main line forces. This program will address the critical needs as they are perceived by the special operations communities and will deal, early on, with technologies for improving underwater and air mobility, communications and position location, specialized weapons, and bulk and weight reduction of combat gear.

G. RELATED ACTIVITIES: The Electro-Magnetic Gun (EMG) program is a joint effort with the Army Armaments Research and Development Command (ARRADCOM) and has maintained close ties with related work pursued by both the U.S. Air Force and the Government of Australia. Further, the U.S. Navy's on-going program in pulsed power sources (funded through both the Office of Naval Research and the Naval Air Systems Command) can be expected to contribute in the area of energy supplies and storage devices for electro-magnetic gun-type weapons. The entire Department of Defense (DoD) effort is coordinated by a "DoD Working Group", which includes representatives of the Services, the national laboratories, and DARPA. DARPA will demonstrate the feasibility of EMG technology for military development, and ARRADCOM will have primary Service responsibility for implementing the technology in advanced development programs. The AIFS Advanced Autonomous Seeker Technology subprogram enhances technology developed under Assault Breaker and the Advanced Seeker Technology program and has an "all Service" application potential. The AIFS Advanced Technology Ramjet subprogram is developing solid fuel ramjet propulsion which can be applied to a wide variety of missiles (SSM, ASM, AAM, SAM, GLCM) and projectiles.

H. WORK PERFORMED BY: Approximately 85% of the work is performed by industry, 5% by universities, and 10% by DoD in-house laboratories. The principal contractors are: Hughes Aircraft Corporation, Canoga Park, California; Martin Marietta Corporation, Orlando, Florida; McDonnell Douglas Corporation, Torrence, California; Norden Systems, Incorporated, Norwalk, Connecticut; Texas Instruments, Dallas, Texas; and Northrop Corporation, Palos Verdes, California. Universities include: University of California - Los Alamos Scientific Laboratories, Los Alamos, New

Mexico; Lawrence Livermore Laboratories, Livermore, California; Massachusetts Institute of Technology, Cambridge, Massachusetts; University of Texas, Austin, Texas; and U.S. Naval Postgraduate School, Monterey, California. Government laboratories are: U.S. Army Armaments Research and Development Command, Dover, New Jersey; U.S. Army Missile Command, Huntsville, Alabama; U.S. Air Force Armament Development Test Center, Eglin Air Force Base, Florida; White Sands Missile Range, New Mexico; and U.S. Naval Surface Weapons Center, White Oaks, Maryland.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments:

Advanced Indirect Fire System (AIFS): This program was initiated in early FY 1979 to develop an advanced technology, artillery autonomous weapon system with self-contained target acquisition. During FY 1982 the AIFS program absorbed the Advanced Seeker Signal Processing program. Two subprograms were established, the Advanced Autonomous Seeker Technology subprogram and the Advanced Technology Ramjet subprogram. The expanded scope of the AIFS program encompasses a wider application of autonomous seeker development and a more intensive approach to ramjet propulsion development. Application of these base technologies is no longer limited to cannon launch fire-and-forget projectiles, but now considers a much wider application potential such as surface to air missiles, air to surface missiles, surface to surface missiles, air to air missiles and ground launched missiles.

Electro-Magnetic Gun (EMG): By FY 1980, engineering designs were completed and fabrication initiated for a large hypervelocity laboratory rail gun intended to accelerate a projectile to a velocity of 3 kilometers per second. This device has been installed at the Army Armaments Research and Development Command (ARRADCOM), Dover, New Jersey, where it is being used in a coordinated program for advancing the technology base in rail gun components, power supplies, projectiles, and hypervelocity terminal ballistics. Simultaneously, several alternative electromagnetic launcher configurations were examined, including explosively driven rail guns, plasma pinch accelerators, and helical rail guns capable of launching small gliders at high payload efficiencies.

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Project: #TT-2
Program Element: #62702E
USDR&E Mission Area: 530

Title: Weapons Technology and Concepts
Title: Tactical Technology
Budget Activity: 1. Technology Base

Substantial progress was achieved in reducing the size and weight of homopolar generator power sources capable of supplying the energy required (tens of Megajoules) for weapon scale launchers. Operational analyses were completed for gun systems incorporating emerging electro-magnetic propulsion technologies and indicated that the significant increases in projectile speeds can produce major increases in effectiveness in applications where reduced time-of-flight and/or increased projectile kinetic energy are important factors.

Advanced Seekers Technology: During FY 1982, progress was made on the development of long wavelength infrared (LWIR) focal plane arrays and improved trackers. As reported above, this and earlier work will be factored into the AIFS Advanced AUtonomous Seeker Technology sub-program.

2. FY 1983 Program:

Electro-Magnetic Gun (EMG): The final components for the EMG laboratory hypervelocity launch system are fabricated and assembled, and preliminary commissioning tests completed. The laboratory launch system has been installed at the Army Armaments Research and Development Command (ARRADCOM), Dover, New Jersey. The performance objectives for the laboratory launch system were to accelerate a mass to 3000 m/sec.

Further experimentation is being carried out on the EMG launching of military projectiles (for anti-air warfare), and initial concept design studies are being commissioned for the first of the proposed military demonstration systems (an EMG artillery launcher).

Project: #TT-2
Program Element: #62702E
USDR&E Mission Area: 530

Title: Weapons Technology and Concepts
Title: Tactical Technology
Budget Activity: 1. Technology Base

Advanced Indirect Fire System (Advanced Autonomous Seeker Technology) (AIFS(AAST)): Development and refinement of target acquisition algorithms for imaging infrared seekers and their implementation in real-time capable hardware will continue. Phase I will be completed with helicopter captive flight test of the seeker/signal processor and the technology will be transitioned to the U.S. Army for Phase II development and demonstration in an advanced TGSM. Extended captive flight testing of two MMW radar autonomous lock-on-after-launch seekers will continue through FY 1983. Evaluation of the results of these tests, which are being conducted in challenging clutter environments, and against a wide variety of targets, will determine the utility of weaponization of these seeker concepts. Other alternative MMW and imaging infrared seekers, are being evaluated during FY 1983.

Advanced Indirect Fire System (Advanced Technology Ramjet) (AIFS(ATR)): The 8" Howitzer Solid Fuel Variable Thrust (Thrust=Drag) Ramjet projectile is starting its final phase of development in FY 1983. The Ramrod, solid fuel ramjet propelled hypervelocity rod penetrator is beginning critical component development in FY 1983. The boron fueled integral rocket ramjet propulsion technology development is beginning in FY 1983.

3. FY 1984 Planned Program:

Electro-Magnetic Gum (EMG): A coordinated technology program further developing the technology base in rail gun components, projectiles, power equipment, and hypervelocity ballistics will be run on the DARPA/ARRADCOM launcher during FY 1984. Improvement will be achieved in compact homopolar generators by design and fabrication of counter-rotating generators. Concept designs will be refined to identify needed critical component developments. Initial design studies for military applications will begin, as will exploratory development of alternative propulsion and pulse-power technology.

The AIFS (AAST) effort will concentrate on seeker algorithm development and refinement, seeker component hardening, seeker component miniaturization and weaponization of the advance lock-on-after-launch technology. The AIFS (ATR) 8" Howitzer Solid Fuel Variable Thrust (Thrust=Drag) Ramjet projectile will be demonstrated in FY 1984. The ramrod solid fuel ramjet propelled hypervelocity rod penetrator will undergo limited test firing in FY 1984. The metalized boron fueled integral rocket ramjet propulsion technology will undergo preliminary critical component testing and possibly limited test firing during FY 1984.

The increase from FY 1983 is due primarily to the initiation of the Special Operations Technology program.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-2
Program Element: #62702E
USDR&E Mission Area: 530

Title: Weapons Technology and Concepts
Title: Tactical Technology
Budget Activity: 1. Technology Base

4. Program to Completion:

Electro-Magnetic Gun (EMG): The first prototype electro-magnetic gun system will be completed and demonstrated late in FY 1985 or early in FY 1986.

AIFS (AAST): Advanced autonomous lock-on-after-launch seeker miniaturization, integration and drop testing will begin in FY 1985. Full integration into a projectile testbed demonstration will take place in FY 1986.

AIFS (ATR): The Ramrod ramjet powered hypervelocity rod penetrator will be demonstrated during FY 1985. The metalized boron solid fuel integral rocket-ramjet propulsion technology will be demonstrated during FY 1985.

Milestones and program plans are currently being further defined in the Special Operations Technology program.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Advanced Autonomous Seeker Technology		
Early FY 1983	Early FY 1983	Seeker/Tracker Captive Flight Test.
Electro-magnetic Gun		
Late FY 1982	Late FY 1983	Initiate development of EMG technology demonstrator.
--	Mid FY 1984	Demonstrate compact counter-rotating homopolar generator.

--	Late FY 1984	Demonstrate high current switch technology.
--	Late FY 1985	Completion and demonstration of first prototype system.

AIFS(AAST)

--	Mid FY 1983	Captive flight test MMW seekers.
--	Early FY 1983	Alternative (MMW, IR) seeker analysis.
--	Mid FY 1984	Dual seeker technology definition.
--	Early FY 1985	Seeker miniaturization, integration, drop testing.
--	Early FY 1986	Test firing of seeker/projectile.

AIFS(ATR)

--	Early FY 1984	8" Howitzer thrust=drag ramjet demonstration.
--	Early FY 1984	Critical component development for Ramrod.
--	Late FY 1985	RAMROD demonstration.
--	Late FY 1985	Boron Solid Fuel Integral Rocket Ramjet development and demonstration.

6. Explanation of Milestone Changes: The changes indicated in Section 5 reflect further definition of the programs.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-3
Program Element: #62702E
USDR&E Mission Area: 530

Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objective of the Naval Warfare project is to investigate new technologies and system concepts which would significantly enhance the maintenance of effective surveillance, targeting, and control of surface and subsurface ocean areas. While continuing an earlier emphasis on surveillance of the Soviet submarine forces, the overall program has been expanded to address a wider range of ocean warfare issues, including advanced techniques for Over-the-Horizon (OTH) weapon targeting for both surface and submerged targets and the development of more capable weapon system concepts to meet the expanding Soviet threat. The program emphasizes the performance of key experiments validating critical technology elements or system concepts prior to Navy transition. Major initiatives currently being pursued include: (1) The Advanced Autonomous Array (A3) program, to demonstrate an advanced system concept for rapidly deployable, expendable horizontal line array sonobuoys, which incorporate in-buoy microprocessing (2) the ARIADNE program (formerly the Long Haul Array Program) to investigate the application of fiber optic cabling and telemetry techniques for strategic or tactical undersea surveillance; (3) the Systolic Array Processor program which seeks to develop novel digital architectures for providing the enhanced signal processing capacity needed in real-time multi-channel processors for towed and conformal array applications; and (4) the Arctic Surveillance program, which is developing specialized surveillance techniques for ice covered regions, beginning initially with a through-the-ice acoustic sensor.

The Naval Warfare project is seeking to expand involvement in the "end game" of ASW and the larger issue of Ocean Warfare in general. Major Tactical ASW and Ocean Warfare research programs include: (1) The Advanced Conformal Submarine Acoustic Sensor (ACSAS), which is intended to establish the basis for a new class of hull-mounted attack submarine sonars; (2) The Ocean Tactical Targeting (OTT) program, which addresses the advanced technologies for acquiring and processing multi-sensor broad area surveillance data to provide Over-the-Horizon targeting information to tactical Navy units; (3) the Advanced Torpedo Technology program addressing the urgent need for increased speed, range, and warhead lethality in advanced torpedo configurations; (4) the Advanced Undersea Vehicle program in which aerospace technologies are being applied to the design of a small unmanned submersible,

and (5) the Fiber Optic Sensor program, which exploits emerging fiber optic sensing concepts to demonstrate a wide range of field sensors, with emphasis on acoustic towed array and submarine conformal array applications.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-3
Program Element: #62702E
USDR&E Mission Area: 530

Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

G. RELATED ACTIVITIES: Overall coordination is maintained with representatives of the Under Secretary of Defense for Research and Engineering, the Assistant Secretary of the Navy for Research, Engineering and Systems, and the Chief of Naval Operations. The Ocean Tactical Targeting (OTT) program complements the Navy's Over-the-Horizon (OTH) and Integrated Ocean Surveillance programs, by pursuing multi-sensor integration, and is coordinated with the Naval Electronics System Command (NAVELEX), a DARPA program agent, and the Naval Ocean Systems Center (NOSC), as technical coordinator. The Fiber Optic Sensor Program is coordinated through the Navy's Fiber Optic Sensor System (FOSS) program, which is jointly sponsored by five separate Navy commands. The Systolic Array Processor program is coordinated through the Naval Electronics Systems Command (NAVELEX) and the Naval Sea Systems Command (NAVSEA), and a Memorandum of Understanding has recently been signed. The Advanced Autonomous Array (A3) is coordinated through the surveillance office of NAVELEX, which is jointly sponsoring the A^3 program in FY 1983 and FY 1984 prepatory to assuming total A^3 responsibility in FY 1985. Similarly, the ARIADNE program is also coordinated with NAVELEX, which is jointly sponsoring the development of certain aspects of the required technology base. The Advanced Conformal Submarine Acoustic Sensor program is being pursued as a joint venture by DARPA, the Office of Naval Research, and the Office of the Chief of Naval Operations (Submarine Warfare). The Advanced Torpedo Technology Program is coordinated with Naval Undersea Systems Center (NUSC), the Office of Naval Technology, and NAVSEA.

H. WORK PERFORMED BY: About 80% of the work is carried out by industry, 5% by universities, and 15% by DoD in-house agencies. Industrial contractors involved in research programs under this project are: Bolt, Beranek and Newman, Inc., Arlington, Virginia and Cambridge, Massachusetts; Stanford Research Institute, Menlo Park, California; Institute for Defense Analyses, Arlington, Virginia; Systems Development Corp., Sunnyvale, California; RCA, Camden, New Jersey and Burlington, Massachusetts; RAMCOR, Vienna, Virginia; C. Starke Draper Laboratory, Cambridge, Massachusetts; Decision Sciences, Inc., La Jolla, California; Sanders Associates, Nashua, New Hampshire; Systems Planning Corporation, Arlington, Virginia; Pacific-Sierra Research Corp., Santa Monica, California; Verac, Inc., San Diego, California; ESL Corporation, Sunnyvale, California; Ampex Corporation, Redwood City, California; and Honeywell, Incorporated, Bloomington, Minnesota. The universities are: University of Texas, Austin, Texas;

University of Detroit, Detroit, Michigan; John Hopkins University Applied Physics Laboratory, Laurel, Maryland; Pennsylvania State University Applied Research Laboratory, State College, Pennsylvania; Massachusetts Institute of Technology, Cambridge, Massachusetts; and University of California, Los Angeles and San Diego, California. The in-house effort is performed by the Naval Ocean Systems Center, San Diego, California; the Naval Underwater Systems Center, New London, Connecticut and Newport, Rhode Island; the Naval Ship Research and Development Center, Carderock and Annapolis, Maryland; the Naval Oceanographic Research and Development Activity, Bay St. Louis, Mississippi; and the Naval Research Laboratory, Washington, DC.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments:

Advanced Autonomous Array (A3): New designs for the array and display subsystems were completed. In addition, agreement with the Navy was reached in FY 1982 for joint DARPA-Navy funding of A^3 in FY 1983 and FY 1984, and for transfer of A^3 to sole Navy sponsorship beginning in FY 1985.

ARIADNE: The former Long-Haul Array (LHA) Program was redirected from its previous emphasis on use of fiber-optic technology as a substitute telemetry channel for conventional, shore-powered, single array undersea surveillance, to application of fiber-optics in large fields of ocean sensors This new direction was undertaken to fully exploit the potential of fiber-optics in light weight, less expensive sensor networks for undersea surveillance.

Advanced Conformal Submarine Acoustic Sensor (ACSAS): FY 1982 was the first year for the ACSAS program and a number of significant accomplishments were achieved in both the technical and management areas. In the technical area, fifteen hydrophones fabricated from a new piezo-electric polymer material, Poly-vinylidine Fluoride (PVDF), were successfully built and tested, and work was begun on an experiment involving KAMLOOPS vehicle Other technical accomplishments include the baseline design of an inner decoupler, the development of computer models for evaluating structural modifications,

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USDR&E Mission Area: 530

Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

Ocean Tactical Targeting: The major focus of the Ocean Tactical Targeting Program was to complete the analysis of the results of the PATHFINDER Experiment, using an enhanced ship as a source for collection of multi-source sensor detection data to support prediction and understanding of fusion results. The analysis identified sensor bias effects and procedures for correction. It also verified auxiliary sensor capability in ocean areas and the potential of such sensors for analysis of background shipping. Other work verified the potential of cueing and feedback methods and the capability of artificial intelligence (AI) technology to support real-time analysis of surveillance data.

Advanced Undersea Vehicle: A successful demonstration of the Suction Afterbody Propulsion (SAP) hydrodynamic concept was completed in the David Taylor Naval Ship Research and Development Center subsonic wind tunnel. Fabrication of hardware for critical demonstrations in the technology areas of energy storage, navigation, and structures was also initiated.

Fiber Optic Sensor: A one inch diameter integrated acousto-optic extended sensor hydrophone was designed and fabricated to provide better performance and improved high speed, self-noise performance over current Navy tactical towed arrays. The feasibility of a 256 channel optical telemetry system necessary to support long, thin line Navy tactical towed arrays was demonstrated, and a prototype fiber optic two cable for the acousto-optic towed array feasibility demonstration model (FDM) was fabricated and tested.

2. FY 1983 Program:

Advanced Autonomous Array (A3): The redesigned array and display subsystems for the A^3 are being developed, tested, and integrated with the existing A^3 buoy, processor, and communications subsystems. In addition, plans are being prepared for an FY 1984 at-sea operational ASW exercise using the updated A^3 exploratory development model.

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Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

ARIADNE: The ARIADNE program is developing techniques for deploying distributed sensor fiber-optic telemetry links and developing distributed power sources, as well as a combined repeater, multiplexer, and connector module for use in distributed fields of sensors. Additional investigations focus on defining and enhancing the survivability of small and potentiall inexpensive fiber-optic cables in the ocean environment. Alternate techniques for processing signals obtained from distributed sensor fields in a variety of acoustic environments are being defined and tested.

Arctic Surveillance (New Start): The Arctic Surveillance program is a development effort to apply microprocessor technology and an innovative data sparsing and signal processing technique to the problem of submarine surveillance A buoy and processor denoted ICE PICK, capable of being deployed by aircraft, is being designed to monitor and sample and to transmit a data message on the target characteristics. The buoy is designed to have a one year lifetime In FY 1983 the initial design work is being completed, and an initial test of a hand implanted buoy is being carried out

Systolic Array Processor (New Start): This first year, the program is completing specification and design of a multichannel processor for adaptive filtering and beamforming of a tactical towed array. The processor specification will then form the basis for detailed systolic cell designs, which will be validated by computer emulation.

Advanced Conformal Submarine Acoustic Sensor (ACSAS): Efforts during this fiscal year are emphasizing experimental tests on scale model bodies to understand the phenomena of flow noise and structural noise propagation. Early in FY 1983, a series of pop-up tests using the KAMLOOPS are being conducted to test the performance of various polymer hydrophone configurations. The purpose of these tests is to evaluate the effect of flow noise on the performance of candidate hydrophone shapes To examine the effect of structural body modifications on the propagation of structural noise, tests are being performed with a 1/15 scale model which incorporates alternative outer body configurations for measurement of acoustic structural noise when the body is subjected to controlled excitation at various frequencies.

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Program Element: #62702E
USDR&E Mission Area: 530

Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

Ocean Tactical Targeting (OTT): The OTT program is examining the use of an artificial intelligence approach as the basis for advanced analyst support techniques. The primary focus for this work will be on the selection of appropriate analysis techniques, process control, user interaction methods, and data management systems. These preliminary results are an essential basis for more robust future implementations, and are expected to provide an indication of the impact of advanced analyst work station technology on operational performance.

Advanced Torpedo Technology: Laboratory demonstrations coupled with analysis and correlation are being conducted for several drag reduction and energy storage techniques. The drag reduction approaches under study offer the promise of a factor of ten improvement over current torpedo practice, and energy storage techniques offer near term potential for twice the energy density of the prototytpe Stored Chemical Energy Propulsion System (SCEPS). This work is expected to establish the feasibility and identify the critical technology areas required for the next generation of Navy torpedoes.

Advanced Undersea Vehicle (AUV): During this year preliminary design and critical demonstrations of a number of advanced technologies are being investigated in the areas of required on-board sensors, high strength hulls, reliability, autonomous navigation, and hydrodynamics. Already accomplished are at-sea demonstrations of a deep ocean velocity measurement sensor for the navigation system, laboratory testing of the advanced energy source, and strength testing of a sample hull. A preliminary vehicle design based on the latest hydrodynamic results has also been completed, and laboratory simulations and at-sea experiments are being performed to demonstrate autonomous control and portions of the navigation system.

Fiber Optic Sensor System: Four acousto-optic extended sensor hydrophones and one calibrated ceramic reference hydrophone are being fabricated for incorporation with a four channel signal conditioning module (SCM) and fiber optic receiver, a 1500 meter fiber optic tow cable, and integrated optoelectric connectors into a towed array module. Component testing and system integration of the acousto-optic towed array feasibility demonstration model (FDM) is being conducted with follow-on laboratory testing and in-water demonstration of the FDM.

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USDR&E Mission Area: 530

Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

3. FY 1984 Planned Program:

Advanced Autonomous Array (A3): A major at-sea operational ASW exercise featuring the A^3 exploratory development system will be conducted in FY 1984. This exercise will focus on demonstration and evaluation of A^3 potential as an off-board sensor operating in conjunction with ship-towed sonar arrays.

ARIADNE: The various fiber-optic telemetry module developments, link survivability, and deployment investigations initiated in FY 1983 will be completed and evaluated. The feasibility of large-volume/low-cost production of small fiber-optic undersea cables will be determined and investigations of signal processing and environmental acoustics for distributed systems will continue.

Arctic Surveillance: The Ice Pick Buoy will be tested in an air-launched sequence.

Systolic Array: The processor circuit chips will be manufactured and tested, and a systolic array will be constructed using aproximately 400 of these components.

Advanced Conformal Submarine Acoustic Sensor (ACSAS): Major testing of various system components will be the primary effort in FY 1984 with substantial building on the results of the FY 1983 tests. A significant effort during this year will be the fabrication of a completely new front end for the KAMLOOPS vehicle, whose design and shape will be the result of analytic studies and testing during the previous two years. During the FY 1984 testing, compatibility with other components and outer decoupler candidate designs will be evaluated and documented to arrive at an optimal design for each.

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Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

Ocean Tactical Targeting (OTT): During the remainder of the OTT Program, advanced analyst support technology will be developed and demonstrated at the functional level, and concepts initially developed during FY 1983 will be completed and validated in semi-operational applications. Specific program objectives include: (1) control of cueing for demonstration of interoperability; (2) interactive operation of multiple analyst work stations; (4) hardening of the functional prototype to support continuous, real-time operation; (5) data association strategy development; and (6) surveillance scene generation, scoring and reporting methods.

Advanced Torpedo Technology: Demonstrations in the previously identified critical areas of drag reduction and energy storage will form the basis for selection of the most promising drag reduction and energy storage techniques for integrated technology demonstrations in FY 1985 and beyond.

Advanced Undersea Vehicle (AUV): The final design of all AUV advanced technology items will be completed, performance of most automomous control functions demonstrated in laboratory simulations, and procurement of a large number of components begun.

Fiber Optic Sensor System: The feasibility demonstration model test data will be analyzed, and based on the test results, the acousto-optic extended sensor hydrophone configuration will be optimized. The design of the Thin Line Array implementation of interferometric and intensity hydrophones will be completed and miniaturized versions of the optical demodulator and other optical components developed for a one inch diameter thin line tactical towed array.

The funding increase indicated from FY 1983 to FY 1984 is due principally to the substantial increase in large scale experiments in both the Advanced Conformal Submarine Acoustic Sensor and ARIADNE programs.

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Program Element: #62702E
USDR&E Mission Area: 530

Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

4. Program to Completion:

Advanced Autonomous Array (A3): The A^3 program will transition to the Naval Electronics System Command at the beginning of FY 1985 and will be continued in advanced development by the Navy. The A^3 program will terminate at DARPA at the end of FY 1984 with total program transition to NAVELEX.

ARIADNE: If it is decided to pursue a system level demonstration with Navy support, preparations will be undertaken in FY 1985

Systolic Array: Early in FY 1985, the processor will be tested in the laboratory with multichannel recorded data from the parallel NAVSEA program. Then, the processor will be readied to interface with the shipborne sensor being developed under the cosponsoring NAVSEA program. In FY 1986, the combination of processor and sensor will be tested to assess the systems capabilities for tactical applications.

Arctic Surveillance: In FY 1985 the Ice Pick program will transfer to the Navy.

Advanced Conformal Submarine Acoustic Sensor (ACSAS): This program is scheduled to be completed in FY 1987. Efforts remaining to be completed include component sea tests and KAMLOOPS verification tests in FY 1985 and Large Scale Vehicle tests in FY 1986. Management transition of the program from the Office of Naval Research to the Naval Sea Systems Command is anticipated in FY 1985.

Advanced Torpedo Technology: Beginning in FY 1985, design and fabrication of an in-water demonstrator employing brassboard versions of the selected drag reduction and energy storage technologies will begin. This work will be completed in early FY 1986 with a limited series of in-water tests.

Advanced Undersea Vehicle (AUV): The activities remaining after FY 1984 include the fabrication of all hardware, the integration of all advanced technology items and the performance demonstration of the combined technologies. The culmination of the program in FY 1986 will occur after a series of sea tests that will occur during that year.

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Project: #TT-3
Program Element: #62702E
USDR&E Mission Area: 530

Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

Fiber Optic Sensor System: The FOSS project will transition to full Navy development in FY 1985.

5. Milestones: The milestones cited in the FY 1983 Descriptive Summaries with completion dates through Mid FY 1983 have been completed or are expected to be completed on schedule.

Last Year's Reported Plan	Current Plan	Milestones
Advanced Autonomous Array (A^3):		
--	Early FY 1984	A^3 Engineering Test
--	Late FY 1984	A^3 Operational Demonstration
ARIADNE:		
--	Late FY 1983	Deployment of first lightweight fiber optic cable
--	Late FY 1984	Development of fiber optic telemetry link
--		
Systolic Array Processing:		
--	Late FY 1983	Design processor for adaptive beamformer and corresponding systolic cell chip set.
--	Mid FY 1984	Manufacture and test chips in array processor

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Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

Arctic Surveillance:

--	Early FY 1985	Deploy ICE PICK in operational demonstration in Arctic

Advanced Conformal Submarine Acoustic Sensor (ACSAS):

--	Late FY 1983	1/15 scale structural propagation tests
--	Late FY 1984	KAMLOOPS test series with new bow and array
--	Late FY 1986	Potential full scale demonstration test.

Ocean Tactical Targeting:

--	Early FY 1984	Demonstration of automation of analyst work station based on artificial intelligence approaches
--	Early FY 1985	Integration of sensor cueing and feedback algorithms work station
--	Mid FY 1985	Conduct controlled real-time operational impact demonstration

Advanced Torpedo Technology:

--	Late FY 1983	Feasibility demonstration for selected energy storage and drag reduction techniques
--	Mid FY 1985	Design of technology demonstration vehicle completed
--	Late FY 1986	In-water test of technology demonstration vehicle

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Title: Naval Warfare
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Advanced Undersea Vehicle:

---	Mid FY 1984	Demonstration of individual critical technologies
---	Late FY 1985	Fabrication of technology demonstration vehicle
Late FY 1985	Late FY 1986	Completion of at-sea test series

Fiber Optic Sensor System:

Late FY 1983	Late FY 1983	At-sea test of fiber optic towed array module
--	Early FY 1985	Transition to full Navy development

6. Explanation of Milestone Changes: Advanced Autonomous Array (A3): Per agreement with the Navy on transition to advanced development, substantial upgrading of the A^3 experimental hardware has been necessary prior to final operational demonstration in FY 1984. This has necessitated some schedule slippage and the new set of milestones presented above. ARIADNE: Formerly the "Long Haul Array Program", ARIADNF has been re-structured as a joint program with Naval Electronic Systems Command to demonstrate critical technologies prior to a potential system demonstration. This has resulted in the new set of milestones shown. Systolic Array Procesing: This is a new start in FY 1983 and has not been treated in prior Descriptive Summaries. Artic Surveillance: This is a new start in FY 1983 and there have been no prior milestones. Advanced Conformal Submarine Acoustic Sensor: As a result of the first year's technical work and an appraisal of potential future support, it was decided that much stronger emphasis should be placed on an experimental approach to answering critical technical questions about the performance of very large hull-mounted conformal arrays in a flow noise environment. This has required a substantial recasting of the program plan to include a larger test series, more experimental hardware, and resulting changes in milestones. The first KAMLOOPS test, for example, was performed earlier in FY 1983 than had

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-3
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Title: Naval Warfare
Title: Tactical Technology
Budget Activity: 1. Technology Base

been planned previously. Ocean Tactical Targeting (OTT): The OTT program has been substantially down scoped and re-oriented to emphasize the application of artificial intelligence techniques to the fusion and analysis of wide area sensor data. Correspondingly, the new program plan has eliminated large scale demonstration tests in favor of inserting prototype equipment and algorithms into real-world operational situations for validation and impact assessment in the face of real-time data. The set of milestones presented above reflect the new orientation. Advanced Torpedo Technology: This is a new program in FY 1983, and no prior milestones exist. Advanced Undersea Vehicle: The previous plan to demonstrate a prototype vehicle at sea in late FY 1985 has been stretched into FY 1986, in accordance with a decision to emphasize the technology demonstration aspects of the program.

Also, additional milestones have been added to clarify the path to Navy transition.

19:

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-4
Program Element: #62702E
USDR&E Mission Area: 530

Title: Advanced Armor Technology
Title: Tactical Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: An objective appraisal of U.S.

The Advanced Armor Technology program is structured to by demonstrating the technical feasibility of new armor and anti-armor systems concepts defined for incorporation into new armored fighting vehicles and anti-tank guided missiles and projectiles to be fielded in the 1980s, and by exploring advanced armor and warhead concepts to determine their technical feasibility and potential for further development. The latter activity is designed to broaden the base of these technologies with proven concepts that will be available either to countermeasure advances in foreign technologies, as they emerge, or to be incorporated into the new fighting vehicles or anti-armor systems of the The Advanced Armor Technology Program is designed for maximum flexibility, efficiency, and responsiveness by containing a core program consisting of a small group of qualified scientists and engineers. The members of the core program are tasked to explore advanced armor systems, kinetic energy projectile systems, Such an arrangement not only allows for rapid development of new system concepts, but also for rapid development of countermeasures to those systems. External to the core program, specific topics within these technologies are explored to develop and demonstrate technical solutions to current-and-near term tactical problems.

G. RELATED ACTIVITIES: Coordination of current activities is maintained with the Office of the Undersecretary of Defense Research and Engineering and appropriate Service laboratories. In particular, joint program activities are conducted with the Army Armaments Research and Development Command, Army Applied Mechanics and Materials Research Center, Naval Surface Research and Development Center, Naval Surface Weapons Center (White Oak), Naval Surface Weapons Center (Dahlgren), and Marine Corps Development and Education Command.

H. WORK PERFORMED BY: About 80% of this program is contracted to industry; the remaining 20% is contracted to universities and in-house government laboratories. The principal industrial contractors are: Aerojet Ordnance Company, Downey, California; Aeronautical Research Associates of Princeton, Princeton, New Jersey; Battelle

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Project: #TT-4
Program Element: #62702E
USDR&E Mission Area: 530

Title: Advanced Armor Technology
Title: Tactical Technology
Budget Activity: 1. Technology Base

Columbus Laboratories, Columbus, Ohio; GEO-Centers, Inc., Newton Upper Falls, Massachusetts; Martin-Marietta Company, Orlando, Florida; Physics International, San Leandro, California; Systems Planning Corporation, Arlington, Virginia; and United Technologies Corporation, Sunnyvale, California. An in-house laboratory effort is performed at U.S. Army Armament Research and Development Command, Dover, New Jersey. University effort is performed by the University of California, Lawrence Livermore National Laboratory.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Program Accomplishments:

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Project: #TT-4
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Title: Advanced Armor Technology
Title: Tactical Technology
Budget Activity: 1. Technology Base

2. FY 1983 Program:

3. FY 1984 Planned Program:

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #TT-4
Program Element: #62702E
USDR&E Mission Area: 530

Title: Advanced Armor Technology
Title: Tactical Technology
Budget Activity: 1. Technology Base

4. Program to Completion: The Advanced Armor Technology Program is a continuing program. New initiatives are evaluated continually as developmental concepts are transferred to the Services and incorporated into the program. Advanced

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Late FY 1983	Late FY 1983	Complete exploratory development of for advanced warheads designs.
Late FY 1983	Mid FY 1984	Demonstrate advanced
--	Late FY 1985	Demonstrate improved self-forged fragment warhead technology
--	Late FY 1986	Demonstrate HUNTER technology and transfer to Army/Marine Corps.

6. Milestone Changes: The demonstration of advanced lightweight armor systems has changed from late FY 1983 to mid FY 1984 because of the difficulty of procurring required materials in a timely manner. This has delayed technical progress in this activity.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62707E
USDR&E Mission Area: 530

Title: Particle Beam Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
FY 1983 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENTS	$32,500	$31,000	$31,000	N/A	Continuing	N/A
FY 1984 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT	$30,550	$33,000	$33,100	$36,400	Continuing	N/A

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports basic research to determine the scientific feasibility of particle beam weapon concepts which have the advantages of near-speed-of-light delivery, rapid reload, and deep target penetration with a variety of kill mechanisms. The major objective of this effort is to demonstrate stable, predictable propagation of a relativistic electron beam within the atmosphere for potential point defense applications which This program also supports research on the production of low divergence neutral particle beams for potential space applications In FY 1983 a new task, which is developing Space Nuclear Power technology in a joint program with NASA, was added to the Particle Beam Technology program. This new Technology for Advanced Space Power (TASP) program will develop the technology for 100 kilowatt-class power systems through FY 1985. In FY 1986, a decision on whether to construct a space qualifiable reactor for a ground demonstration will be made.

C. BASIS FOR FY 1984 RDT&E REQUEST: The major objective of this program is to demonstrate the feasibility of stable predictable propagation of high-power relativistic electron beams in the atmosphere over distances of military interest Efforts to achieve this objective during FY 1984 will focus on beginning atmospheric propagation experiments with the 50 million electron-volt (MeV) Advanced Test Accelerator (ATA), and on continuation of supporting theoretical beam propagation studies. Successful demonstration of the propagation of electron beams in the atmosphere with the Advanced Test Accelerator will provide the basis for decisions by the Military Departments for potential point defense applications This program also includes research to evaluate the feasibility of generating low-divergence neutral particle beams for potential long-range defense applications.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62707E
USDR&E Mission Area: 530

Title: Particle Beam Technology
Budget Activity: 1. Technology Base

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: The Technology for Advanced Space Power (TASP) program was initiated in FY 1983 in recognition of the need for 100 kilowatt-class power systems to support a broad spectrum of military applications, including neutral particle beams for space defense applications. The increased funding in FY 1983 reflects the $2 million addition by the Congress for initial efforts to determine the utility of the ATA for the Electron Laser Research. The increased funding in FY 1984 reflects the addition of the TASP.

E. OTHER APPROPRIATION FUNDS: None.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #PB-1
Program Element: #62707E
USDR&E Mission Area: 530

Title: Particle Beam Technology
Title: Particle Beam Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: Charged and neutral particle beam concepts are being considered for applications in a variety of advanced weapon systems. The impetus for interest in these concepts is the expectation that particle beams can deliver large amounts of energy at close to the speed of light and lethally deposit it deep within a target with high coupling efficiency. The applications for charged particle beam technology include ship defense

The potential applications for neutral particle beam systems include

The key issue for development of charged particle beam concepts is the capability to propagate electron beams in the atmosphere. Theoretical models for electron beam propagation have been developed and have been verified by low-energy experiments at sub-atmospheric densities. However, until now, no electron accelerators of sufficient energy and current had been developed in the United States which would permit critical propagation experiments to be performed at full atmospheric densities. Such experiments are essential. Therefore, a major objective of the Particle Beam Technology Program is to develop the required high-energy accelerator and to demonstrate the feasibility of predictably propagating powerful electron beams to distances of military interest
Extrapolations of low energy beam propagation experiments have indicated that an electron beam having an energy of
is necessary to demonstrate propagation at full atmospheric densities. Construction of the Advanced Test Accelerator (ATA), which was initiated by DARPA at Lawrence Livermore National Laboratory (LLNL) in FY 1979 with the objective of providing such an electron beam, was completed at the end of FY 1982. The Experimental Test Accelerator, which represents the front-end of the ATA, is being operated at LLNL as a testbed for continued evaluation of the ATA design and to perform low-energy propagation experiments.

The critical issue for neutral particle beam system concepts is the capability to generate low divergence neutral beams. Such systems consist of a source of negative hydrogen ions, ion accelerator and focusing systems, and a neutralizer which converts the high energy ion beam to a neutral beam. All of these system elements contribute to the final beam divergence and thus, the maximum effective range. The Accelerator Test Stand, at Los

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #PB-1
Program Element: #62707E
USDR&E Mission Area: 530

Title: Particle Beam Technology
Title: Particle Beam Technology
Budget Activity: 1. Technology Base

Alamos National Laboratory, has been constructed to operate
This device will be used to evaluate the critical beam divergence contributions from the low energy stages of a potential neutral particle beam system which will require energies of depending on specific applications.

The joint NASA-DARPA Technology for Advanced Space Power (TASP) program was initiated to complement the Department of Energy's activities in space nuclear power technology development. The objectives of the program deal both with a 100 kilowatt class space nuclear power system, appropriate for military and civil applications and with the 1 to 100 megawatt class systems which may eventually be necessary to support directed energy weapons in space. Within the constraints of a strict safety plan and a civil and military mission requirements definition process, the TASP program is exploring alternate concepts and technologies for the 100 kw class system with a specific objective of providing the technical information necessary for a 1985-1986 decision on embarking on engineering development. For the multimegawatt arena the objectives are more modest -- to determine potential operating regimes of interest in terms of power and run time, to compare nuclear and conventional options in these regimes, and to determine the highest payoff technology areas for development. If the developing mission requirements and technology efforts warrant, a modest development effort in these high payoff areas will be initiated.

The program in the near term consists of a search for system concepts to allow for effective trades to be made between power output and material development risk, cost, and leadtime. Technology being developed at this point is principally the heritage of the ongoing NASA efforts in power conversion and the DOE's heat pipe reactor technology efforts in the SP-100 program. Specific objectives are to develop silicon-germanium thermoelectric conversion technology capable of long-life operation above 1200° K and to develop more exotic materials and techniques, such as silicon-germanium with gallium or boron carbides, offering much higher conversion efficiencies and higher operating temperatures. TASP will also supplement the DOE SP-100 high temperature fuel and heat pipe development efforts. As the program matures over the next year and specific competitive space nuclear power

concepts are defined, additional work will be started in technologies directly supporting these concepts in the areas of different conversion systems (possibly thermionic or dynamic concepts), high temperature reactor materials, lightweight high-temperature shielding materials, controls, and space structural materials. Again, the overall objective at the 100 KW level is to get the technology data needed for an engineering development decision by 1985-86.

G. Related Activities: In FY 1980 the Under Secretary of Defense for Research and Engineering approved the Particle Beam Technology Program plan which, beginning in FY 1981, consolidates the DoD particle beam efforts under the overall technical direction of DARPA. Under this plan, DARPA has assumed responsibility for both charged and neutral particle beam feasibility experiments. The Military Departments are responsible for advancing those technologies which are essential in order to rapidly develop particle beam weapons once they are proven feasible.

The Department of Energy's SP-100 program has been developing the nuclear technology aspects of a space nuclear power system based on heat pipe cooled reactors and thermoelectric conversion. In this modest technology effort LANL and DOE have made significant progress in materials and fabrication issues for high-temperature, high power heat pipes. NASA has long been responsible for advanced thermoelectric power conversion and space system aspects of this concept. It is anticipated that shortly NASA, DARPA, and DOE will have a single joint program as a step beyond the current efforts which are mutually planned and coordinated.

H. WORK PERFORMED BY: This effort is performed by in-house activities (5%), by federally funded research facilities (85%) and by industrial contractors (10%). In-house participants include: the Naval Surface Weapons Center, Silver Spring, Maryland; and the Naval Research Laboratory, Washington, D.C. Federally funded research facilities include The Lawrence Livermore National Laboratory, Livermore, California and the Los Alamos National Laboratory, Los Alamos, New Mexico. Industrial contractors include Science Applications, Inc., Palo Alto, California; SRI International, Menlo Park, California; Avco Everett Research Laboratory, Everett, Massachusetts; Mission Research Corporation, Santa Barbara, California; La Jolla Institute, La Jolla, California; B. K. Dynamics, Inc., Rockville, Maryland; and Physical Dynamics, Inc., La Jolla, California. Approximately 90% of the program

funding is directed toward charged particle beam research, and 10% toward neutral particle beam experiments. For Space Nuclear Power Technology, Industry (60%), federally contracted research facilities (30%), and Government in-house (10%). Major contractor teams are being selected. Major industrial contractors include General Electric, Valley Forge, PA; and General Atomic, San Diego, California. Federally contracted research facilities and National Laboratories include the Jet Propulsion Laboratory, Pasadena, California; and Los Alamos National Laboratory, Los Alamos, New Mexico. In house work is done at NASA Lewis Research Center, Cleveland, Ohio.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments:

Charged Particle Beams. The Advanced Test Accelerator at the Lawrence Livermore National Laboratory (LLNL) was assembled and electrical testing of the injector for ATA was begun. Favorable electron beam propagation results were obtained on the Experimental Test Accelerator at LLNL and in propagation experiments at Los Alamos National Laboartory (LANL) and Sandia National Laboratory (SNL). The ETA experiments demonstrated

The LANL and SNL experiments demonstrated the ability of an electron beam As a part of the program to develop accelerator technology, high repetition rate magnetic switches were designed and tested at LANL. These switches successfully met the goal of producing This allows upgrading the repetition rate of the ATA by a factor of if necessary.

Neutral Particle Beams. Construction of the Accelerator Test Stand (ATS) at LANL at the level was completed. The major element in this completion was the radio-frequency quadrapole (RFQ) accelerator. The RFQ bunches the negative ion beam and accelerates it to The RFQ was tested with input powers of almost from the klystron radio-frequency power supply. This represented an without arcing between electrodes or significant power losses.

AD A125 228 JUSTIFICATION OF ESTIMATES FOR FISCAL YEAR 1984 SUBMITTED TO CONGRESS(U) OFFICE OF THE SECRETARY OF DEFENSE WASHINGTON DC JAN 83 3/6

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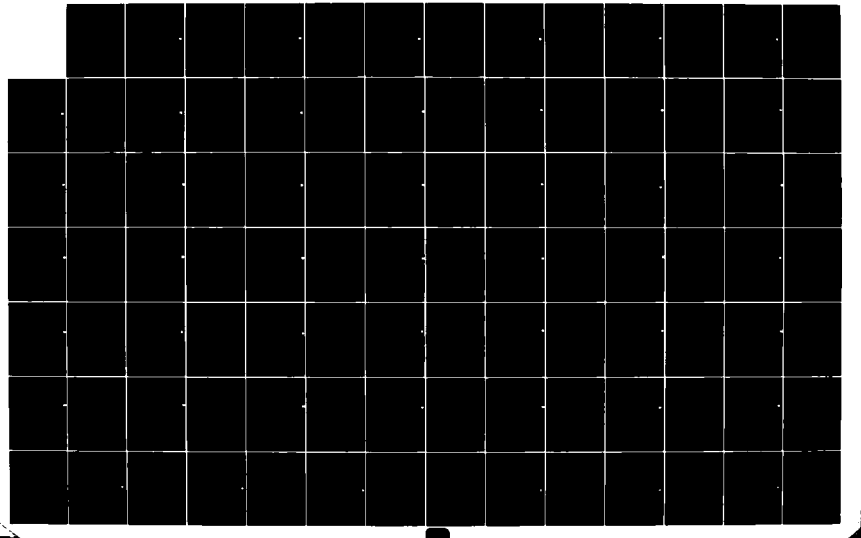

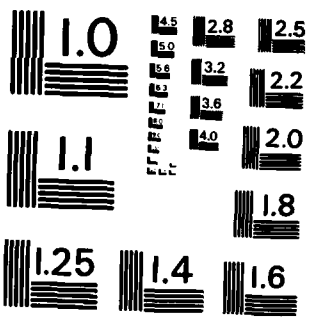

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #PB-1
Program Element: #62707E
USDR&E Mission Area: 530

Title: Particle Beam Technology
Title: Particle Beam Technology
Budget Activity: 1. Technology Base

Space Nuclear Power Technology. The TASP program is a new start. In late FY 1982 the program structure was defined and a draft program plan completed.

2. FY 1983 Program:

Charged Particle Beams. The Advanced Test Accelerator (ATA) is being tested at up to the full design values of 50 MeV and 10 kiloamps. ATA will then be used to establish beam conditioning techniques necessary for performing atmospheric propagation experiments under optimum conditions. Finally, simple propagation experiments will be performed in a small diameter (25 centimeter) tank using the conditioned beam. The Experimental Test Accelerator will continue to be used to develop experimental techniques and diagnostics for ATA. Experiments to determine the ability of an electron beam to follow a preformed channel will be continued at NRL and SNL. Theoretical efforts in electron beam propagation will allow development of a fundamental physical understanding validated by ATA experiments, of electron beam propagation in the atmosphere.

Neutral Particle Beam. This program is being redirected to place increased emphasis on basic research in accelerator technology. The tasks include emittance measurements on the radio-frequency quadrapole, redesigning the low energy beam transport system for higher transport efficiency, and improving the negative ion source for increased reliability.

Space Nuclear Power Technology. Competitive concept definition efforts are being initiated. The ongoing thermoelectric conversion technology program will be directed towards higher temperature and higher performance materials, and options among a broad spectrum of conversion technologies will be selected for further development. A shielding technology program is being initiated and high power heat pipe and fuel tests conducted in concept with DOE. A safety plan covering all aspects and phases of the program is being completed.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #PB-1
Program Element: #62707E
USDR&E Mission Area: 530

Title: Particle Beam Technology
Title: Particle Beam Technology
Budget Activity: 1. Technology Base

3. FY 1984 Program:

Charged Particle Beam.

Experiments on channel tracking will continue at Los Alamos National Laboratory, the Naval Research Laboratory, and Sandia National Laboratory. Supporting theoretical work will continue.

Neutral Particle Beam Program. The Accelerator Test Stand will be operated with the goal of producing a negative hydrogen atomic beam.

Space Nuclear Power Technology. System concepts supporting definite civil and military applications will be completed and supporting technology development activities for selected concepts will be initiated. Thermoelectric and heat pipe technology development will continue within DOE but it is expected that earlier work will dictate that new areas of conversion and reactor technology as well as control and space structure technologies be added.

4. Program to Completion:

Charged Particle Beams. The demonstration of
The feasibility of
Following these successful demonstrations, the program will be transferred to the Military Services.

Neutral Particle Beam. A drift tube linac will be added to the Accelerator Test Stand in 1985. The demonstration of producing a negative hydrogen atom beam will be completed in FY In FY 1987, the program will be transferred to the Army or the Air Force for further development.

Space Nuclear Power Technology. By late 1985 or 86 concepts will be selected for engineering development. As inputs to that decision this program will have produced mission requirements validated by users, system concepts, technology data, and detailed plans for the engineering development phase.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #PB-1
Program Element: #62707E
USDR&E Mission Area: 530

Title: Particle Beam Technology
Title: Particle Beam Technology
Budget Activity: 1. Technology Base

5. Milestones:

Last Years Reported Plan	Current Plan	Milestone
Charged Particle Beam		
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Neutral Partical Beam		
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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #PB-1
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Title: Particle Beam Technology
Title: Particle Beam Technology
Budget Activity: 1. Technology Base

Space Nuclear Power Technology

--	Early FY 1984	Complete conceptual designs for space power systems.
--	Mid FY 1984	Complete detailed technology plan to support concepts.
--	Late FY 1985	Demonstrate high temperature operation of a space quantifiable thermoelectric conversion panel.
--	Early FY 1986	Select concept for engineering development.

6. Explanation of Milestone Changes:

All TASP milestones are new following initiation of the program in FY 1983.

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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62708E
USDR&E Mission Area: 530

Title: Integrated Command and Control Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Cost
FY 1983 Congressional Total For Program Element		41,100	45,300	49,300	N/A	Continuing	N/A
FY 1984 Congressional Total For Program Element		41,100	45,300	50,000	55,000	Continuing	N/A
IC-1	Distributed Information Systems	20,564	22,478	24,998	29,000	Continuing	N/A
IC-2	Advanced Command Control and Communications Technology	18,402	20,322	23,002	24,000	Continuing	N/A
IC-3	Systems Technology	2,134	2,500	2,000	2,000	Continuing	N/A

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of DARPA's research in Integrated Command and Control technology is to develop advanced information processing, computer-communications and system sciences technology which can provide the technology base for future command and control systems, and to demonstrate and evaluate them with the Services in selected operational environments.

C. BASIS FOR FY 1984 RDT&E REQUEST: The objective of the project in Distributed Information Systems (IC-1) is to develop new information processing technology which will support distributed strategic and tactical requirements, and which can also exploit the inherent advantages of survivability, reliability, and expandability which are found in distributed systems. Distributed systems based on personal workstations interconnected by high bandwidth local networks are being developed which can support large-scale testing, evaluation and refinement. Applications for distributed systems are being developed, including a distributed message system, distributed wargaming and a distributed sensor network. The work in software technology includes the development of programming support environments to aid in software development for distributed systems, methodologies to improve productivity in software development and a new thrust to use artificial intelligence to aid in the specification, implementation and maintenance of software. The wideband satellite channel will be integrated into the internet system, and experiments will be conducted to evaluate protocols and alternative routing strategies based on type of service requirements of the network traffic. Techniques will continue to be explored and developed to meet requirements for end-to-end network security and multi-level operating system security.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62708E
USDR&E Mission Area: 530

Title: Integrated Command and Control Technology
Budget Activity: 1. Technology Base

The objectives of the project in Advanced Command, Control and Communications Technology are to develop advanced computer-communication technology, and to demonstrate and transfer this technology to the Services. A major thrust in this project is to develop computer and communications systems which are survivable. The multiple, low-orbiting satellite effort is investigating a survivable communication system architecture which can be internetted with existing packet switched networks. Research in the areas of robust protocols, C3 counter measures and the reconstitution of network resources will lead to greater network survivability. Experiments will be conducted with large networks of mobile nodes to evaluate the reliability and survivability of these networks. Fast turnaround fabrication services are being provided for VLSI designers at geographically dispersed locations. Joint testbed programs with both the Air Force and Army provide a means to evaluate the technology and apply it to specific Service problems. A joint program with the Strategic Air Command (SAC) and the Defense Communication Agency (DCA) will develop and demonstrate the technology needed to reconstitute both communications and databases following a nuclear strike in which portions of the communication resources may become unavailable. Following the conclusion in FY 1983 of an on-going program with the Army to evaluate packet radio in a tactical environment, a new effort will be initiated to explore the use of distributed processing in an operational tactical environment.

The Systems Technology Project is developing team training technology for practicing combat skills using a network of low cost, portable, part task training simulators.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:

Milestone Changes

- o Long range packet radio operation in military aircraft delayed from late FY 1982 to mid FY 1983.
- o Secure operation of packet radio at Ft Bragg delayed from mid FY 1983 to late FY 1984.
- o Implementation of a certifiable end-to-end remotely keyable security system delayed from mid FY 1983 to mid FY 1986.

E. OTHER APPROPRIATION FUNDS: None.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #IC-1 Title: Distributed Information Systems
Program Element: #62708E Title: Integrated Command and Control Technology
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objectives of this project are to develop and demonstrate technology for building geographically distributed information systems which can be secured, operate in real-time and be easily expanded to meet the increasing demand for information processing in DoD command, control and communications applications. Techniques are being developed to support secure distributed processing among computers on different packet networks. Work continues on end-to-end encryption techniques to secure the SAC and Ft Bragg testbeds. The feasibility of integrated voice/data networks is being demonstrated through the use of a wideband satellite channel connected to local networks of computers and low-cost packet voice terminals. Mechanisms to control and regulate the performance of the internet environment are being developed. Distributed operating systems, data bases and programming environments are being developed, as are several applications which run in a distributed environment of personal workstations. A distributed network of low-cost, unattended, communicating sensors, each with local processing, is also under development. Program support environments are being developed to facilitate program development and the use of high level languages, such as Ada, in distributed processing applications. A new initiative in AI-based software will use techniques from artificial intelligence to aid in the specification, development and maintenance of software systems.

G. RELATED ACTIVITIES: Overall coordination of the security efforts is maintained by OUSDRE(C3I) with DARPA responsible for the development of basic technology and architectural concepts for secure systems. Concept demonstration systems development is jointly funded or otherwise supported by DCA, NSA, and the Defense Intelligence Agency. The Distributed Message System Architecture effort is coordinated with DCA and OUSDRE (C3I) in relation to the DOD Standard Automated Message Handling System initiative. The wideband speech experiment is being carried out jointly with DCA and the Services. The internetting effort is coordinated with DCA, RADC, NSA and OUSDRE (C3I).

H. WORK PERFORMED BY: 63% Industry, 32% University and 5% In-house. The major performers are MIT Lincoln Laboratory, Lexington, MA; Linkabit Corporation, San Diego, CA; Hazeltine Corporation, Greenlawn, NY; SRI International, Menlo Park, CA; Bolt Beranek and Newman, Cambridge, MA; University of California, Los Angeles, CA; Stanford University, Stanford, CA; University of Southern California, Information Sciences Institute, Marina del Rey, CA; Carnegie Mellon University, Pittsburgh, PA; Massachusetts Institute of Technology, Cambridge, MA.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: The internet system was developed to the point that it could be regularly used by a large community of users. An internet electronic message and forwarding system was developed; the standard DoD TCP/IP protocols were implemented on most ARPANET hosts; the TAC access control was specified and implementation was begun. The packet speech program was completed; specific accomplishments include developing a compact, low cost Linear Predictive Coding

Project: #IC-1 Title: Distributed Information Systems
Program Element: #62708E Title: Integrated Command and Control Technology
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

(LPC) vocoder; demonstration of point-to-point and conferenced speech across the internet (packet radio, wideband satellite and local cable network); demonstration of mobile LPC speech over the packet radio net; and demonstration of a non real-time very low rate vocoder. A flexible VLSI array processor was completed and is undergoing testing. The Wideband Satellite channel was successfully operated using a packet speech multiplexor to aggregate traffic.

A security architecture for the integrated packet voice/data system was explored. Development of a certifiable, end-to-end encryption system was initiated with manual keying to support the Fort Bragg and SAC testbeds (See project IC-2). Hardware development of a certifiable remotely rekeyable version was deferred but development of the encryption control software was initiated. Several different approaches to distributed processing for personal workstations were implemented; these include extending the UNIX operating system to a distributed environment, developing a distributed kernel (ACCENT) and developing an integrated language/system (ARGUS). A distributed message system and a high-performance Ada-based distributed data management system were both designed. A prototype system for accessing non-homegeneous databases (MULTIBASE) was tested on two sample Naval databases. An advanced programming support environment was designed, along with a high-level specification language for use in developing Ada programs. A three-node prototype distributed sensor network (DSN), was used to track low-flying aircraft with acoustic sensors, and three additional nodes were added to the DSN.

2. FY 1983 Program: The transition to internet protocols on the ARPANET is being carried out, and the TAC access control system demonstrated. The internet system is being monitored to detect gateway faults and semi-automated debugging and down-line loading of software is provided by the network operations center performance. Testing of the internet system continues. Multi-user packet voice experiments are being carried out on the wideband channel to determine the effectiveness of packet multiplexing protocols. Integrated data/voice experiments are being initiated on the network and packet video, file transfer and other bulk data transport applications are being supported. Techniques for internet conferencing are being explored and an effort is being initiated to incorporate real-time communication, resource allocation and security techniques into the existing internet architecture.

Development of a certifiable end-to-end encryption system for the Ft. Bragg and SAC testbeds based on the Internet Private Line Interface (IPLI) is continuing. The encryption control software for the remotely keyable system will be demonstrated using the IPLI hardware. A multi-level secure operating system based on hardware supported tagging and capability management is being designed. Initial versions of the distributed computing system and a distributed message system are being completed, and evaluation will begin. The Ada version of MULTIBASE is being completed and will be demonstrated with operational databases. Implementation of the high performance distributed data management system is continuing. The design of a distributed wargaming architecture based on natural language programming is being initiated. Tools for a programming support environment are being developed, including configuration control tools, distributed debugging aids and

verification software. Experiments are being conducted with a six node distributed sensor net including three mobile nodes. Improved distributed detection and tracking capabilities are being developed and incorporated. A position location capability is being integrated into the network for automated system registration. A multiple target detection capability is being developed for use with background noise and clutter, and theoretical work on the foundations of distributed signal processing is continuing.

3. FY 1984 Planned Program: Techniques will be developed to tightly integrate the host and communication resources in the internet environment and various structures will be explored for higher level protocol standards. Name servers will be developed and demonstrated on the Arpanet to help locate important internet resources. The wideband network will be further integrated into the internet system by implementing "Type-of-Service" routing to automatically direct high volume, delay-insensitive traffic onto the wideband channel. Multi-user packet voice tests will be completed and the packet multiplexing protocols evaluated. Network partition detection and recovery mechanisms will be installed in the internet and used to support the SAC testbed (Project IC-2). The IPLI's will be interfaced with the packet radio technology and used with classified traffic at Ft. Bragg; initial performance tests will be carried out. The remotely keyed system using IPLI hardware will be demonstrated on the ARPANET with unclassified traffic.

An initial version of the multi-level secure operating system will be completed for use with a tagged hardware architecture. The experimental distributed systems will be evaluated by larger communities of users, and will be enhanced as required. Experiments will be conducted to evaluate capabilities such as distributed debugging, dynamic extensibility, and resource protection. The distributed message system will be enhanced to support multi-media document editing, and the system will be ported to other hardware configurations. An advanced Ada programming environment will be developed for a distributed system, and the high performance distributed data management system will be completed. An automated system for detecting inconsistencies between a program and its high level specification will be developed. Implementation of a distributed wargaming system will begin. Techniques for using artificial intelligence in developing software systems will be explored. Testing of the six node distributed sensor network will be carried out using mobile nodes with automated system registration. The position location capability will be refined and tested in a multipath environment. A capability for signal characterization using knowledge based artificial intelligence and signal processing techniques will be investigated.

4. Program to Completion: The internet environment will become a tightly integrated network of networks. Techniques for combining data and voice will be explored and evaluated. The wideband satellite network will be made available for general use in multimedia command and control experiments. Hardware development for the end-to-end remotely rekeyable network security system will be completed and certified with the encryption control software to secure the operation of the joint

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #IC-1 Title: Distributed Information Systems
Program Element: #62708E Title: Integrated Command and Control Technology
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

testbeds with the Services. The multi-level, secure, tagged architecture operating system will be completed and integrated into a multi-layer secure network. Distributed computing systems and advanced programming support environments will be field-tested with selected Service organizations. AI-based software and verification technology will be developed and demonstrated in the software development process. The distributed wargaming system will be developed and demonstrated with multiple organizations across the internet. Distributed database technology will be secured. The performance of a low-cost distributed sensor net of 6-12 nodes will be evaluated using both laboratory data and limited field testing. A multiple target detection capability will be demonstrated in a mobile environment and distributed sensor net technology will be applied to large scale tactical deployments.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Early FY 1983	Early FY 1983	Certify manually rekeyed end-to-end encryption system for use at Fort Bragg.
Late FY 1983	Late FY 1983	Demonstrate initial distributed computing system operating on a network of personal workstations.
Late FY 1983	Late FY 1983	Demonstrate ARPANET TAC access control system.
Late FY 1983	Late FY 1983	Demonstrate MULTIBASE implemented in Ada with operational databases.
Mid FY 1984	Mid FY 1984	Complete implementation of tagged, multi-level secure operating system.
Mid FY 1984	Mid FY 1984	Complete development of internet security system.
Mid FY 1984	Mid FY 1984	Complete testing of six node prototype Distributed Sensor net.
---	Late FY 1984	Demonstrate prototype Ada-based Distributed Data Management System
Mid FY 1983	Mid FY 1986	Implement a certifiable end-to-end, remotely keyable security system.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #IC-1 Title: Distributed Information Systems
Program Element: #62708E Title: Integrated Command and Control Technology
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

6. Explanation of Milestone Changes:

The certifiable end-to-end remotely keyable security system was deferred to FY 1986 because the IPLI technology with manual keying will support the existing testbeds through FY 1986 and lower cost hardware will be available for certification at that time. Resource constraints precluded hardware development of both the manual and remotely keyed systems in parallel.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #IC-2 Title: Advanced Command Control Communication Technology
Program Element: #62708E Title: Integrated Command and Control Technology
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objectives of this project are to develop, demonstrate and transfer advanced command and control technology to the Services. Survivable networks are being explored which can function in the presence of jamming, spoofing and the loss of communication resources, and techniques are being developed for utilizing and controlling large-scale communication networks consisting of thousands of nodes. Low-cost packet radios are being procurred to support experimentation with large scale networks. A survivable satellite network architecture consisting of multiple, low-orbiting, low-cost satellites is being designed. This system supports high bandwidth inter-satellite links and satellite to ground communication based on packet switching technology. A methodology is being developed for rapid implementation of custom and semi-custom integrated circuits which permits the physical separation of the design and fabrication processes, with a goal of reducing the development time for critical Command, Control and Communication (C3) components from completed design to testbed working chips to a few weeks. A testbed program is being renewed with the Army at Fort Bragg, North Carolina to develop distributed ADP application for evaluation in an operational tactical environment, to evolve innovative system concepts for the use of computers in support of future Army requirements, and to develop doctrine for distributed processing in a Corps headquarters. A strategic command and control experiment is being conducted jointly with Defense Communications Agency (DCA) and the Strategic Air Command (SAC) to evaluate the use of packet radio technology, internetting and distributed data base technology as a basis for providing survivable communications and for rapid reconstitution of strategic communications following a major attack.

G. RELATED ACTIVITIES: The Defense Data Network will utilize the DARPA developed internet protocols. The Rome Air Development Center (RADC) is funding related efforts in distributed processing technology. The Strategic Command Control and Communications experiment is a joint effort with the Strategic Air Command and the Defense Communications Agency.

H. WORK PERFORMED BY: 47% Industry; 48% University; 5% In-house. The major performers are SRI International, Menlo Park, CA; Computer Corporation of America, Cambridge, MA; University of Southern California, Los Angeles, CA; University of Southern California, Information Sciences Institute, Marina del Rey, CA; Electromagnetic System Laboratories, Sunnyvale, CA; Linkabit Corporation, San Diego, CA; MIT Lincoln Lab, Lexington, MA; Hazeltine Corporation, Greenlawn, NY; Rockwell International, Dallas, TX; Stanford University, Stanford, CA.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Packet radio network control software was implemented and tested. The maximum network size

as limited by the software was increased to hundreds of packet radios, and reliable operation was achieved with multiple control stations and with a backup stationless control mode. Performance evaluation of the advanced anti-jam packet radio was completed. Mobile tests of the packet radio system have been carried out during exercises at Ft. Bragg, N.C. An architecture for using the Internet Private Line Interface (being developed under the network security program) to provide end-to-end security for the packet radio testbed at Ft. Bragg was developed. Development of a low-cost packet radio to support large survivable network development was continued, and the specification of the initial software for such a network initiated. Analysis of the control mechanisms for large networks having time-varying spread spectrum codes was initiated.

Short-range airborne packet experiments were carried out with small commercial aircraft and low-power radius (10 watts) to evaluate air-to-air and air-to-ground performance for the strategic C3 experiment. A seven node packet radio network was installed at SAC, Omaha, Nebraska and development of the high power amplifiers (500 watts) to support long-range airborne operation was initiated. Development of redundantly configured distributed data bases to support reconstitution experiments was initiated. A preliminary design of the multiple satellite system was refined and critical aspects of the space segment electronics were breadboarded. The Very Large Scale Integration (VLSI) fast turnabround fabrication facility (called MOSIS) was used with commercial vendors to fabricate circuit designs submitted by researchers over the ARPANET. A testbed for VLSI fast turnaround research became operational and was used to fabricate both NMOS and CMOS test devices. A product assurance methodology was demonstrated for NMOS wafer acceptance.

2. FY 1983 Program: Integration and testing of the multiple-station and stationless packet radio network control software is being completed and the software installed in both the Ft. Bragg testbed and Strategic C3 testbed. Packet radio field exercises with the Ft. Bragg Testbed are being completed and the testbed transferred to the Army. The control of large packet radio networks with time-varying spread spectrum codes is being investigated, and development of the low-cost packet radio is being completed; procurement of low-cost packet radios is being initiated to provide enough radios to support testing of large-scale distributed processing concepts. Design of the ground segment architecture for the multiple satellite system is being completed and a laboratory implementation of a low-cost satellite is being initiated to demonstrate engineering feasibility. The MOSIS system is being upgraded to support fabrication of chips having two levels of metal, and to provide user authentication and protected libraries; it will continue to accept designs over the network and support both NMOS and CMOS fabrication commercially. Initial experiments in rapid fabrication using E-beam direct

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write are being conducted at the fast turnaround testbed. The product assurance methodology is being extended to bulk CMOS technology.

The extended-range packet radio amplifier is being completed for use in the strategic C3 experiment and demonstrated on several military aircraft at SAC. Distributed data bases are being completed for experimental use including a bomber recovery application and aircraft scheduling and a demonstration of long-range airborne access to ground data bases and command/control centers is being conducted. Initial software aids for reconstitution of communications are being developed and unclassified experiments are being conducted with SAC to evaluate the reconstitution techniques. Database replication techniques to ensure data survivability are being investigated.

3. FY 1984 Planned Program: Theoretical and experimental work on the control of large networks will continue, and increased emphasis will be placed on the development of survivable network techniques including robust protocols and C3 countermeasures. Additional low-cost packet radios will be procurred for experimentation with large networks and survivability, and network control algorithms will be adapted to utilize the code changing features of the unit. Laboratory implementation of a low-cost satellite will continue and experiments conducted to test key concepts. The multiple satellite system design will be finalized for both the ground segment and space segment. An architecture will be designed for decentralized control of network based ADP resources in the battlefield in conjunction with the Army. VLSI fast turnaround fabrication services will continue to be provided over the Arpanet. Additional process technologies such as gallium arsenide will be evaluated for incorporation into the MOSIS system, and efforts will be made to achieve a turnaround time of two weeks in the testbed. A new effort will be initiated to develop automated control of the VLSI fabrication facilities. A state-of-the-art CMOS fabrication capability is being included as part of the network-based foundry service.

The capability for long range airborne access will be installed on the SAC aircraft for extended testing in the Strategic C3 program; strategic planning aids will be developed and improvements made to the reconstitution software based on unclassified experimental results. Data survivability and updating methods will be evaluated using local and remote computer access. Airborne and ground based experiments will be conducted to demonstrate the ability to survive network partitions. The manually keyed end-to-end network security system will be tested at SAC. The increased funding in FY 1984 over FY 1983 supports the automated control of VLSI fabrication facilities.

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4. Program to Completion: A network management system for large scale survivable networks will be developed and evaluated. Position location and end-to-end security capabilities will be integrated into the network. Laboratory development of the low cost satellite will be completed and a demonstration of the multiple satellite system concept will be carried out in a laboratory setting to validate the architecture and to test key concepts prior to deployment. A distributed system architecture will be developed and evaluated jointly with the Army to evaluate battlefield data decentralization concepts. The MOSIS System will be used to support VLSI fabrication over the Arpanet. The VLSI fast turnaround testbed will be automated to support management and control of a multi-use fabrication facility. The airborne packet network will be secured with the end-to-end security system and airborne experimentation with classified data bases will replace the unclassified simulated data. Advanced techniques for post-strike reconstitution of failed communication links will be demonstrated using airborne and ground-mobile platforms.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Late FY 1982	Mid FY 1983	Demonstrate long range packet radio operation in military aircraft.
Late FY 1983	Late FY 1983	Demonstration of low-cost packet radio prototypes.
Late FY 1983	Late FY 1983	Demonstrate access to distributed ground-based data from airborne packet radio.
----	Early FY 1984	MOSIS supports 3μ CMOS fabrication.
Mid FY 1983	Late FY 1984	Demonstrate secure packet radio network at Ft. Bragg.
Late FY 1984	Late FY 1984	Demonstrate communication and database reconstitution.
Late FY 1984	Late FY 1984	Software available for large survivable network testing.

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----	Early FY 1985	Secure Network at SAC.
Mid FY 1985	Mid FY 1985	Demonstrate low-cost multi-satellite communication in the laboratory.
----	Late FY 1985	MOSIS supports GaAs test runs.
Mid FY 1986	Mid FY 1986	Demonstrate large survivable network.

6. Explanation of Milestone Changes:

The long range packet radio demonstration in military aircraft was slipped due to delays in receiving the high power frequency allocation.

Because of contractual delays, the availability of network security devices has slipped until 1984.

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Title: Experimental Evaluation of Major Innovative Technologies
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A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
FY 1983 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		$237,040	$268,500	$375,554	N/A	Continuing	TBD
FY 1984 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		$199,449*	$253,500*	$290,000*	$315,500*	Continuing	TBD
EE-2	TEAL RUBY Experiment	28,550	31,000	33,000	36,000	45,000	241,879
EE-3	X-Wing	6,683	12,100	14,700	13,000	60,000	52,283
EE-4	Advanced Command and Control Architectural Testbed	2,000	0	0	0	0	11,902
EE-5	Technology Assessments	740	0	0	0	0	7,882
EE-6	Advanced Sensor Demonstration	17,804	16,000	0	0	0	72,411
EE-7	Space Acquisition, Tracking and Pointing Experiment - TALON GOLD	25,626	35,000	61,000	67,600	58,000	275,962
EE-8	High Power Chemical Laser Ground-Based Demonstration - ALPHA	20,415	24,900	43,100	54,500	58,400	229,716

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EE-9	X-29 Advanced Technology Demonstrator (formerly Forward Swept Wing Demonstration	28,125	43,000	35,000	22,000	0	141,454
EE-10	Assault Breaker Demonstration	26,500	0	0	0	0	170,165
EE-12	Large Optics Demonstration Experiment - LODE	13,173	14,200	23,500	33,000	32,500	157,024
EE-15	SORAK Demonstration (Korean Equipment Upgrade)	5,001	0	0	0	0	5,001

*Total includes classified projects not identified herein.

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:

TEAL RUBY Experiment: This is a space experiment to demonstrate infrared detection of strategic aircraft from a space platform, to measure target and clutter background signatures from space, and to demonstrate advanced infrared detector technology. Expansion of the basic sensor mission is being investigated to include signature measurements of tactical targets and high altitude mission plumes. The sensor and the associated USAF spacecraft are for an early launch date aboard the space shuttle.

X-Wing: The X-Wing is a major innovation in Vertical Takeoff and Landing (VTOL) aircraft design which, by stopping the rotor in flight, combines the vertical lift efficiency of a helicopter with the speed, range, and altitude performance of a transonic fixed wing aircraft. Design analysis indicates an operational X-Wing vehicle would have approximately three times the speed, range, and altitude performance of a conventional helicopter with equivalent payload lifting capability. Such characteristics portend a very broad operational applicability such

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as: more flexible sea-basing for the Navy wherein two or more aircraft on non-aviation ships could conduct long range anti-submarine warfare, over-the-horizon targeting of surface and air targets, tactical jamming and other existing (or emerging) missions; new Army roles such as close air support and sensor carrier with intratheather, self-deployment capabilities; new Air Force tactical missions which release dependence on fixed Air Bases and increase pre-launch survivability.

Advanced Sensor Demonstration: The purpose of the Advanced Sensor Demonstration program is to experimentally demonstrate critical elements of the electro-optical sensor technology necessary to maintain the current advantagous strategic surveillance position held by the U.S.A. In FY 1984 this work will be transferred to Project ST-2 of PE 62301E.

Space Acquisition, Tracking & Pointing Experiment - TALON GOLD: The goal of the TALON GOLD experiment is a space test of laser pointing technology. The experiment is designed to achieve long range target acquisition and tracking at ranges up to with pointing accuracies and beam stablization of better than This is a key element in the development by DARPA of space-based high energy laser technology required for

High Power Chemical Laser Ground-Based Experiment - ALPHA: The objective of the ALPHA Project is the demonstration of the feasibility of a

Emphasis in this effort is placed on the ground-based test and evaluation of a

X-29 Advanced Technology Demonstrator: The X-29 manned Forward Swept Wing (FSW) aircraft, made possible with advanced composite structure and a digital fly-by-wire flight control system, will be designed, fabricated, and flight tested to investigate and quantify the technical benefits and performance capabilities of such an integrated advanced technology vehicle. Flight test will develop confidence in numerous individual technologies, make them available as viable design options for advanced tactical aircraft and greatly reduce the risk and time associated with future application.

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Large Optics Demonstration Experiment (LODE): The objective of this program is to demonstrate in a ground-based experiment the performance obtainable from a laser beam control system coupled to a large aperture beam expander designed for Issues related to wavefront control and internal alignment, large optical structures, sub-microradian fine tracking and internal energy management will be addressed. This is a key element in the development of technology required by

C. BASIS FOR FY 1984 RDT&E REQUEST: The FY 1984 funding for TEAL RUBY will be used to complete the testing on the qualification unit and to begin integration testing with the spacecraft. The flight sensor will proceed through acceptance testing. Critical design reviews will be completed for mission planning and software development. These activities represent major milestones toward achieving a launch in early FY

X-Wing: The objective of this program is to design, fabricate and flight test a X-Wing/Rotor of a size representative of an operational aircraft. The FY 1984 program continues the joint DARPA/NASA demonstration program using the NASA/ARMY Rotor Systems Research Aircraft (RSRA) to evaluate the rotor.

The Advanced Sensor Demonstration program will continue under Project #ST-2 (PE23012E).

The funding for TALON GOLD will continue the Phase II portion of the program for detailed design, fabrication, integration and testing, consistent with a post FY launch. Experiment content will be definitized and detailed design will be completed.

FY 1984 will be the first hardware intensive year in the ALPHA program. Activity will center around initiation of fabrication of all the assemblies of the ALPHA laser device and the modification of the test facility.

The first flight of the X-29 Advanced Technology Demonstrator (ATD) will be in mid FY 1984. Flight testing will be accomplished so as to make design and test evaluation results available to government and industry users by late FY 1985 so the new concepts will be available for the Air Force Advanced Technology program.

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Significant improvement of short takeoff and landing (STOL) performance, excellent high angle of attack maneuver control, more efficient transonic performance, and considerable design flexibility are the most obvious advantages of this unique configuration. These FSW technology attributes could well provide major reductions in the weight and costs of future vehicles.

LODE funding in FY 1984 is to complete the final design of the LODE experiment and risk reduction breadboard activities at the integrated system level. The final design of test and simulation facilities will also be completed.

D. COMPARISON WITH THE FY 1983 DESCRIPTIVE SUMMARY: The FY 1984 requirements for the TEAL RUBY program have increased because; (1) more emphasis will be placed on developing software for factory testing, mission planning and flight experimentation and (2) the program was rebaselined for a high confidence schedule which includes provisions to solve probable failures during testing. The Advanced Sensor Demonstration program was restructured to emphasize critical near-term technology demonstration. Plans for a space flight were deleted. In FY 1984, research of these basic technologies will be transferred to Project #ST-02 (PE62301E). The X-Wing program has been accelerated to meet an advanced flight test date. The X-29 Advanced Technology Demonstrator program requirements have increased because of a more precise definition of program tasks and flight tests to be performed by the contractors and Government activities. The FY 1983 and FY 1984 funding for TALON GOLD has been increased due to the procurement of a three-axis orientation system necessitated by NASA's cancellation of the Advanced Gimbel System program. The FY 1983 and FY 1984 funding for ALPHA increased due to refinement of hardware fabrication cost projections, especially for optical components. Portions of the increase are due to increased risk reduction activities undertaken as a result of the Preliminary Design completed in mid FY 1982. The FY 1983 and FY 1984 funding for LODE has increased due to the addition of risk reduction activities in the program. The SORAK Demonstration (Korean Equipment Upgrade) program has been terminated.

E. OTHER APPROPRIATION FUNDS: None

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Project: #EE-2 Title: TEAL RUBY Experiment
Program Element: #62711E Title: Experimental Evaluation of Major Innovative Technologies
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: DARPA initiated the TEAL RUBY Program in 1974 to demonstrate the feasibility of detecting strategic air vehicles using a space-based infrared sensor and to provide a future option for warning of bomber attack against North America or Naval Battle Groups. Detection of weak aircraft signatures against the strong earth background clutter required a large number of advanced technology, detectors. Target and background measurements performed by DARPA showed the feasibility

These measurements, coupled with successful production of large mosaic arrays, formed the basis for TEAL RUBY. The TEAL RUBY Space Experiment will use 13 fixed narrow band infrared spectral filters in wavelength band with each focal plane zone containing detectors. spectral filters were developed to demonstrate spectral in a single focal plane Although the filter was demonstrated successfully in the laboratory, it will not be included in the TEAL RUBY flight test in order to eliminate cost and schedule constraints. Measurements will be performed from a inclined orbit using cooperative air vehicles targets to validate performance. The sensor is designed with sufficient sensitivity to detect targets the size of strategic bombers but experiments also will be conducted against much dimmer targets such as cruise missiles. Infrared background measurements, required for the design of future operational sensors, will be made on a worldwide basis and under a variety of climatological and geographic conditions. Experimental orbital flights will be conducted,

In addition, the feasibility of using the sensor to measure high altitude signatures is being examined.

G. Related Activities: Development of the focal plane technology, accomplishment of target and background measurements from aircraft platforms, and definition and preliminary design of the flight experiment were accomplished under the DARPA Warning Technology Project, Program Element 62301E, Project ST-6. The TEAL RUBY Experiment provides the transition of DARPA concepts, technology and design data into a variety of future space systems being considered by the Air Force, Navy and Army. TEAL RUBY will provide global background data, target signature data (for band selection) and validation of the mosaic concept for the Air Force Advanced

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Warning System, Navy Integrated Tactical Surveillance System (ITSS), Air Force Space Based Surveillance System (SBSS), the Space Based Laser and the Air Force Anti-Satellite (ASAT) programs. The TEAL RUBY international cooperation effort, has been formulated and chartered in order to facilitate the joint experiments and to exchange data in cooperative defense areas.

H. Work Performed By: The TEAL RUBY effort is performed by industry (92%) and by a Federal Contract Research Center (FCRC) (8%). Rockwell International, Seal Beach, California, is the prime contractor on the TEAL RUBY sensor; support contractors are: Logicon, San Pedro, California, Magnavox, Torrance, California; MRJ, Fairfax, Virginia; and the Environmental Institute of Michigan, Ann Arbor, Michigan. The FCRC support is provided by the Aerospace Corporation, El Segundo, California. The program is managed by the Air Force Space Division, Los Angeles, California, with support in Naval areas of interest by the Naval Ocean System Center, San Diego, California. Target support is provided by the Air Force Geophysics Laboratory (AFGL), Hanscom Field, Massachusetts and operational support will be provided by the Air Force Sstellite Control Facility at Sunnyvale, California.

I. Program Accomplishments and Future Programs:

1. FY 1982 Accomplishments: Three very significant activities occurred in FY 1982. First, the TEAL RUBY Qualification Sensor was fully assembled and testing was initiated. Second, the program schedule and cost were completely rebaselined, which resulted in a new, high confidence launch schedule and funding profile. The third major activity was in the growing area of mission planning, including detailed experiment planning, a TEAL RUBY user's conference, initiation of the international cooperative effort and achievement of an improved structure for software development. Many technology achievements in FY 1982 contributed to the completion of the qualification sensor and to the start of the qualification test program. The following TEAL RUBY qualification unit components were among those completed: focal plane assembly, inflight calibration unit, telescope, cryostat, data processor unit, yoke-spindle assembly, rate gyro and electronics, In addition, over thirty percent of the TEAL RUBY flight hardware was completed and tested and the buildup of the flight sensor was

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initiated. Fabrication of the earth shield assembly was also completed. Testing of the flight telescope unit was also started and assembly of the flight rate gyro and electronic unit was completed. The Air Force Satellite Control Facility (AFSCF) interface software design has been completed and coding is proceeding. The revised Space Experiment Plan and the first draft of the Orbital Operations Support Document were also issued.

2. FY 1983 Program: The major portion of the qualification test program is being completed, including acoustical and radiometric testing. The latter test provides the first comprehensive system-level performance data. The responsivity, noise and uniformity levels for the the focal plane are being determined. Since has different requirements for optimum target and background measurements, these test results are key inputs for mission planning and software development. A new radiometric chamber is also being calibrated and brought on-line to support this test. The TEAL RUBY flight sensor components are being acceptance tested in preparation for sensor assembly in FY The mission planning and operations software requirements are being completed and work on software design specifications, including software acceptance testing plans, is being started. Development of the Rockwell Computer Operations Center (COC) and installation of the COC Network Interface Data System, which will govern the interconnection with the AFSCF, is being initiated. Planning for the baseline target and background experiments is also being completed. In addition, the target aircraft operations plan is being formulated with the Air Force Geophysics Laboratory (AFGL). The major portion of the increase in planned FY 1983 funding is to accommodate the increased time allocated to complete the qualification test program and flight hardware and software design. Previously, the FY 1983 budget for this project was predicated on the qualification test program being completed in FY 1982 with all the major flight hardware to be delivered within this time frame. Engineering and parts problems encountered during completion and testing of several of the electronic units have caused delays in meeting these milestones, making it necessary to continue to support both prime and subcontractor efforts through FY 1983. In addition, several tasks were added and/or expanded in the mission planning and software development areas. The software effort supports mission planning and includes command generation, data reduction and "quick look" data analysis. The data reduction software provides research tapes for the Services' design analysis efforts. The software for mission execution, data processing and reduction

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is a major effort since the sensor data rate and quantity of data exceeds conventional sensors The data analysis software is based upon the experience and software generated by the DARPA Highly Calibrated Airborne Measurement Program (HI-CAMP) sensor and will provide the basis for the advanced systems discussed earlier.

3. FY 1984 Planned Program: Testing will be completed on the qualification unit and the unit will be provided for integration with the P-80 Shuttle spacecraft The TEAL RUBY/P-80 spacecraft integration test program will also be accomplished using a qualification sensor while the flight sensor proceeds through acceptance testing. The acceptance tests include two radiometric tests to verify the performance level and stability of the sensor. In the mission planning and software development area, the Critical Design Reviews (CDR) will be completed and the software coding initiated. The integration and testing of the Rockwell Computer Operations Center will be completed and work on the Rockwell Decryption Center will approach completion. The budget for FY 1984 has been increased by approximately $10 million over the amount estimated in last year's summary. There are two principal reasons for this increase. The first reflects the additional effort required for software and mission planning. There are over lines of code in the TEAL RUBY software. The job of developing, verifying and testing the flight, mission planning and factory test software ranks as one of the most sophisticated space software developments ever undertaken. An independent assessment team recommended that both the software development and the mission planning parts of the program receive increased emphasis. Additional manpower and tasks have been added for a more structured development and increased verification and testing. The second reason for the budget increase is the total program rebaselining, which has produced a high confidence schedule including provision for probable failures and allowance for the time and funds needed to take corrective actions.

4. Program to Completion: the acceptance testing of the TEAL RUBY flight sensor will be completed and the qualification sensor removed from the spacecraft and replaced with the flight sensor for the final integration testing. The system will then be packaged and delivered for P-80 Shuttle integration
After insertion into final orbit, the TEAL RUBY sensor will be checked out and orbital

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experiment operations initiated. Experimental missions will be conducted for nominal time periods of twice a week, corresponding to orbital passage over targets and/or background areas of interest. Experimental segments or missions are generally categorized as: (1) target missions demonstrating on-board detection of cooperative air vehicle targets; and (2) background missions where multispectral radiometric data will be recorded. Priority in time sequence of experiment execution will be given to aircraft measurement/detection and collection of global background data, with emphasis on geographic regions critical to U.S. air and fleet defense. Focal plane operation will be monitored using a variety of temperature, signal and noise measurements. The estimated life of the TEAL RUBY sensor is nominally one year and is limited by the supply of stored solid cryogen. Each set of mission data will receive a "quick look" for feedback to subsequent missions to increase the efficiency of collection over the lifetime of the satellite. A final experiment evaluation report will follow mission completion by approximately six months.

5. Milestones:

Last Year's Summary	Current Plan	Milestones
Mid FY 1982		Deliver qualification sensor to P-80 Shuttle Spacecraft.
Early FY 1984		Launch of P-80 Spacescraft.
Early FY 1985		Complete Orbital Operations.
Mid FY 1985		Complete Program.

6. Explanation of Milestone Changes: The qualification test schedule was lengthened to allow for expected failures and repair times. The flight unit will replace the qualification unit in late FY The change in launch date is due to the lengthening of the schedules to allow for expected failures during test. The completion of orbital operations and the final program reporting slip accordingly.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-3
Program Element: #62711E
DoD Mission Area: 530

Title: X-Wing
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The X-Wing is a major innovation in Vertical Takeoff and Landing (VTOL) aircraft design which combines the vertical lifting efficiency of a helicopter with the speed, range and altitude performance of a transonic fixed wing aircraft. This unique capability is made possible through the use of a quasi-elliptical circulation control airfoil in the design of the rotor blades. The lift on each rotor blade can be selectively controlled by varying the momentum flux of air blown through tangential slots along each rotor trailing edge. The X-Wing aircraft uses the circulation control system to produce lift and achieve stability and control of the vehicle during all flight modes including in-flight stopping/starting of the rotor/wing. The objective of this effort is to demonstrate the utility of the concept through the design, fabrication and flight test of a demonstration vehicle representative of an operational size aircraft. Emphasis was changed in FY 1980 to an operational size aircraft from the original 3,200 lb test vehicle. A twenty five foot graphite composite rotor and active fly-by-wire flight control system have been successfully tested in the NASA Ames 40 x 80 foot wind tunnel. Preliminary design of a larger operational scale rotor system and compatible airframe has been initiated. Design analysis indicates an operational X-Wing vehicle would have substantially greater range, speed and altitude than a conventional helicopter with equivalent payload lifting capability. These characteristics portend a very broad operational applicability. For example, they could greatly enhance Navy missions such as early warning, antisubmarine warfare, and over-the-horizon targeting and could also make new missions possible such as long range Surface Launched Air Targetable (SLAT) missile anti-air warfare, dispersed electronic jammer and missileer missions. Preliminary studies of multi-mission X-Wing designs employing fifty foot diameter rotors and convertible fan/shaft engines indicate an excellent potential for non-aviation ship compatibility. Other analyses and test data verified a capability for significantly improved handling qualities during turbulent shipboard takeoff and landing operations. The extended range and speed capability of the X-Wing enhances its operational utility for Air Force, Navy and Coast Guard extended range Search and Rescue missions as well as troop insertion and personnel evacuation roles. Cumulative findings strongly support the X-Wing as an ideal vehicle to provide the flexible sea basing and deployment options sought by the Navy. Potential Army missions include Special Equipment Mission Aircraft (SEMA-X), Scout Attack (LH-X), new/Close Air Support missions, Anti-Air, intratheater transport and cross-FEBA interdiction. The X-Wing also appears capable of providing a measure of self-deployment ferry capability for Rapid Deployment Force applications.

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Project: #EE-3 Title: X-Wing
Program Element: #62711E Title: Experimental Evaluation of Major Innovative Technologies
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

Objectives of the program are: (1) to acquire and develop the technology and data base sufficient to design a full scale X-Wing aircraft; (2) to utilize the NASA Rotor System Research Aircraft (joint DARPA/NASA program) to flight demonstrate the rotor/wing dynamic system in conversion, fixed and rotory wing flight modes; (3) to integrate results from the off-line develoment of the Convertible Engine System and other DARPA work on elimination of the tail rotor.

G. RELATED ACTIVITIES: The X-Wing Vertical Takeoff and Landing (VTOL) initiative is derived from the Circulation Control Rotor work performed by the David Taylor Naval Ship Research and Development Center (DTNSRDC) and also takes advantage of advanced stopped rotor dynamics and control work done by the Army in the late 1960s. The Navy is using a 44 foot diameter Circulation Control Rotor in a current flight test program on the UH-2D helicopter for the purpose of demonstrating improved reliability, maintainability and active vibration suppression. Also, the wing of an A-6 aircraft was modified by the Navy to demonstrate a Circulation Control Wing for Short Takeoff and Landing (STOL) performance improvement and completed a very successful flight test program, during which minimum landing speeds were reduced from 120KTS to 75KTS. A joint DARPA/NASA convertible turbofan/shaft engine program is being conducted in a parallel effort to provide a new and more efficient propulsion system for the X-Wing program as well as other Vertical Takeoff and Landing (VSTOL) aircraft and advanced compound rotorcraft concepts.

H. WORK PERFORMED BY: About ninety-five percent of the X-Wing program is being performed by industry. Five percent of the work is being conducted by the David Taylor Naval Ship Research and Development Center, Carderock, Maryland. NASA Ames Research Center is also supporting the program through wind tunnel testing and flight research. The two prime contractors are the Boeing Vertol Company, Philadelphia, Pennsylvania; and Sikorsky Aircraft Company, Stratford, Connecticut.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: During FY1982, Boeing and Sikorsky proceeded with "Phase I - X-Wing Design Definition" contracts consisting of: (1) conceptual design of larger flight demonstrator vehicle candidates and development of program options; (2) detail designs of a larger (50 ft) X-Wing rotor system; (3) complementary risk

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Program Element: #62711E
USDR&E Mission Area: 530

Title: X-Wing
Title: Experimental Evaluation of Major Innovative Technologies
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reduction and technology development activities by both contractors. Parallel with these contracts, a separate DARPA/NASA Convertible Engine program was initiated to comply with earlier USDR&E direction. The demonstrator engine for this program (TF-34 Turbofan) was selected for its direct applicability to single or twin engine X-Wing aircraft ranging in gross weight from 18,000 to 30,000 pounds with significant growth capability.

(Program Options) Initial demonstrator design activites were directed toward an all-new vehicle. Cost analyses for this "full blown" approach indicated a program cost significantly beyond the reach of a DARPA-only program. Subsequent to the "full blown" option, 12 other programs were evaluated. The lowest cost and preferred technical approach which still retains the full-scale rotor and permits assessment of the most critical risks associated with the X-Wing concept is to employ the NASA/Army Rotor Systems Research Aircraft (RSRA) built by Sikorsky to test the rotor/hub fly-by-wire controls and pneumatic system up to 300 knots. This program has the added advantage of transitioning in a very logical manner to a service prototype by continuing off-line development of the Convertible Engine.

(Risk Reduction and Detail Design) Primary initial effort was toward reducing the high technical risk associated with scaling from the 25 ft rotor design value to a Navy operational size. In addition, the blade pressure ratios, pneumodynamic response, and structural resonant frequencies were also extended to large scale values. Models being used are a ½ scale rotor-only model, a 1/8 scale fixed-wing model and a very sophisticated 1/5 scale dynamic/aeroelastic model capable of simulating the sea-level envelope in rotary, conversion and fixed-wing modes. Other activities included component laboratory testing of rotor blade sections, hubs and valves and high frequency pneumodynamic tests. Modification and additional testing of the existing 25 foot rotor was conducted by DTNSRDC and supported by both contractors in order to extend the design data base to operational scale tip speeds and disc loadings. DTNSRDC testing activities were focused primarily on extending the Mach number/Reynolds number range of X-Wing airfoils and providing improved analytic methods of aerodynamic calculation.

2. FY 1983 Program: During FY 1983 a joint DARPA/NASA RSRA program will be initiated with approximately equal funding from each agency. The significant FY 1983 funding increase initiated contracts for this activity.

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The NASA portion of the program is to be carried under: 'Technology for Next Generation Rotorcraft' (within the Rotorcraft Systems Technology Program UPN532) beginning in FY 1984. The X-Wing/RSRA program is composed ot the following major tasks: (a) Design and Analysis; (b) Basic Design Data; (c) Fabrication of a large (50 foot diameter) rotor system; (d) Ground Tests and Software Development; (e) Contractor and NASA Flight Tests.

During FY 1983 the X-Wing Rotor System Design and Basic Design Data will be completed and RSRA modification and subsystem fabrication begun. Contractor rotor System Design activities are supported by DTNSRDC and NASA in-house programs of subscale wind tunnel testing and analytic correlation. A sophisticated Mach Scaled dynamic model will be utilized extensively during this period to provide Basic Design Data and to conduct a full RSRA pre-flight evaluation. Fabrication activities consist of modification of the existing RSRA airframe, the rotor drive system, the RSRA controls system and new construction of all full scale X-Wing rotor system components.

3. FY 1984 Program: During FY 1984 the program will complete fabrication of most subsystems and enter them into proof load, fatigue, lab, and ground tests. Major subsystems include blades, compressors, hub moment sensors, gear boxes, and computer hardware. A Propulsion System Test Bed will be developed for ground testing of the engine-transmission-rotor-control system. Subscale RSRA aerodynamic and stability refinements will be completed. Simulation facility hardware/software will be completed and initial evaluations of control logic performed. NASA funding participation will begin in FY 1984 to complement the planned DARPA profile and permit rapid program execution.

4. Program to Completion: During FY 1985 the X-Wing rotor system will be installed on the RSRA airframe. The Propulsion System Test Bed, component qualifications tests, hub-sensor calibration, and airframe shake testing will be completed. Following these activities the airframe will be tied down for integrated systems testing. Final adjustments to the flight control and higher harmonic control system will be inserted from sub-scale data and simulation. Following flight safety review and tie down testing the aircraft will initiate flight testing. Flight testing objectives include: (1) the in-flight aerodynamics associated with the Circulation Control boundary layer control system; (2) the capability of the pneumatic control system to provide flight control, vibratory airload

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suppression and gust control - particularly during conversion to fixed wing flight; (3) the performance of the closed loop fly-by-wire stabilization and control system in all flight modes; (4) structural and aeroelastic performance of the graphite composite fore/aft swept X-Wing wings; (5) an operational air speed/altitude envelope up to the limits of the RSRA airframe.

5. Milestones: The X-Wing/RSRA contract definitization process is currently well underway with the following tentative milestones identified.

Last Year's Reported Plan	Current Plan	Milestones
Early FY 1983	Early FY 1983	Selection of flight vehicle program; definitize DARPA/NASA RSRA Contract.
--	Mid FY 1983	Complete Basic (Subscale Tests) Design Data; Rotor Detail Design Review (New).
--	Late FY 1983	Complete Basic Flight and Vibration Control Data at sub-scale Complete Blade Segment Fatigue Tests (New; replaces last year's operational size rotor test).
Early FY 1984	Early FY 1984	Flight demonstrator Hardware Design Review; first test blades available, flight control computer available.
--	Late FY 1984	Initiate Propulsion System Test Bed, flight blades available (New).
--	Early FY 1985	Ground Testing; flight clearance review; conduct first flight.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-3 Title: X-Wing
Program Element: #62711E Title: Experimental Evaluation of Major Innovative Technologies
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--	Mid FY 1985	Flight Test Data Review.
--	Early FY 1986	NASA receipt of aircraft.

6. Explanation of Milestone Changes: All FY 1982 milestones of prior Descriptive Summary were met. The FY 1983-85 milestones are revised to correspond to DARPA/NASA RSRA contract dates. Last year's 'Late FY 1985' Flight Clearance Review Date has been moved forward to 'Early FY 1985' due to selection of the RSRA demonstrator approach.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-6
Program Element: #62711E
USDR&E Mission Area: 530

Title: Advanced Sensor Demonstration Program
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The success of the DARPA High Altitude Large Optics (HALO) program for development of advanced infrared surveillance sensor technology has led to the formulation of the Advanced Sensor Demonstration (ASD) Program. The thrust of this program is the development and laboratory demonstration of the key elements of a sensor applicable to advanced surveillance missions. Performance necessary to achieve major system improvements in sensitivity and measurement precision as well as significant improvements in spatial and precision will be demonstrated. These capabilities will maximize operational systems flexibility and minimize national vulnerability to changes in Soviet systems. Confidence will be obtained in the ability to perform those surveillance tasks, that are needed to support defensive and offensive force management in space as well as treaty verification. The long observation time and high sensitivity will be demonstrated. The processor being demonstrated is essential in order to obtain real-time user-oriented data using modest bandwidth data links. This is needed in order to demonstrate the capability necessary to provide functional support to the war fighting missions of the Services. The experimental configuration is not yet finalized, but it is expected that it will be a focal plane operating in the micron spectral range, coupled to a laboratory brassboard adaptive processor. An important function of the processor is to support and manage the focal plane and to generate target tracks from raw detection data. The signal encoding, overload sensing and control, temporal filtering, threshold detection, and target track formation functions would be performed by the on board processor, resulting in a major reduction in data volume. The data compression to be demonstrated by the processor is essential to the concept of survivable data links which pass only validated target tracks to small simplified ground stations. These functions will be implemented with a brassboard processor consisting of key portions of the final planned processor built with custom logic and memory chips to demonstrate the ultimate processor size and weight potential.

G. RELATED ACTIVITIES: The balance of the funding from FY 1984 to completion of this effort in FY 1985 will be provided under Project Number ST-2 (PE 62301E). This program is also related to the USAF's Advanced Warning Sensor (AWS) for Missile Early Warning and Space-Based Satellite Surveillance (SBSS) for space defense
The USAF Space Division, in its role as Advanced Warning Sensor (AWS) and Space-Based Satellite Surveillance (SBSS) manager and DARPA agent for the Advanced Sensor Demonstration (ASD) Program, provides a transfer point. The technology base demonstrated by ASD is related to air vehicle detection, satellite surveillance, and theater surveillance systems as well as attack assessment.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-6 Title: Advanced Sensor Demonstration Program
Program Element: #62711E Title: Experimental Evaluation of Major Innovative Technologies
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

H. WORK PERFORMED BY: Ninety percent of this program will be performed by industry and 10% performed by Federal Contract Research Centers (FCRC). Industrial contractors include: Hughes Aircraft Company, Culver City, California; and C.S. Draper Laboratory, Cambridge, Massachusetts. FCRC support is obtained from the Aerospace Corporation, El Segundo, California.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: The major highlight was the successful performance of the micron Mercury Cadmium Telluride (HgCdTe) element mosaic array when hybridized with a background suppressor readout chip. The device was evaluated on a newly completed automated Infra-Red (IR) test set. Key accomplishments were the high percentage of the detectors that were active after array bonding, the excellent detector uniformity, the completion of advanced facilities and procedures for volume automated array testing, and the routine production of the unusually large substrates required for detector array development. Major progress has also been seen in the process improvements necessary to increase the cutoff wavelength of the heterojunction detector arrays from microns. Intermediate micron cutoff detector arrays were hybridized with a background supression multiplexer. Another accomplishment was the initial thermo-mechanical testing of the integrated assembly of detector arrays and multiplexer chips making up a module demonstrating close detector packing. This close packing demonstration required development of cabling, interconnection and mounting devices, and assembly procedures in order to maintain the detector area active. In addition, a was fabricated and tested. Experimental tests confirmed the feasibility of this filter theory. The processor development and demonstration, involving the use of custom logic and Random Access Memory (RAM) chips, software, breadboard and brassboard, made significant progress. The custom Large Scale Integration (LSI) logic chips and complementary metal oxide semiconductor devices needed for the processor have been designed and fabrication initiated. Two chips have been installed in the processor breadboard for demonstration. The 16K byte RAM design was verified in extensive testing, and the manufacturing process matured sufficiently to produce fully tested devices which meet or exceed all functional electrical requirements. Preliminary testing indicates that these devices are more tolerant than expected. The majority of the processor breadboard software has been developed, tested, and used in a demonstration of the processor's ability to detect and track targets.

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Project: #EE-6
Program Element: #62711E
USDR&E Mission Area: 530

Title: Advanced Sensor Demonstration Program
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Budget Activity: 1. Technology Base

2. FY 1983 Program: Focal plane development is continuing, leading toward demonstration of high performance, large scale Long Wave Infra-Red (LWIR) detector arrays with a close packed background suppressor multiplexer mounted in a carrier assembly with necessary cabling and control electronics. A Mercury Cadmium Telluride (HgCdTe) materials process development aimed at improving detector performance and moving the cutoff wavelength is continuing. Implantation procedures for array fabrication are also being developed. The close-packed version of the multiplexer chip is being completed. Preliminary circuit and packaging designs for the focal plane drive and control electronics are being developed. In addition, the multi-processor channel brassboard assembly has begun. Software development for the transition from the breadboard to the brassboard processor has also begun.

3. FY 1984 Planned Program: These efforts will be continued under PE 62301E, Project No. ST-02.

4. Program to Completion: This is a continuing effort under PE 62301E, Project No. ST-02.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestone
Late FY 1982	Late FY 1983	Demonstrate Mercury Cadmium Telluride element Long Wave Infra-Red demonstration chip.
Mid FY 1984	Deleted	Payload Preliminary Design Review.
Early FY 1986	Deleted	System Preliminary Design Review
Late FY 1985	Deleted	Payload Critical Design Review
New Milestone	Mid FY 1983	Custom Large Scale Integrated Circuit logic chips completed.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-6 Title: Advanced Sensor Demonstration Program
Program Element: #62711E Title: Experimental Evaluation of Major Innovative Technologies
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

New Milestone	Late FY 1983	16K byte Random Access Memory chip development completed.
New Milestone	Late FY 1983	Focal plane electronics circuit design complete

6. Explanation of Milestone Changes: The program was restructured to emphasize critical near-term technology demonstrations In FY 1984 the basic technologies will be transferred to Project Number ST-02 (PE 62301E) to be carried to completion under a single major Advanced Infra-Red Surveillance Technology Program.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-7
Program Element: #62711E
USDR&E Mission Area: 530

Title: Acquisition, Tracking and Pointing Experiment - TALON GOLD
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: Talon Gold is an Acquisition, Tracking and Pointing (ATP) experiment designed to establish the feasibility of achieving ATP performance levels commensurate with the requirements of a space-based high energy laser weapon system. A weapon system of this type requires high performance ATP capabilities because of the stringent conditions which are complex products of range, engagement kinematics, target signatures, and reaction times, as well as desired system accuracy and stability. The Talon Gold Program is intended to establish the feasibility of achieving the appropriate performance levels by developing and performing a space experiment. The selection of a space test approach was based on the necessity of evaluating the system in the appropriate zero-G and vacuum environment, and obtaining the required test data in an unambiguous manner. As a consequence, the Talon Gold Experiment serves as a major milestone in the development of the requisite spaced-based laser technologies, a means of obtaining ATP subsystem and system performance data in a representative environment, and an opportunity to demonstrate the ATP capabilities required for a space-based laser weapon system.

G. RELATED ACTIVITIES: Talon Gold is part of the DARPA space laser "TRIAD" which includes the ALPHA and the LODE programs. Collectively these three projects will demonstrate the key technologies for a space-based laser weapon system. Talon Gold is closely related to the DARPA High Energy Laser (HEL) technology project (Program Element #62301E, Project #ST-3) which provides the technology base for extending the results of the Talon Gold experiment to other missions and to shorter wavelength laser devices. A close working interface exists between this program and the Military Departments' High Energy Laser programs dealing with acquisition, tracking and pointing technology. The principal Service agent for this program is the Air Force Space Division. The Air Force Space Test Program (Program Element No. 63402F) is responsible for integrating the Talon Gold Experiment instrumentation into the Space Transportation System and for providing the necessary flight services and launch charges.

H. WORK PERFORMED BY: This effort is performed by industrial contractors (97%) and by a federal contract research center (3%), Aerospace Corporation, El Segundo, California. Industrial contractors include: Lockheed Missiles and Space Company, Sunnyvale, California; Jet Propulsion Laboratory, Pasadena, California; Charles Stark Draper Laboratories, Cambridge, Massachusetts; General Research Corporation, McLean, Virginia; and Science Applications Incorporated, Stuart, Florida.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-7
Program Element: #62711E
USDR&E Mission Area: 530

Title: Acquisition, Tracking and Pointing Experiment - TALON GOLD
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: In FY 1982 the Talon Gold source selection process was concluded with the award of a contract for the design, fabrication, integration and test of the Acquisition, Tracking and Pointing (ATP) payload to Lockheed Missiles and Space Company. System requirements and specifications were prepared along with the necessary interface requirements documents. Technical designs of hardware and software elements were completed in preparation for the Interim Design Review (IDR) that commenced at the start of FY 1983. Subcontract efforts, comprising approximately 30% of the ATP payload effort, were defined and negotiated.

Activities designed to translate the ATP payload into a Space Transportation System (STS) flight experiment were initiated. These include definition of the Cargo Element requirements and establishment of an STS integration approach. Termination of the NASA-funded Advanced Gimbal System (AGS) three-axis pointer which was to be borrowed for the Talon Gold Experiment necessitated the incorporation of this requirement into the Talon Gold program. Mission design planning and analysis tasks were conducted to adequately define the scope of and requirements for the conduction of the Talon Gold mission operations. Such operational issues as safety, security, contamination control, communications and ground processing links were addressed. Part I of the Integrated Program Management Plan and the STS Interface Requirements Document were completed. The Working Group Structure and Program Wide Systems Engineering requirements have been established to properly coordinate the numerous interfaces that must be managed throughout the development process.

2. FY 1983 Program: During FY 1983 the Interim Design Review for the ATP payload hardware and software will be held and approval given to begin the detailed design phase. The STS integration concept will be baselined and an integration contract initiated. The Preliminary Design Review of the integration hardware is scheduled to occur in the last quarter. The Flight Feasibility Review is scheduled in the second quarter to identify mission incompatibilities and to verify that sufficient mission design and planning has occurred to insure a successful mission outcome.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-7
Program Element: #62711E
USDR&E Mission Area: 530

Title: Acquisition, Tracking and Pointing Experiment - TALON GOLD
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

3. FY 1984 Planned Program: During FY 1984 the System Critical Design Review (CDR) of the ATP payload and the Flight Integration Equipment will be held. The CDR will examine the hardware designs, supporting analyses, fabrication process specifications, space qualification/acceptance plans, and software specifications. Contractor efforts will increase significantly as hardware fabrication and software programming begin. This accounts for the increase in funding from FY 1983 to FY 1984.

4. Program to Completion: Fabrication and assembly of the components and subsystems will be initiated in FY 1985, based on the approved design. Additional tests and analyses will be performed, as required, based on the recommendations of the Design Review Board.

The development of the flight hardware will continue through the completion of the fabrication, assembly, space qualification and acceptance test of the subsystems and full experiment payload. Alignment, calibration and preflight performance tests of the payload will be conducted as part of the final acceptance tests. The preflight tests will evaluate the system performance within the limits imposed by the ground test environment. The Acquistion, Tracking and Pointing payload will then be delivered to the eastern launch site for integration into the space shuttle orbiter.

The first test flight is scheduled for late FY with a second flight in late FY The results of these tests will be analyzed to establish the design requirements and approaches appropriate for future systems, and to assess the potential performance of operational systems.

5. Milestones:

Last Year's Report Plan	Current Plan	Milestones
Mid FY 1983	Mid FY 1983	Interim design review.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-7
Program Element: #62711E
USDR&E Mission Area: 530

Title: Acquisition, Tracking and Pointing Experiment - TALON GOLD
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

Late FY 1984	Late FY 1984	Critical design review.
		Delivery of experimental hardware to integrator.
		Launch and space test.

6. Explanation of Milestone Changes: There are no changes in the milestone schedule since last year.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-8
Program Element: #62711E
USDR&E Mission Area: 530

Title: High Power Chemical Laser Ground-Based Experiment - ALPHA
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objective of the ALPHA program is to develop the technology for, and demonstrate the feasibility of, multi-megawatt chemical lasers which, in a space-compatible concept, can generate near diffraction-limited beams with high fuel efficiency. ALPHA is one of the "TRIAD" of DARPA laser programs which will collectively demonstrate the key technologies for space-based chemical laser weapon systems. The other two programs, both of which are in Program Element No. 62711E, address the critical technologies in acquisition, tracking and pointing (Talon Gold, Project #EE-7), and large-aperture beam control (Large Optics Demonstration Experiment, Project #EE-12). In the ALPHA program, the critical chemical laser device technology issues are being resolved through the design, fabrication and ground testing of a
laser device, designated the ALPHA laser. The design of this laser is based upon technology which is projected to be scalable will
establish this scalability in an integrated manner, namely in the context of all the functional elements of a laser required to produce high optical quality beams. Thus, successful completion of this program will provide the device technology for future space-based chemical laser weapon systems.

G. RELATED ACTIVITIES: Other DARPA programs that support the ALPHA laser device development are the Large Optics Diamond Turning Machine (LODTM) development being carried out by Lawrence Livermore National Laboratory and the HF optical coating development effort (both Program Element #62301E, Project ST-3). The general area of Adaptive Optics technology development has complementary elements being developed under both the ALPHA and LODE programs. In addition, DARPA closely monitors several chemical laser technology programs being sponsored by the Services and coordinated through the Office of the Assistant for Directed Energy Weapons, Office of the Under Secretary of Defense for Research and Engineering.

H. WORK PERFORMED BY: The ALPHA project is performed completely by industrial contractors. They are: TRW Inc., Los Angeles, California; R&D Associates, Albuquerque, New Mexico; W. J. Schafer Associates, Arlington, Virginia; and Science Applications, Inc, Atlanta, Georgia. These contractual efforts are managed with the assistance of the Air Force Weapons Laboratory, Albuquerque, New Mexico, which functions as DARPA's agent.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-8
Program Element: #62711E
USDR&E Mission Area: 530

Title: High Power Chemical Laser Ground-Based Experiment - ALPHA
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: The detailed design of the gain generator, optical resonator, and exhaust manifold assembly were initiated, with completion scheduled for mid FY 1983. Design requirements and design specifications were translated into hardware fabrication drawings which in turn formed the basis for completion of the bill of material, a detailed cost/risk trade analysis, a make/buy plan and updated cost estimates. Design verification and fabrication process validation experiments were initiated to reduce the risk associated with the fabrication of the components of the optical resonator. In addition, the contractor initiated the preliminary design of the test facility element which will be completed in early FY 1983. The facility hardware includes the reactant storage, reactant feed, mounting and support, optical diagnostics, instrumentation and control, and the handling and refurbishment assemblies.

2. FY 1983 Program: The objective in FY 1983 is to complete the entire design for the ALPHA laser and the test facility. Critical design reviews for the gain generator, optical resonator and exhaust manifold assemblies are scheduled for mid FY 1983 and similar reviews for the test facility occur at the end of FY 1983. Risk reduction experiments verifying the nonlinear interaction between the gain medium and optical resonator are underway. In addition, experiments addressing uncertainties in the fabrication processes for the optical coatings, mirror cladding and heat exchanger are being completed. Design and fabrication of the full-scale optics demonstrator have begun. Finally, to prepare for the initiation of fabrication of the ALPHA laser in FY 1984, long-lead materials are being purchased and tooling is being designed.

3. FY 1984 Planned Program: FY 1984 will be the first hardware-intensive year in the program. With all design efforts completed by the end of FY 1983, and all the design verification, risk reduction experiments concluded in early FY 1984, the major activity will be initiation of fabrication of all assemblies of the ALPHA laser device and all modifications to the test facility. In addition, fabrication of the cladding and optical coating facilities will be completed. Fabrication of the heat exchangers for the full-scale optics demonstrator will be completed, and these optics will be used to checkout the cladding process. These optics will also be diamond turned on the LODTM at the Lawrence Livermore National Laboratory.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-8
Program Element: #62711E
USDR&E Mission Area: 530

Title: High Power Chemical Laser Ground-Based Experiment - ALPHA
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

The transition of the program from design and experiment oriented in FY 1983 to hardware-fabrication oriented in FY 1984 is the cause for the $18,200K increase in funding requirement in FY 1984 ($24,900K in FY 1983 to $43,100K in FY 1984). While such an increase normally occurs in hardware programs, it is especially pronounced here since the ALPHA laser requires several advanced fabrication techniques in order to maintain strict tolerances, especially in the optical resonator assembly.

4. Program to Completion: Fabrication of the laser device and facility hardware will be completed early in FY at which time system integration will begin. After assembly and integration, ground testing will be initiated. Approximately eight months is required for thorough testing of the integrated gain generator and optical resonator. These tests will fully establish the feasibility of producing near diffraction limited beam performance for high-power chemical lasers appropriate for space applications.

5. Milestones:

Last Year's Report Plan	Current Plan	Milestones
Mid FY 1983	No Change	Complete detailed design of laser subsystems.
Late FY 1983	No Change	Complete detailed design of test facility subsystem.
--	Mid FY 1984	Single-point diamond turning of full-scale optics demonstrator.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-8
Program Element: #62711E
USDR&E Mission Area: 530

Title: High Power Chemical Laser Ground-Based Experiment - ALPHA
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

6. Explanation of Milestone Changes: No changes have occurred from last year's descriptive summaries. The single-point diamond turning of the full-scale optics demonstrator has been added to the list to emphasize its significance to successful fabrication of the ALPHA optical resonator assembly.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-9
Program Element: #62711E
USDR&E Mission Area: 530

Title: X-29 Advanced Technology Demonstrator (Forward Swept Wing)
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The X-29 Advanced Technology Demonstrator Program (X-29 ATD), formerly known as the Forward Swept Wing (FSW) Program, has the potential of achieving major technical breakthroughs in air vehicle design which can be translated into significant operational performance improvements. Breakthroughs are anticipated in the areas of structures, aerodynamics, stability and control, and configurational design freedom. Composite structure is used to solve the aeroelastic divergence phenomenon, a static structural instability experienced by forward swept wings that has restricted the exploitation of FSW aerodynamic and configurational design advantages. Advanced composite wings can be designed and fabricated to handle this phenomenon without the weight penalty associated with metal FSW. The ability to design and build such a wing was conclusively demonstrated earlier in this program through large scale wind tunnel testing of two specific designs. The aerodynamics of the forward swept wing design and the favorable interaction of the canard and wing provide greater useful lift at given angles of attack and allow higher angles of attack to be achieved before wing stall. As a result, significantly lower take off and landing speeds and substantially improved high angle of attack maneuverability are possible. The FSW configuration generates lower drag due to lift during transonic maneuvering flight and the proper phasing of the three control surfaces--canard, wing flaps and strake flaps -- results in high aerodynamic efficiency because of low subsonic and supersonic trim drag penalties. Weight and/or volume can be varied significantly without serious controllability impact. The X-29 is designed to be statically unstable, to achieve greater maneuverability and permit a smaller and lighter vehicle to be built. It is easily controlled with the full authority, all moveable canard and is the first modern day aircraft so designed. A digital fly-by-wire flight control system used to handle the instabilites is expected to be flexible and easy to modify and will build confidence for future systems. These technical achievements are important when considered individually, but when combined in this flight vehicle, they synergistically produce considerable operational performance improvement. Early analysis indicated that a FSW aircraft could be as much as 30% lighter than an equivalent aft swept wing aircraft. This weight reduction can be translated into equivalent range/payload or performance improvements and any weight reduction can be translated into a cost saving. In addition, the competing designs for this program were point designed for high transonic maneuverability yet had impressive STOL capabilities even without sophisticated high lift devices. Such capabilities are due to the excellent low speed stability and control characteristics inherent in the FSW design. These performance improvements would be valuable to an Air Force advanced tactical fighter where runway denial is an operational concern or to the Navy for operations from small ships.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-9
Program Element: #62711E
USDR&E Mission Area: 530

Title: X-29 Advanced Technology Demonstrator (Forward Swept Wing)
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

G. RELATED ACTIVITIES: The Flight Dynamics Laboratory (AFWAL/FI) has been conducting research in the use of advanced composite materials for aeroelastic tailoring of aft swept wings since the early seventies. The computer techniques developed by the AF are being applied and extended in the X-29 program. In addition, the aerodynamic and structural techniques developed under the NASA/Air Force high maneuverability aircraft technology program (HIMAT) have also been used for X-29 analysis. The advanced digital flight control design and implementation efforts by the Air Force, the Navy, NASA and within industry are being tested and extended in this program. A DARPA/NASA Memorandum of Agreement has been signed for NASA Ames, Dryden Flight Research Facility to conduct the flight test phase of FSW program. Also, NASA Langley has conducted dynamic structures testing and high angle of attack and spin wind tunnel testing to determine the aerodynamic coefficients and stability derivatives to use in AF, NASA and contractor flight simulations of the planned flight vehicles. Numerous NASA facilities and personnel have supported the program to build the aerodynamic, structural and flight control data base upon which the design is based and a great deal of effort is continuing to insure an effective and efficient flight test program. A DARPA/Air Force Memorandum of Agreement has been signed for the AF Systems Command to continue as the DARPA Agent responsible for procurement and technical monitoring of the contracted effort. The AF Program Office will also address the military utility of the numerous X-29 advanced technologies and their importance to the Services' advanced flight vehicle programs.

H. WORK PERFORMED BY: Approximately 90% of the effort is performed by industry with the principle contractor being Grumman Aircraft Corporation, Bethpage, New York. Approximately 10% is being performed in-house by the Air Force System Command and by NASA Centers. The NASA percentage will increase to a much larger share as the flight test phase approaches. The technical agent responsible for program oversight is the Air Force Wright Aeronautical Laboratories, Flight Dynamics Laboratory (AFWAL/FI), assisted by NASA Dryden Flight Research Facility, Edwards AFB, California.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-9
Program Element: #62711E
USDR&E Mission Area: 530

Title: X-29 Advanced Technology Demonstrator (Forward Swept Wing)
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Procurement negotiations resulted in a firm fixed price contract in mid FY 1982. During FY 1982 60% of the final drawings were released and tooling and fabrication were started. Lay-up of the first composite wing cover was successfully completed in late FY 1982 as scheduled and two F-5 nose sections were delivered to the contractor. NASA wind tunnel testing of the Grumman inlet design and three months of final configuration documentation were also completed in the NASA Ames wind tunnels. High angle of attack and spin tunnel testing were completed at NASA Langley. Work continued on designing the control laws with the analog reversion mode completed. Flight control hardware was designed and three computers delivered for use in contractor man-in-the-loop simulation. The instrumentation package was finalized. Work on the simulation at NASA Dryden, intended to support the government flight tests, was begun. An initial flight test plan has been prepared with a strong emphasis on developing an audit trail to link flight test results with the conceptual design, analysis and ground testing. An X-29 Future Applications Committee for Technology was formed by DARPA with government and industry representatives to speed the technology transition to the potential users.

2. FY 1983 Program: Fabrication is being completed and the vehicles prepared for the contractor's functional flight tests and the follow-on government testing. The flight control system software and hardware will be completed and validation and verification will begin. Vehicle fabrication will be completed in June 1983 and all systems will then be ground tested, the instrumentation calibrated and structural proof and load tests completed to prepare for flight tests. Engineering and flight safety reviews will be conducted to clear the vehicles for flight testing. Contractor manhours peak in FY 1983 as the vehicles are assembled and the ground test phase starts. This peak activity accounts for the $15 million increase in FY 1983 over FY 1982.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-9
Program Element: #62711E
USDR&E Mission Area: 530

Title: X-29 Advanced Technology Demonstrator (Forward Swept Wing)
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

3. FY 1984 Planned Program: First flight of the X-29 will occur in Mid FY 1984 following extensive ground testing. After functional flight tests by the contractor, the vehicles will be delivered to NASA and government flight testing will begin. A nominal flight envelope will be cleared to gain experience with the systems and then the structural divergence envelope will be investigated followed by low speed testing. NASA will conduct the flight tests and will be supported by the Air Force Program Office. A strong emphasis will be placed on developing the audit trail from design through flight test to validate the new technologies and add to the data base. Program expenditures decline in FY 1984 as the vehicle is ground tested, flown and delivered for government flight testing.

4. Program to Completion: The currently structured DARPA funded flight test program will be completed in FY 1985. The X-29 aircraft will then be assigned to a flight research organization for additional testing or be modified to investigate other concepts or technologies. A major effort will be conducted to transfer the flight test information to government and industry users as it is generated. This is a long range estimate based on success of meeting expected technical and management milestones.

5. Milestones:

Last Year's Reported Plan	Current Plan	Milestones
Mid FY 1983	Mid FY 1983	Fabrication of the flight vehicle will be completed and ground testing will begin.
Early FY 1984	Mid FY 1984	First flight of X-29 and completion of contractor functional check flights.
Mid FY 1984	Mid FY 1984	Start of government flight test program.
Mid FY 1985	Late FY 1985	Completion of flight test program.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-9
Program Element: #62711E
USDR&E Mission Area: 530

Title: X-29 Advanced Technology Demonstrator (Forward Swept Wing)
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

6. Explanation of Milestone Changes: The milestones cited in the FY 1983 Descriptive Summaries with completion dates through FY 1985 have been completed or are expected to be completed on schedule except that first flight has been delayed from Early to Mid FY 1984 and flight tests will extend from Mid to Late FY 1985.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-10
Program Element: #62711E
USDR&E Mission Area: 530

Title: Assault Breaker
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The Assault Breaker program is developing and demonstrating the technologies required to deny the Warsaw Pact its second echelon exploitation and reserve forces with a capability for standoff acquisition and destruction of armored formations at ranges in excess of beyond the Forward Edge of the Battle Area (FEBA), engaging and destroying the second echelon forces of a combined arms Army. The system includes Assault Breaker missiles and associated Pave Mover low probability of intercept radars. The long range, airborne radar provides the capability for standoff surveillance to find and track targets and guidance for standoff missile attack or penetrating aircraft direct attack of the targets. The missiles and their munition dispensers provide the capability for delivering terminally guided submissiles to a high degree of accuracy (circular error probability of and achieve a high kill probability The program has competitively developed the radar and weapon systems elements and demonstrated them to provide the basis for full-scale development decisions by the Army for the Corps Support Weapons System and the Air Force for the Pave Mover radar.

G. RELATED ACTIVITIES: Responsibility for managing the Assault Breaker program was assigned to DARPA by the Congress in FY 1978, bringing together service efforts in the development of terminally guided submunitions and low probability of intercept airborne radars. The program was jointly funded by the Army, Air Force and DARPA under the overall direction of a Steering Committee composed of senior representatives of the three agencies and the review of an Executive Committee composed of the Under Secretary of Defense for Research and Engineering and the Army and Air Force Assistant Secretaries for Research and Development. The ground launched missile phase of the program is managed by the Army's Missile Command (MICOM) and the development of the radars and the air launched demonstration phase by the Electronic Systems Division, Air Force Systems Command.

H. WORK PERFORMED BY: 90% of the program is contracted to industry including Martin Marietta Corporation, Orlando, Florida; Vought Aerospace Corporation, Dallas, Texas; Boeing Corporation, Wichita, Kansas; Hughes Aircraft Company, Culver City, California; Grumman Aerospace Corporation, Bethpage, New York; General Dynamics Corporation, Pomona, California; and AVCO International, Wilmington, Massachusetts. The remaining 10% covers in-house costs and test support at U.S. Army Missile Command, Huntsville, Alabama; Air Force Rome Air Development Center, Griffiss Air Force Base, New York; Air Force Armaments Division, Eglin Air Force Base, Florida; Air Force Electronics Systems Division, Hanscom Air Force Base, Massachusetts; and White Sands Missile Range, New Mexico.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-10
Program Element: #62711E
USDR&E Mission Area: 530

Title: Assault Breaker
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: The Assault Breaker program began in FY 1978 with the objective of developing and demonstrating the technologies for standoff acquisition and destruction of stationary and moving targets in the Warsaw Pact second echelon at ranges as great as beyond the Forward Edge of the Battle Area. From FY 1978 through the first quarter, FY 1981, initial component technologies were developed and demonstrated for the Pave Mover radar, T-16 PATRIOT ground launched missile and munitions dispensers, and terminally guided submissiles and submunitions. The two competing Pave Mover radars were integrated in F-111 aircraft, and both continued to undergo surveillance and target tracking tests in FY 1982. These tests qualified the Pave Mover to be tested with the Assault Breaker Missile. The munition dispenser for the T-22 Lance II missile has successfully completed its qualification tests. Both the infrared terminally guided submissile and the smart bomblet submunition have completed full-function qualification tests at White Sands and Sandia Laboratories, New Mexico, to qualify them for the flight test program. The ground launched Assault Breaker demonstration at White Sands was conducted as a comparative evaluation of the T-16 PATRIOT and T-22 Lance II ground launched missiles. Two missiles of each type were fired during FY 1981. They were fired with inertial guidance only to verify basic missile accuracy, to demonstrate the capability of their dispensers to distribute dummy submunitions and to measure the ballistic accuracy achieved. Airborne integration of the Pave Mover radars was initiated during the third quarter of FY 1981. The guidance and small area moving target track modes were integrated and evaluation of those modes was started during the first quarter of FY 1982. During FY 1982 Two T22 missiles and six T16 missiles were fired, successfully demonstrating all of the program objectives except submunition performance to achieve multiple tank hits. The Pave Mover radar provided target acquisition and guided the missile to target engagement.

2. FY 1983 Program: To address the issue of submunition dispense and performance, additional wind tunnel testing was conducted, and additional submunition dispense events were conducted. On 15 December 1982, a T16 missile test carrying 5 TGSMs, resulted in 5 tanks hit. The program transitioned to the services in 1st quarter FY 1983.

3. FY 1984 Program: None

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-10 Title: Assault Breaker
Program Element: #62711E Title: Experimental Evaluation of Major Innovative Technologies
USDR&E Mission Area: 530 Budget Activity: 1. Technology Base

4. Program to Completion: No effort planned beyond 1st quarter FY 1983.

5. Milestones: The milestones cited in the FY 1983 Descriptive Summaries with completion dates through Mid FY 1982 have been completed:

Last Year's Reported Plan	Current Plan	Milestones
Mid FY 1982	Early FY 1983	Transition Weapon program.

6. Explanation of Milestone Changes: Surface to surface missile and submunition dispense and performance called for an additional test, which was accomplished successfully in 1st quarter FY 1983. Program transferred to joint USA/USAF munitions program.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-12
Program Element #62711E
USDR&E Mission Area: 530

Title: Large Optics Demonstration Experiment - LODE
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The Large Optics Demonstration Experiment (LODE) will demonstrate critical beam control and optics technology in a series of ground-based experiments that simulate the space environment. LODE is one of the "TRIAD" of DARPA laser programs that will collectively demonstrate the key technologies essential for space-based chemical laser weapons. These technology developments initially targeted at supporting relatively near term system concepts will in large part provide technologies scalable to even more capable laser weapon systems. Specific program objectives include demonstration of the ability to manufacture a large aperture segmented mirror that includes active figure control, alignment and wavefront correction, complex interactive control systems, and energy management in an overall beam control system that yields wave optical quality and is consistent with pointing accuracy in a simulated operational environment. The actual demonstration will be conducted in ground-based facilities using low power laser and simulator techniques to establish with high confidence the required beam control performance. The advances contemplated in this program will, high-energy laser systems possible.

G. RELATED ACTIVITIES: This project is closely related to the other DARPA TRIAD programs (Program Element #62711E); namely, Talon Gold (Project #EE-7) and Alpha (Project #EE-8). Also, the DARPA High Energy Laser (HEL) Technology Program Element #62301E, Project #ST-3, provides the fundamental optics technology efforts required to support the advanced component requirements of this program.

H. WORK PERFORMED BY: Effort is performed primarily by industrial contractors (89 percent). Included are: Lockheed Missiles and Space Company, Palo Alto, California; Corning Glass Works, Corning, New York; Perkin-Elmer Corporation, Danbury, Connecticut; Itek Corporation, Lexington, Massachusetts; Eastman Kodak Corporation, Rochester, New York; W. J. Schafer Associates, Wakefield, Massachusetts. The University of Arizona, Tucson, Arizona and the University of New Mexico, Albuquerque, New Mexico participate to the extent of about eight percent. The remaining effort, about three percent, is performed by the Service agents as in-house effort, involving the Air Force Weapons Laboratory, Kirtland AFB, New Mexico and the Rome Air Development Center, Griffiss AFB, New York.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-12
Program Element #62711E
USDR&E Mission Area: 530

Title: Large Optics Demonstration Experiment - LODE
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Early in FY 1982 the conceptual design of the Large Optics Demonstration Experiment (LODE) was completed. The technical scope of the program was defined based upon both system requirements and available resources. Tradeoffs of such beam control features as wavefront control (adaptive optics), large beam expander structures, infrared autoalignment, and laser interfaces led to definition of a firm baseline design. Technology risk reduction and breadboarding programs were also laid out for execution during the final design phase. After concept definition, Lockheed Missiles and Space Company was chosen as the selected source for LODE and a contract was awarded for the detailed design of LODE. Design of the LODE segmented primary mirror began in February 1982 with the Perkin Elmer Corporation and Itek Corporation competing through the preliminary design phase. These mirror activities include limited breadboard activities on controls, actuators, sensors, and fabrication methods. Manufacture of all ULE glass needed for the LODE mirror was completed.

2. FY 1983 Program: Source selection for the LODE mirror occurs in mid FY 1983. This follows an intensive preliminary design review (PDR) of the two competing mirror designs and an evaluation of the supporting mirror brassboard results. Award of a follow-on mirror final design contract to the selected source also allows procurement of long-lead raw materials and glass faceplates for the mirror segments. Continued brassboard activities validate the fabrication and methology techniques for the full scale mirror. In LODE, the major event occurs with the initiation of preliminary design reviews in late FY 1983. Data from the 65-cm visible LODE brassboard is used to verify LODE design concepts and hardware trades. The design reviews cover the test configuration facilities and simulation software as well as the experiment hardware items.

3. FY 1984 Program: Activities in FY 1984 will culminate in a critical design review (CDR) of LODE. This will consist of the sequential presentation of design packages, backed up with design analyses, fabrication drawings, and preliminary fabrication plans for the the Beam Expander Assembly, the Beam Transfer Assembly and other (Beam Diagnostic Assembly, facilities, software, etc.) subsystems. After thorough review and approval by the Government, these will represent the LODE design to be fabricated in FY 1985 and beyond (Phase III) under a new contract. The LODE design will be supported by the completion of the 65-cm visible brassboard risk reduction

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-12
Program Element #62711E
DSDR&E Mission Area: 530

Title: Large Optics Demonstration Experiment - LODE
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

program. This activity will provide extensive data on software and control algorithms, operation and integration of a segmented active (subscale) mirror, measurement diagnostics, and the overall integration of a subscale system (visible sensors) that is functionally very similar to the full scale LODE (infrared sensors). By mid to late FY 1984 the design of the large LODE mirror will be completed under separate contract and after extensive review, its fabrication will be initiated under a new Phase II mirror contract. Critical long lead items will be purchased for the mirror during this period. The funding for this program increases 9.3M from FY 1983 to FY 1984. The reason is the normal growth from preliminary design (FY 1983) activities to the later labor intensive final designs (FY 1984) that require the preparation of fabrication ready drawings and the actual purchase of substantial amounts of long lead materials. The LODE brassboard, using contractor funded equipment, required little Government funding in FY 1983 while heavy investments (manpower) are required in FY 1984.

4. Program to Completion: The development of a beam control system technology for large aperture space laser weapons will continue with the fabrication, acceptance test, and subsystem integration of the Large Optics Demonstration Experiment (LODE) hardware and its supporting simulation and test facilities. The complete LODE hardware will be delivered in late FY and integration activities (including test facilities and simulation) will be initiated. The 4-meter mirror will be delivered in and integrated with the LODE hardware. Finally, following successful integration, the program will culminate with the extensive ground testing of the LODE hardware The results of these sophisticated test programs will be analyzed and the impact of the demonstration upon future space laser weapons system capabilities will be assessed.

5. Milestones:

Last Year's Report Plan	Current Plan	Milestone
Late FY 1983	Late FY 1983	LODE Preliminary Design Review (PDR).
Early FY 1984	Early FY 1984	Delivery of active mirror subscale brassboard.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #EE-12
Program Element #62711E
USDR&E Mission Area: 530

Title: Large Optics Demonstration Experiment - LODE
Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 1. Technology Base

Mid FY 1984	Mid FY 1984	Mirror design completion and initiation of fabrication.
Mid FY 1984	Mid FY 1984	mirror faceplate complete.
Late FY 1984	Late FY 1984	LODE Critical Design Review (CDR).
		LODE hardware delivery.
		Delivery of segmented mirror.

6. Explanation of Milestone Changes: The only change was the deletion of the Mirror Faceplate Complete" milestone. In this case, the program approach has been changed so that a single large faceplate is no longer required; instead, a series of smaller glass plates, delivered sequentially over an extended period, are used to manufacture the mirror segments one at a time.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62712E
USDR&E Mission Area: 530

Title: Materials Processing Technology
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Cost
FY 1983 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		$13,300	$15,400	$19,300	N/A	Continuing	N/A
FY 1984 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		$14,830	$ 15,400	$ 25,700	$ 29,200	Continuing	N/A
MPT-1	Material Processing Technology	11,786	13,221	19,159	22,421	Continuing	N/A
MPT-2	Electronic Processing Technology	3,044	2,179	6,541	6,779	Continuing	N/A

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element develops novel materials, processes, structures and device technologies that will give new capability to future defense weapon systems. Examples are: application of rapidly solidified superalloys to gas turbine engine components; development of ceramics and carbon/carbon composites for high temperature engine applications; advanced fabrication methods for structural materials, including ultra-high speed and laser-aided machining; metal-matrix composites for space structures; ceramics from polymer precursors for space-craft and engine components; acoustic emission for dynamic crack detection on aircraft; quantitative non-destructive evaluation; engine disk retirement for cause; development of high strain rate materials capability for improved armor and penetrators; and Intelligent Task Automation for increased productivity and/or reliability of Defense system assemblies. In electronics the emphasis is on the development of solid state circuit technology for military environments and processing technology for low volume custom circuits. Examples are: gallium arsenide random access memories and gate arrays for low power, extremely radiation tolerant space based electronic systems; monolithic microwave circuits for phased arrays and high frequency communications; and beam processing for maskless, untraceable custom chip fabrication. These efforts will provide significant systems performance advances, and are also aimed at reducing acquisition and maintenance costs of present and future DOD systems through advanced materials processing and in-service inspection technologies.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: #62712E
DoD Mission Area: 530

Title: Materials Processing Technology
Budget Activity: 1. Technology Base

C. BASIS FOR FY 1984 RDT&E REQUEST: Programs will be undertaken to demonstrate carbon/carbon composites for gas turbine engine components operating at temperatures up to 1975°C; and metal matrix (graphite/magnesium) composite structures for space and pressure vessel applications. The effort to demonstrate a dual alloy radial turbine wheel based on rapid solidification technology will be continued. Effort to develop metal matrix composites based on casting and continuous silicon carbide fiber reinforcement will be for demonstration of a deep-submersible, lightweight hull component. New technological opportunities in the ultra-high speed and laser-aided machining and the monitoring and control of plasma arc welding will be pursued. Efforts to employ vacuum arc double electrode remelting for the production of very fine grain superalloy ingots with improved forgeability will be concluded. Successful results will be transferred to Air Force and Navy manufacturing technology programs for implementation. Quantitative non-destructive evaluation technology will include development of predictive capability for the failure of structural components based upon the coupling of non-destructive ultrasonic measurements with fracture mechanics principles, continuation of a joint program with the Air Force to develop a "retirement-for-cause" strategy to replace the current "retirement-by-design" approach for the F-100 and TF-30 engines, and laboratory evaluation of advanced acoustic emission sensors and data processing concepts for uniquely identifying fatigue crack growth in aluminum alloys. A new initiative will search for unconventional methods of synthesizing undiscovered materials. One of these will be by pressure quenching whereby metastable states of materials can hopefully be retained at atmospheric pressure. The Intelligent Task Automation (ITA) effort will concentrate on generic technologies for sophisticated robotics such as: three dimensional vision, tactile sensing, floppy arms, and end-point sensing. In addition, in a joint effort with the Air Force, ITA will integrate ten sensor inputs to control and carry out complex defense production tasks. This integration will incorporate artificial intelligence (AI) techniques at the tactical and strategic planning levels. If successful, it should significantly reduce the costs and increase the reliability of labor-intensive, batch defense manufacturing. It will be the groundwork for applying AI and robotics to military tasks in unstructured environments resulting in more efficient and effective use of our military personnel. A new effort has been started to utilize polymeric precursors to fabricate a low cost, domestic source of ceramic fibers for use in advanced composite systems including metal-matrix and fiber reinforced glass composites. This program will also develop the technology for producing an assortment of ceramic-ceramic composites with an impressive range of structural properties (high temperature capability, toughness, etc.) applicable to a wide variety of DoD requirements. In project MPT-2, Electronic Processing Technology, demonstration of gallium arsenide low power, radiation hard integrated circuits, of sufficient complexity, for

utilization in space based systems will be undertaken. Four (4) kilobit Gate Arrays random access memory with junction field effect transistors, and analog to digital converters capable of 8 bit resolution at a one gigahertz sampling rate will be developed. In addition, work on packaging for these circuits that is capable of input-output clock speeds in excess of 100 megahertz will be initiated. Beam processing for maskless fabrication of integrated circuits will be demonstrated at the small scale integration level with further effort devoted to realizing practical fabrication capability for feature sizes approaching .1 micrometer. Beam processing technology will also be utilized to demonstrate the capability to customize large scale integrated circuits and repair high value chips. Long term effort to realize three-dimensional solid state circuits for optimum packing density and minimize on chip time delay will continue.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: The FY 1984 $6.4M increase in this program element compared to the funds requested last year, is split evenly between projects MPT-1 and MPT-2. On the former the increase is due to a new effort in ceramic polymers which should result in structural material with unique properties applicable to turbine engine components, laser mirrors and spacecraft, helicopter and missile components; and an increase in the Intelligent Task Automation program for extending the research to other militarily important areas such as, obstacle avoidance, robotic diagnosis and retrieval of battlefield casualties, and mobility/power requirements for autonomous systems. Increased funds in MPT-2 are for digital gallium arsenide integrated circuitry which is being initiated based on excellent research results achieved in PE 61101E. This new effort provides technology base support for the low power, radiation hard GaAs Pilot Line Task being initiated in FY 1983 in PE62301E, Project ST-10, Strategic Computing and Survivability.

E. OTHER APPROPRIATION FUNDS: None.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #MPT-1
Program Element: #62712E
USDR&E Mission Area: 530

Title: Materials Processing Technology
Title: Materials Processing Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objectives of this program are: (1) development of rapid solidification rate (RSR) turbine blades and vanes for jet engines; this is the first program in the history of jet engines to explore simultaneously three technologies (alloy development, coating chemistry, and cooling design) with an objective of a 300°C increase in turbine inlet temperature and defined milestones for establishment of production methods; (2) retirement-for-cause which will lower defense costs by both minimizing overly-conservative design practices and facilitating maintenance-for-cause strategies and (3) advanced manufacturing process technologies in support of DoD advanced weapons systems. DARPA has pioneered ceramic and carbon/carbon composite materials for turbines and other advanced propulsion power plants because these materials promise engine designs with reduced weight, increased performance, reduced dependence on costly and critical alloy materials, lower specific fuel consumption, and reduced pollutants. Unique fabrication methods being explored include ultra-high speed, laser-aided machining, and self-optimizing welding processes. Today's robots lack control via sensory feedback; there is a need for research in vision, touch, end point, force sensing, and the integration of multiple sensors for robotic control at both the tactical operations and strategic planning level. The development of these and other technologies and their integration into systems under the appropriate control will have a significant impact on intelligent task automation for the fabrication of defense systems and the ultimate application of robotics to military tasks. A major new program is the development of the technology for processing ceramics from polymeric precursors. This novel approach allows low temperature forming of high temperature structures and will lead to a low cost, high performance, domestic source of ceramic fibers and matrices for ceramic-ceramic composites. These composites will offer properties (high specific strength, high temperature capability, fracture resistance, laser resistance, etc.) applicable to a wide range of strategic and tactical systems including spacecraft structures and engine components.

G. RELATED ACTIVITIES: Programs to develop high performance ceramic materials for gas turbine engine components are being conducted by all services, National Aeronautics and Space Administration, and the Department of Energy; plans and programs are reviewed by an interagency ceramics coordinating committee. The Air Force is providing a share of the funding for the Radial Wafer Blade Program. Materials development related to improved armor and penetrators is coordinated with other service and agency efforts. Generally, the Services are sponsoring different aspects related to unique manufacturing methods than those pursued by DARPA, and duplication of effort is prevented by direct coordination with the Office of Under Secretary of Defense for Research and Engineering (USDR&E) and the

Project: #MPT-1
Program Element: #62712E
USDR&E Mission Area: 530

Title: Materials Processing Technology
Title: Materials Processing Technology
Budget Activity: 1. Technology Base

Manufacturing Technology Advisory Group (MTAG). The intelligent task automation program is related to and complemented by efforts by the Air Force Wright Aeronautical Laboratories and the National Bureau of Standards. The program devoted to the fabrication of ceramics from polymer is coordinated with all three Services through a joint steering committee. Heavy government laboratory participation (e.g. Naval Research Laboratory, Air Force Wright Aeronautical Laboratory, Army Materials and Mechanics Reserch Center) is anticipated. The intelligent task automation program is related to and complemented by efforts by the Air Force Wright Aeronautical Laboratories, the National Bureau of Standards, Air Force Office of Scientific Research, Office of Naval Research, and the Office of the Director of Army Research.

H. WORK PERFORMED BY: Approximately 85% of this work is performed by industry, 10% by universities, and 5% in-house. The top industrial performers include: Pratt and Whitney Aircraft Group, West Palm Beach, Florida; AVCO, Speciality Materials Division, Lowell, Massachusetts; Special Metals Corporation, New Hartford, New York; Minneapolis Honeywell, Rosedale, Minnesota; and Martin Marietta Aerospace, Denver, Colorado. The universities include: Massachusetts Institute of Technology, Cambridge, Massachusetts; Cornell University, Ithaca, New York; University of Michigan, Ann Arbor, Michigan; Ames Laboratory, Iowa State University, Ames, Iowa; Stanford University, Palo Alto, California; and Carnegie Mellon University, Pittsburgh, Pennsylvania. The Naval Research Laboratory, Washington, D.C. is the in-house performer.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Fundamental understanding of the factors influencing the performance of metal matrix composite penetrators was developed, and the information has been transferred to the Services. An important demonstration of the feasibility of radial wafer blade technology was achieved through the successful operation of two first stage turbine blades in an engine ground test. The engine was run under simulated tactical air command mission cycles, and the blades experienced no problems after twenty-four such cycles. A heretofore unsuspected problem associated with the destructive effects of contact stresses between static ceramic gas turbine engine components was encountered. Significant new understanding of the contact stress phenomenon has been achieved. Metal matrix composite technology capability was demonstrated through fabrication of aluminum/graphite antenna boom components suitable for spacecraft application. Plain carbon steels containing 1.0% and 2.3% carbon have been

modified by thermal-mechanical working to be superplastic (readily forgeable) at warm temperatures, while maintaining strength and toughness at room temperatures. A major advance was achieved using laser assisted machining to shape silicon carbide and silicon nitride materials which previously could only be ground or polished to obtain a finished part. The capability of machining metallic parts at high speed with greatly improved surface finish with laser assistance was also demonstrated. New tooling for high speed machining has increased tool life six fold. Significant advances in quantitative non-destructive evaluation included: demonstration of a linear correlation between acoustic emission events and fatigue crack growth during in-flight aircraft testing; feasibiiity demonstration of a phased-array ultrasonic imaging system based on digital electronic technology; experimental validation of low-frequency ultrasonic inversion methodology for extracting critical material flaw parameters of structural components; and the development of an ultrasonic approach to measure microcracks in aluminum alloys.

2. FY 1983 Program: In FY 1983, development of optimum alloys and processing for blades and vanes is continuing under the Radial Wafer Blade program. Verification of coating performance, cooling designs and prototype manufacturing processes will be accomplished. Disks made of carbon/carbon material are being spin-tested to validate their suitability for cruise missile engines. New efforts are continuing to obtain five grain super alloy ingots by vacuum arc double electrode remelting. Efforts in quantitative non-destructive evaluation are being coupled with fracture mechanics to predict remaining life in critical aircraft engines and structures. Adaptive imaging and ultrasonic inversion techniques for flaw characterization and component life prediction is being demonstrated under simulated field inspection conditions to validate the methodology for transfer to the Services. Development of a "retirement-for-cause" capability for F-100 engine disks is being expanded to include detailed analysis of the non-destructive inspection requirements and crack growth rates in candidate disks. Initial efforts on the ceramics from polymers programs are focused on preceramic polymer processing and fiber spinning/curing technology to produce a ceramic fiber superior in high temperature capabilities to that now available exclusively from Japan. Limited work on ceramic composite systems is being pursued. The intellingent task automation (ITA) program was initiated by supporting research in generic robotic technologies which have near term applications to defense manufacturing and also have the potential for other complex military tasks. The following ITA research objectives are being pursued in the DARPA program: (1) to develop the capacity to

accomplish touch tasks much more rapidly and increased grasping control using dexterous hands so that robots employing force and tactile sensors can use a variety of ordinary tools; (2) to develop a geometric modeling system based on a range-data, 3-dimensional vision system which moves in concert with the end effector and uses structured light; (3) to develop a vision-range sensor and control system capable of real-time adaptive control of a robot arm by refining commercially available technologies such as through Camera Lens focusing and the Parallel Image Processor and; (4) to investigate the feasibility of producing micro-acuators based on the striated structures found in natural muscles. The joint DARPA/Air Force Material Laboratory program will speed the advent of the next generation robots capable of performing in an unstructured environment. In response to the request for proposals, seven industrial/academic teams and two universities submitted separate proposals. Two of the teams have been awarded contracts to begin in FY 1983.

3. FY 1984 Planned Program: In FY 1984, a program will continue with the Air Force, to develop and validate inspection and analysis capabilities for retiring F-100 engine disks for cause and demonstrating these procedures on real components. These components will be subjected to spin-pit testing to validate the overall methodology. The inflight acoustic emission program will complete a detailed analysis of the requirements and technical capabilities for the in-flight demonstration phase. The ultra-high speed machining and advanced welding programs will establish limits of the technology for improving manufacturing productivity. An effort to apply rapid solidification rate technology to the fabrication of a dual alloy radial turbine wheel will be completed with the objective of achieving 1200^{o}C uncooled operating temperature, and heretofore unattained thermal efficiency in small gas turbines for transportable power generator sets and other shaft driven defense equipment. Novel processing methods for the fabrication of lower cost, reproducible metal matrix composite structural components will be developed. The laser-aided machining program will be nearly complete, with designs for the first generation processors, computer control, and phenomenological models complete, and a facility set up for routine feasibility evaluation. If success is achieved, the use of dynamic compaction for forming of shapes from rapidly solidified steel powders will be available to applicable DoD programs. Other efforts to demonstrate performance improvements for rapidly solidified alloy components will be undertaken. The entire retirement-for-cause methodology will be evaluated by performing "retirement-for-cause" during spin-pit testing; generic technologies will be researched for intelligent task automation. The $5.9M increase in this project in FY 1984 is for a significant increase in effort on fabrication of ceramic-ceramic composites with emphasis on novel fabrication techniques. Polymeric systems will be expanded to produce a wide range of ceramics for both fibers and matrices, and fibers tailored specifically for

Project: #MPT-1
Program Element: #62712E
USDR&E Mission Area: 530

Title: Materials Processing Technology
Title: Materials Processing Technology
Budget Activity: 1. Technology Base

metal matrix applications will be developed. This should result in new structures with unique properties applicable to a wide variety of DoD systems including turbine engine components, laser mirrors, and spacecraft, helicopter and missile components. The ITA program will lead to a better understanding of 3-dimensional vision/range sensors, lighter weight robot arms, improved end point sensory control, a more sensitive dexterous 3-finger hand with 3 jointed fingers, and improved understanding of striated micro-actuators for robotic motion. Within the joint DARPA/Air Force ITA program, the enabling technology development will be completed, and the feasibility of the following modules will be shown: vision/range, force/touch, control, micro-manipulation, inspection, micrometer and depth gage, single arm inspection, feature recognition, stereo versus laser range tradeoff, and tactical planner.

4. Program to Completion: Successful materials science projects related to materials processing research (PE #61101E, MS-1) will be transferred into this program element for final feasibility demonstration before transfer to the Services. In this unique manufacturing area, efforts will continue to stress major cost reductions through high-speed, in line, quality and process control; continuous processing; and product reproducibility. Efforts will continue toward improving our ability to utilize advanced materials and structures safely and economically through advanced non-destructive evaluation technologies and materials failure modeling. The intelligent task automation program will demonstrate significantly improved technologies and integrate these into a system to demonstrate a Service-related fabrication or assembly task. The three year ceramics from polymers program will terminate in FY 1985, when the technological expertise will be on hand to produce ceramic fibers and ceramic-ceramic composites for a wide range of DoD applications. Follow-on component design, fabrication and demonstration will be transitioned to the Services Man Tech program.

5. Milestones: The milestones reported in the FY 1983 Descriptive Summary have been completed or are expected to be completed on schedule except as noted below:

Last Year's Reported Plan	Current Plan	Milestones
Late FY 1982	--	Demonstrate Graphite-Magnesium Composite Antenna Rib.

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Late FY 1982	Late FY 1983	Spin-test coated carbon-carbon disk at 100,000 rpm at 1975°C.
--	Mid FY 1983	Demonstrate Graphite-Aluminum Composite Antenna Boom
Late FY 1983	Late FY 1983	Fabricate turbine engine vanes from rapidly solidified nickel base alloy.
Late FY 1983	Late FY 1983	Transfer new high speed machining techniques to Services for Implementation.
Early FY 1984	Early FY 1984	Demonstrate Dual Alloy Radial Turbine.
--	*Late FY 1984*	*Feasibility demonstrations* of ITA subsystems for programmed assembly, and for inspection/verification.
--	Early FY 1985	Initiate Phase of joint ITA program, prototype development of selected demonstration.

6. Explanation of Milestone Changes: The testing of a coated carbon-carbon disk at 100,000 rpm at 1975°C for one hour has slipped from early FY 1982 due to failure of the high temperature testing rig. The demonstration of a composite metal-matrix satellite component has changed in nature, from a graphite-magnesium antenna rib to a graphite-aluminum antenna boom.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: #MPT-2
Program Element: #62712E
USDR&E Mission Area: 530

Title: Electronic Processing Technology
Title: Materials Processing Technology
Budget Activity: 1. Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The feasibility of using beam process sequences and direct ion implantation for fabricating digital and microwave integrated circuits (IC's) in gallium arsenide (GaAs) and techniques for maskless fabrication of IC's using focused ion, electron, and laser beams was first demonstrated in PE #61101E, MS-2. This effort seeks to demonstrate utility of these techniques to provide high performance, submicron feature ICs and device structures for radar, electronic countermeasures, and related DoD systems. Low power, radiation hard GaAs digital IC Technology also initially demonstrated in PE 61101E, Project MS-2, will be further developed in this project for survivable satellite systems.

G. RELATED ACTIVITIES: Developments in electronic device processing methods are coupled to the Services' programs through the DARPA agent and frequently through joint funding agreements, to assure that no unnecessary duplication of research with the Services or other DoD agencies occurs.

H. WORK PERFORMED BY: Approximately 66% of this work is performed by industry, 17% by universities, 9% by FCRC and 8% in-house. The top industrial performers are: Rockwell International, Thousand Oaks, California; Hughes Research, Malibu, California; and Westinghouse Electric Company, Baltimore, MD., and Pittsburgh, PA. The top university performers are: Stanford University, Palo Alto, CA; and Cornell University, Ithaca, N.Y.; the FCRC is Lincoln Laboratory, Bedford, Massachusetts, and the in-house performer is the Naval Ocean Systems Command, San Diego, California.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Maskless fabrication of both GaAs and silicon transistors has been accomplished by focused ion beams. These devices had state-of-the-art electrical characteristics. This processing technology will provide a means to affordable custom circuits when only small quantities are needed. Ultra-violet photochemical processing was shown to permit selective etching, doping and metal deposition, providing another means to customization, as well as, repair of expensive very large scale integrated chips. Development effort designed to achieve a monolithic GaAs microwave amplifier with a 3 watt output for the 8-12 gigahertz band achieved design objectives for each of the four states; the final output state represents the largest power output achieved in GaAs from a monolithic structure in this frequency band.

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Project: #MPT-2
Program Element: #62712E
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Title: Electronic Processing Technology
Title: Materials Processing Technology
Budget Activity: 1. Technology Base

2. FY 1983 Program: The advantages of Gallium Arsenide (GaAs) based large scale integrated technology for radiation hard, low power survivable space technology was demonstrated under PE 61101E, project MS-2. A technology development program designed to achieve an all GaAs signal processor has been initiated. Random logic circuits are being developed based on Gate Arrays to minimize the number of chip designs. Processing technology and circuit design for GaAs analog to digital converters are also being pursued. Development of a 3 watt GaAs 8-12 GHz amplifier with 18 db of gain is being successfully completed and transferred to the Navy. The program continues development of beam processing technology for submicrometer devices and circuits, emphasizing problems associated with utilization of these techniques in a manufacturing environment. Focusing to ion spot sizes near 100 Angstroms for ultra-microfabrication is being demonstrated.

3. FY 1984 Planned Program: The planned increase of $4.3M in FY 1984 will be used for the following efforts: fabrication of the successful designs of both GaAs gate arrays and analog to digital converters which are expected to increase possible sampling rates to one gigasamples per second, thus demonstrating a technology for eliminating one of the major bottlenecks in high data rate communications; pursuit of new packaging concepts and designs that would allow input signals to rise and fall at speeds faster than 40 picoseconds; development of a four kilobit GaAs random access memory using junction field effect transistor technology that would be capable of information retention in extremely high dose rate radiation environments (100 gigarads per second); expanded effort in materials systems for three-dimensional device structures that will reduce the long propagation path necessitated in two dimensional very large scale integration; and the initiation of efforts towards achieving monolithic integration of devices built of two or more dissimilar materials to avoid losses inherent in off-chips input-output circuits. Beam processing will continue to develop submicron feature size fabrication and will demonstrate its potential by maskless processing of integrated circuit chips. The experimental efforts to accurately model both GaAs devices and circuits will be completed. The monolithic microwave integrated circuit effort will transfer to the Navy for continued development.

4. Program to Completion: This effort is continuing due to the exceptional importance of information and signal processing capabilities to defense systems. As beam processing is demonstrated in silicon these processing concepts will be transferred to other electronic materials, such as GaAs and indium phosphide, whose basic materials properties offer major functional improvements to electronic circuits. Due to the importance of radiation hard ICs for survivable satellite surveillance and communication systems, development of radiation hard GaAs devices will expand.

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Program Element: #62712E
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Title: Electronic Processing Technology
Title: Materials Processing Technology
Budget Activity: 1. Technology Base

5. Milestones: The milestones reported in the FY 1983 Descriptive Summary have been completed or are expected to be completed on schedule except as noted below:

Last Year's Reported Plan	Current Plan	Milestones
Late FY 1982	Mid FY 1983	Demonstration of a fully monolithic 8-12 gigahertz GaAs power amplifier with 18 db of gain.
Late FY 1983	Late FY 1983	Customization of silicon integrated chips using selective submicron-sized deep ultraviolet laser processing wil be demonstrated.
--	Late FY 1984	Feasibility to further advance lithographic resolution of low voltage electron beam exposures of monolayer resists will reach critical evaluation as well as the use of cryogenic ion sources for .01 micrometer definition
--	Early FY 1984	Design of a 8 bit one gigasample per second A/D converter to be fabricated in gallium arsenide (GaAs) will be completed.
--	Late FY 1984	A 4 kilobit GaAs gate array will be demonstrated.

6. Explanation of Milestone Changes: The demonstration of a fully monolithic 3 watt, 8-12 gigahertz GaAs power amplifier with 18 db of gain is now scheduled for Mid FY 1983 rather than late FY 1982. The delay was caused by processing difficulties associated with the very large, .7 micron resolution fourth stage output transistor that have now been solved.

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USDR&E Mission Area: 530

Title: Nuclear Monitoring
Budget Activity: 1. Technology Base

A. RESOURCES: ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
	FY 1983 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT	$16,800	$ 17,300	$ 22,500	N/A	Continuing	N/A
	FY 1984 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT	$16,916	$ 17,300	$ 19,000	$ 21,000	Continuing	N/A

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Nuclear Monitoring Program conducts research and development to provide new technological options for enhancing U.S. capabilities for monitoring nuclear explosion events. The program also provides technical information needed for developing sound national policy for negotiations on treaties limiting nuclear testing and provides technical support for US participation in treaty-related international activities. The need for this program is exemplified by the unexpected initiation of negotiations for an explosion yield threshold treaty in 1974, requiring the development, in a period of less than a year, of special monitoring provisions for the Peaceful Nuclear Explosion Treaty (PNET). The unpredictable course of negotiations for a comprehensive test-ban treaty involving, for example, definition of numbers of internal monitoring stations, their characteristics, and on-site inspection procedures, have required rapid provision of sound factual information for use by policymakers. At present, special technical efforts are required to provide policymakers with technical options for verification of an explosion yield threshold treaty.

C. BASIS FOR FY 1984 RDT&E REQUEST: This research has provided significant advances in the fundamental understanding of geophysics and instrument design relating to seismic monitoring of nuclear test ban treaties. Results from this program have significantly influenced the operational characteristics of deployed monitoring systems and the analytical procedures used routinely to interpret the data from these systems. International discussions on a complete ban on nuclear weapons testing, as well as continued concern regarding verification of compliance with the 150-kiloton threshold agreement, have focused attention on a number of highly technical issues

involved in test detection, identification, and accurate yield determination. Resolution of these issues requires additional highly specialized research. The question of proliferation of nuclear weapons technology to other countries increase the need to develop techniques to monitor remote parts of the world; also concern over the presence of nuclear materials on foreign space platforms raises the need for advanced technical developments in non-seismic monitoring techniques.

In response to these technology requirements, the FY 1984 Nuclear Monitoring Program will continue the following programs: a cooperative effort with the National Science Foundation, to design and test an ocean-bottom seismic sensor system to establish the feasibility of installing such systems for verifying future test ban treaties; technical support of international cooperative measures for verifying future test ban treaties; development and testing of an advanced international seismic data center; fundamental seismological and geophysical research into the character of earthquake and explosion sources with particular emphasis on high frequency seismological studies to provide a sound technical basis for guiding negotiations and improving the capability to use seismic stations which may be installed in the Soviet Union under provisions of a future comprehensive or reduced threshold test ban treaty; testing of advanced methods to improve the accuracy of yield estimation; investigation of potential evasive testing techniques and development of effective countermeasures; and, the exploration of sensing technology and diagonistic techniques to remotely detect the presence of nuclear materials and to provide nuclear diagnostic characterization of detected nuclear materials.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: In FY 1983, the total funds for the Nuclear Monitoring Program are estimated to be the same as the amount reported in the FY 1983 Descriptive Summary. However, the FY 1984 amount has been reduced by $3.5M. Because of this reduction plans for the follow-on to the marine seismic system and the lithospheric conductivity measurements will be curtailed. Emphasis has been placed on testing a prototype ocean-based seismic monitoring system, and expanding development of new sophisticated, physically sound methods to estimate the yield of underground nuclear explosions and to explore potentially promising non-seismic monitoring techniques.

E. OTHER APPROPRIATION FUNDS: None

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F. DETAILED BACKGROUND AND DESCRIPTION: Verification of a treaty prohibiting nuclear explosion tests is limited by the ability to distinguish between seismic signals from nuclear explosions and earthquakes. For large explosions the problem is essentially solved. However, small explosions or tests designed to minimize the signals will only be detected if we have monitoring stations in the Soviet Union. To use data from such stations, as well as existing stations near the borders of the USSR, research is necessary to improve the capability to interpret poorly understood high frequency seismic data recorded at "regional" distances (less than 2,000 kilometers).

Recent advances in marine technology make possible seismic stations beneath the ocean floor in international waters. Such stations would greatly improve the capability to monitor highly active seismic areas A demonstration that ocean-based stations can be installed in the deep ocean was successfully completed, and testing of components of a complete system is underway.

Technology advances in seismic instrumentation allow large dynamic range recording of broad bandwidth signals. To fully use such data, new automatic data analysis algorithms and management techniques, are necessary. Also, negotiations for future nuclear test ban treaties are likely to provide for the international exchange of seismic data and preliminary studies by a group of experts convened under the U.N. Committee on Disarmament have recommended establishment of international data centers for this purpose in Washington and Moscow. No adequate facility currently exists to perform these tasks. An advanced seismic data center is being developed to provide such a facility, if required, but more importantly to support needed research for improving the capability to verify test ban treaties.

Fundamental studies of the nature of earthquake and explosion sources and the effects of earth structure on seismic wave character are an important part of the program. The objective is to develop earthquake/explosion discriminants based on the physical properties of sources, rather than statistical measures of historical data, thus allowing application to areas for which prior recordings of earthquake and explosion signals are lacking.

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An important objective is improvement of capabilities to monitor compliance with the (unratified) Threshold Test Band Treaty (TTBT), which limits the yields of U.S. and Soviet test to 150 Kt and below. Under the best conditions, the current yield estimates are uncertain because of deficiencies in our fundamental understanding of the physical processes involved in the generation of seismic waves and their propagation to distant (thousands of kilometers) seismometers. The program includes theoretical and experimental research to remedy those deficiencies. Also, concepts for new bilateral technical measures to improve treaty verification capabilities have emerged and are being studied and tested. The results of these efforts will be used to provide technical guidance to U.S. policy-makers who are considering the disposition of this treaty.

The U.S. is concerned with detecting and identifying clandestine nuclear testing in all environments, requiring research to identify non-seismic indicators of nuclear explosions. Several satellite-borne sensors are under active development or in a conceptual study phase. These include development of a high resolution gamma-ray spectrometer,

Other non-seismic techniques are also being studied to determine their capability to complement and enhance current techniques to detect, locate, and identify underground or atmospheric nuclear explosions and to improve our capability to monitor possible proliferation of nuclear materials.

G. RELATED ACTIVITIES: Complementary research is conducted by the National Laboratories of the Department of Energy and by the Air Force Technical Applications Center. These complementary efforts are coordinated through existing interagency agreements and periodic working level coordination meetings. In the development of the Marine Seismic System, arrangements have been made with the National Science Foundation for jointly supporting the deep sea drilling operations using the ship GLOMAR CHALLENGER.

H. WORK PERFORMED BY: Twelve percent of the work under this task is performed by universities, seventy-nine percent by industrial contractors and nine percent by in-house laboratories. University contractors include: St. Louis University, St. Louis, Missouri; University of Nevada, Reno Nevada; Massachusetts Institute of Technology, Cambridge, Massachusetts; University of California, San Diego, California; University of California, Berkeley,

California; Columbia University, New York, New York; California Institute of Technology, Pasadena, California; Pennsylvania State University, State College, Pennsylvania; Georgia Institute of Technology, Atlanta, Georgia; Southern Methodist University, Dallas, Texas; University of Colorado, Boulder, Colorado; University of Maryland, College Park, Maryland; and University of Florida, Gainesville, Florida. Industrial contractors include Teledyne Geotech, Garland, Texas and Alexandria, Virginia; Sierra Geophysics, Seattle, Washington; ENSCO, Inc., Springfield, Virginia and Indian Harbour Beach, Florida; Gould, Inc., Glen Burnie, Maryland; Systems, Science and Software, La Jolla, California; TRW, Redondo Beach, California; Rondout Associates, Stone Ridge, New York; Global Marine Development, Inc., Newport Beach, California; Pacific Sierra Research, Santa Monica, California; Woodward-Clyde Associates, Pasadena, California; Lockheed Missiles and Space Company, Palo Alto, California; Physics Applications, Inc., Fremont, California; Mission Research Corp., Santa Barbara, California; and ITEK Corp., Lexington, Massachusetts. Participating in-house Government laboratories include the Naval Ocean Research and Development Activity, Bay Saint Louis, Mississippi; the U.S. Geological Survey, Golden, Colorado; Lawrence Livermore National Laboratory, Livermore, California; and Sandia National Laboratory, Albuquerque, New Mexico.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Work to improve earthquake/explosion discrimination techniques has emphasized observational and theoretical studies of the complex phases recorded at relatively small distances from low magnitude events. A small array optimized to detect these small signals was designed and deployed in Norway for testing. Also, the physical basis for discrimination was improved by developing better models for earthquake and underground explosion sources. A major milestone was completion of a comprehensive experiment to test various discrimination techniques as applied to USSR events. This experiment clearly identified areas where additional research efforts were needed.

A seismic data analysis center (called the Center for Seismic Studies) was opened in Rosslyn, Virginia to serve as the focal point for research requiring access to large data sets. The center was designed to serve as a test bed for advanced concepts developed in the program. For example, new automated signal processing techniques were developed and shown to be able to replace human visual analysis. The center is also being used to support U.S. experiments in international data exchange anticipated under future test ban treaties.

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Budget Activity: 1. Technology Base

The concept for deploying seismic sensors in boreholes beneath the sea floor was tested in an experiment in the mid-Atlantic in which a seismometer was successfully installed and recovered from a borehole 600 meters beneath the sea floor in 4,500 meters of water using the drill ship GLOMAR CHALLENGER. The design of the ocean-based sensor system was completed and an installation of a prototype station was attempted in September 1982. Unfavorable geological conditions prevented the Glomar Challenger from completing the borehole for the long term installation of the prototype sensor system. Temporary sensors were deployed and recorded limited data which appear to confirm the anticipated background noise reduction.

Substantial progress was made in understanding the seismic signals used for estimating the yield of underground explosions and most of the controlling features can now be simulated with theoretical models. Key experimental programs included deep seismic reflection profiling at the Nevada Test Site (NTS) and operation of digital seismic stations at sites of U.S. explosions.

A number of techniques to extract key information from the signals and use it to improve estimates of the source characteristics were developed and shown to give good results on limited test data sets. From the research we now have a reasonably clear picture of the causes for errors in yield estimates and understand what further information is necessary to improve the estimates.

To counter potential efforts to conduct clandestine tests, a data analysis system was developed to identify explosion signals hidden in earthquake signals. This system was transferred to the operational agency (AFTAC) in FY 1982. Fundamental studies were done to study the effects of cavities on explosion generation of signals . Efforts to support options for new non-seismic monitoring techniques included studies of electromagnetic, ionospheric, and other types of signals potentially generated by nuclear explosions. Evaluation of new developments in satellite-borne detectors was also undertaken.

2. FY 1983 Program: The FY 1983 program includes work to improve seismic instrumentation, data processing techniques, explosion/earthquake discrimination, and explosion yield determination. The instrumentation work includes the field evaluation of a sensitive high frequency borehole seismometer and development of a system

combining strain and inertial measurements. The experimental ocean bottom sensor system is to be installed and tested in cooperation with the National Science Foundation at a site in the Pacific Ocean. The emphasis of the data processing work is on automating the detection, location and event identification tasks now done manually, as well as on techniques to manage the large volume of digital data now available for accomplishing these tasks. This work is being done at the new Seismic Data Center along with several international experiments organized by the UN Committee on Disarmament.

The emphasis of the earthquake/explosion discrimination research is on the incorporation of regional data into the algorithms and on integrating these algorithms with modern data processing technology. A temporary array, optimized to enhance high frequency signals, was deployed in Norway, and other data are being collected to guide the design of arrays to detect regional (less than 2,000 km) signals. Such arrays and the strain -inertial system provide additional options for possible deployment under future test ban agreements. Another important part of the program is development of techniques to counter potential treaty evasion schemes.

The emphasis of the FY 1983 yield estimation work is on a focusing of results developed in previous years to complete the development and prooftesting of those concepts that appear to offer opportunities for significant improvement. A comprehensive review of the technical issues associated with yield estimation was completed in FY 1982 and has provided a guide for the FY 1983 - 1985 program. Major deficiencies remain in our understanding of source coupling to seismic waves, attenuation, generation of surface waves, and in our techniques for recognizing and compensating for such effects. The FY 1983 program includes efforts to address each of these deficiencies. In particular, a large digital data base of explosion recordings was collected for thoroughly evaluating previously developed yield estimation techniques and to provide a base on which new approaches to this problem can be developed. This evaluation is to be completed in FY 1983. Source coupling issues are being addressed with calculations, small-scale laboratory experiments and small-scale chemical explosions in a Texas salt dome. Efforts to develop techniques to remotely estimate seismic wave attenution beneath foreign sites are continuing, along with efforts to collect relevant data.

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Development of non-seismic detection and identification techniques is included in the FY 1983 program. Several satellite-based techniques are in the proof-of-concept stage.
a high-resolution gamma ray spectrometer
analysis techniques to measure small surface effects. Also under study is a neutrino detector which has the potential to eliminate the possibility of

Many of the efforts begun in previous years will be completed in FY 1983. The evaluation of the high frequency borehole seismometer and the strain-inertial seismometer is to be completed, so these instruments will be ready for transfer to the Air Force. The data from the FY 1983 test of the ocean bottom seismometer system will be available for analysis.

In FY 1983 the improved capability to detect, locate and identify nuclear explosions will be prooftested on an integrated system which automates most of these functions. The development of the Center for Seismic Studies is to be completed and efforts there will include integration of new data analysis algorithms with the versatile data handling capabilities of that center. The high frequency array design study will be completed, providing information to plan further evaluation studies if warranted. Also, work will be initiated to develop procedures to counter attempts to evade seismic detection in remote areas of the world.

The comprehensive evaluation of simple data correction techniques to be completed in FY 1983 should set the stage for completing the development and evaluation of methods which greatly expand the amount of information derived from the waveform, Also, there will be a continued emphasis on improving estimates for attenuation and source coupling effects.

The small-scale salt dome tests will be completed in FY 1983. If the results are sufficiently promising, the experimental technique will be used in another material, probably granite.

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The feasibility evaluation of several of the non-seismic treaty verification methods is to be completed in FY 1983. These include neutrino detector. The next step for those techniques deemed feasible is engineering prototype development, or further evaluation on more extensive data sets for those techniques that use existing instrumentation. Additional efforts will be devoted to developing other non-seismic techniques for nuclear monitoring.

3. FY 1984 Planned Program: By the end of FY 1984 many of the projects described in the previous paragraphs will be completed, or nearly so. The instrumentation focus will shift toward development of techniques to use advances in microelectronics to process the data in the field, rather than transmitting it to a central data collection facility. Evaluation of the ocean based seismic system will continue to determine the usefulness of this system for treaty verification. If more systems are to be deployed, it will be necessary to develop techniques to do so with ships other than the GLOMAR CHALLANGER, and efforts to develop such techniques will be initiated. The improved discrimination and yield estimation concepts and procedures developed in previous years will be transferred to the Air Force. The analysis of results from small-scale chemical explosion experiments will be completed and used to test fundamental theories of the explosion source. There will unquestionably be many unresolved fundamental technical questions about explosion seismic waves, especially concerning source coupling, attenuation effects and surface wave generation. A prototype of an array designed to exploit the high frequency energy of regional seismic phases will be tested. The importance of these unresolved questions for practical treaty verification capabilities will become more clear with further progress in the current program. Finally, increasing emphasis will be given in FY 1984 to the development of methods, both seismic and non-seismic, to counter complex methods to evade detection, especially in remote areas of the earth.

4. Program to Completion: The schedule for completion of this program is strongly dependent on international political developments. Possible changes to the Threshold Test Ban Treaty (ratification or revision) introduce new

data and interpretation problems that require further research effort and technical support. Additional research will be needed to guide policymakers on the technical options to improve the verification of this treaty. Increased progress toward a Comprehensive Test Ban Treaty would require an intensified effort to improve capabilities to interpret data from in-country stations, and many important research problems cannot be fully formulated until the number and locations of the in-country stations are negotiated.

The key elements of the program beyond FY 1985 will include experimental validation of refined yield estimation procedures using new data from chemical and nuclear experiments. Also, it is anticipated that fundamental results in seismic source and propagation theory will be applied to reduce further the uncertainties in explosion yield estimation, as well as to improve identification methods. Counters to more complex evasion methods will be under development in the context of existing treaty developments. The Seismic Data Center will be available for test ban treaty research in support of international monitoring activities. Non-seismic monitoring techniques will be developed and transferred to the services for nuclear test monitoring, especially in remote areas of the globe.

A major requirement for work beyond FY 1985 will be for the development and evaluation of comprehensive signal detection and analysis techniques to provide options for future test ban negotiations. These techniques would combine data from current sensors with data from the advanced sensors under current development into a unified system for detection and identification of natural and nuclear events. New instrumentation requirements will be for a prototype multi-sensor monitoring station including on-site processing for recognizing signals and identifying their origin. Additional effort will also be placed on the development of the Marine Seismic System to make the deployment and operation flexible for possible use in remote ocean areas.

5. Milestones: The FY 1982 through early FY 1983 milestones reported in last year's Descriptive Summary were completed on schedule.

Last Year's Reported Plan	Current Plan	Milestones
Mid FY 1983	Mid FY 1983	Establish feasibility of satellite spectrometers for nuclear explosion and materials identification.

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Late FY 1983	Late FY 1983	Complete Development of Regional Discrimination and Identification Techniques.
Late FY 1983	Late FY 1983	Develop Seismic Data Center to meet test ban data exchange obligations.
Late FY 1983	Late FY 1983	Complete feasibility tests on Neutrino Detector.
Early FY 1984	Early FY 1984	Complete development of automated event detection, location, identification system.
Late FY 1984	Late FY 1984	Complete development of improved yield estimation procedures.
Late FY 1984	Late FY 1985	Complete evaluation of small-scale chemical explosion experimental results as a test of fundamental explosions source theory.
Mid FY 1985	Mid FY 1985	Complete development of counter-evasion methods for complex evasion techniques.

6. Explanation of Milestone Changes: The completion of the evaluation of small scale chemical explosions has been postponed from 1984 until 1985. Arrangements are being made to pursue a joint program with the Defense Nuclear Agency in this experiment, with sharing of site preparation and instrumentation. Coordination of the program and the selection of a site suitable to the goals of both programs has delayed the planned completion date.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65898E
USDR&E Mission Area: 530

Title: Management Headquarters (R&D)
Budget Activity: 6. Defensewide Mission Support

A. RESOURCES: ($ in Thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional To Completion	Total Estimated Costs
FY 1983 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		7,776	8,100	8,200	N/A	Continuing	N/A
FY 1984 CONGRESSIONAL TOTAL FOR PROGRAM ELEMENT		7,276	8,100	11,400	11,600	Continuing	N/A

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides funds for payment of salaries to civilian employees and for administrative support costs of the Defense Advanced Research Projects Agency. This funding provides for the personnel compensation and benefits for civilians assigned to DARPA as well as costs for rent, travel, supplies and equipment, communications, printing and reproduction.

In March 1982, the Office of the Inspector General for Auditing (formerly the Defense Audit Service) recommended that the Agency change its procedures for reimbursing Service activities for the administrative support costs associated with contracts undertaken on the Agency's behalf. In the past, these support costs were paid from the same program elements from which the technical work was funded. Beginning in FY 1983, these costs will be funded from this program element. While the FY 1984 request and FY 1985 estimate fully reflect these costs, the FY 1983 budget will not reflect the below threshold reprogramming of $2.8 million until later in FY 1983.

C. BASIS FOR FY 1984 RDT&E REQUEST: Resources are required for the management and administration of the Defense Advanced Research Projects Agency and its administrative support costs at Service activities.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: The FY 1983 funding estimate is the same as in last year's FY 1983 Descriptive Summary and does not yet reflect the $2.8 million in below threshold reprogramming that will be required. The FY 1984 funding increase of $3.2 million reflects the full costs of adding administrative support costs at Service field activities ($3.0 million) and increased personnel costs attributable to the October 1982 payraise and the Government's contribution toward Medicare and health benefit coverage ($.2 million).

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65898E
USDR&E Mission Area: 530

Title: Management Headquarters (R&D)
Budget Activity: 6. Defensewide Mission Support

E. OTHER APPROPRIATION FUNDS: None.

F. DETAILED BACKGROUND AND DESCRIPTION: This project provides funds for normal management and support functions of the Defense Advanced Research Projects Agency. The funding includes civilian personnel compensation and benefits, and costs for travel, rent, supplies, equipment, communications, printing and reproduction. Beginning in FY 1983, funding will be included for reimbursement of administrative support costs associated with contracts undertaken on DARPA's behalf by Service activities.

G. RELATED ACTIVITIES: Not applicable.

H. WORK PERFORMED BY: Civilian and military personnel assigned to the Headquarters, Defense Advanced Research Projects Agency and by DARPA Agent personnel at Service activities.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 Accomplishments: Funding under this program element in FY 1982 supports management and administration for the RDT&E program assigned to DARPA. The majority of the funds were required for the pay of personnel who operate the Agency.

2. FY 1983 Program: Continuation of the management and administrative support costs for DARPA is planned. Beginning in FY 1983, this project will include funding to reimburse the various Service agents for their administration of DARPA contracts for DARPA. These funds were formerly budgeted in DARPA's eight technical program elements which fund the technology base programs. The $2.8 million required for administrative support will be reprogrammed below threshold during FY 1983.

3. FY 1984 Planned Program: Continuation of the management and administrative support costs for DARPA at the same level as FY 1983 are planned. The request includes $3.0 million for reimbursing Service activities for the administration of DARPA contracts.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65898E
USDR&E Mission Area: 530

Title: Management Headquarters (R&D)
Budget Activity: 6. Defensewide Mission Support

4. Program to Completion: Continuing.

5. Milestones: Not applicable.

6. Explanation of Milestone Changes: Not applicable.

RESEARCH, DEVELOPMENT, TEST AND EVALUATION DEFENSE AGENCIES

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

NATIONAL SECURITY AGENCY

FY 1984

JANUARY 1984

NATIONAL SECURITY AGENCY
FY 1983 Budget Estimate
Defense Agencies, RDT&E Program
Summary by Budget Activity
(Dollars in Thousands)

Section 2

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Budget	FY 1985 Authorization
5. Intelligence and Communications				
Total RDT&E-DIRECT				
Reimbursements				
Total PROGRAM				

NATIONAL SECURITY AGENCY
FY 1983 Budget Estimate
Defense Agencies, RDT&E Program
Summary by Program Category
(Dollars in Thousands)

Section 2

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Budget	FY 1985 Authorization
Operational Systems Development				
31011G Cryptologic Activities				
33401G Communications Security				
35885G Tactical Cryptologic Activities				
35167G Computer Security Program				
Total RDT&E-DIRECT				
Reimbursements				
Total PROGRAM				

NATIONAL SECURITY AGENCY
DEFENSE AGENCIES, RDT&E

Analysis of Reimbursable Program
(Dollars in Thousands)

Section 5

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Authorization
Other DoD Components				
Other				
Activities Outside DoD				
Other				
Total Reimbursements				

The RDT&E reimbursable program is used for work or services performed by other government bureaus and agencies such as: NASA; Department of State; FBI; CIA; Bureau of Standards; and the various Military Departments. All support provided is related to the NSA missions of Cryptologic Activities, Tactical Cryptologic Activities, and Communications Security.

DESCRIPTIVE SUMMARIES AND OTHER DETAILS ON NATIONAL SECURITY AGENCY PROGRAMS ARE NOT INCLUDED AS THEY REQUIRE SPECIAL ACCESS. THE ADDITIONAL INFORMATION WILL BE PROVIDED IN THE JUSTIFICATION BOOKS ENTITLED, CONSOLIDATED CRYPTOLOGIC PROGRAM, TACTICAL CRYPTOLOGIC PROGRAM, COMMUNICATIONS SECURITY PROGRAM AND MORE HIGHLY CLASSIFIED DOCUMENTATION PROVIDED TO EXAMINERS OF THE NSA BUDGET.

RESEARCH, DEVELOPMENT, TEST AND EVALUATION DEFENSE AGENCIES

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

DEFENSE NUCLEAR AGENCY

FY 1984

JANUARY 1984

289 270B

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE NUCLEAR AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES

SUMMARY BY BUDGET ACTIVITY
($ in thousands)

		FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
1.	Technology Base	295407	315000	330500	385470
2.	Advanced Technology Development	--	--	--	--
3.	Strategic Programs	--	--	--	--
4.	Tactical Programs	--	--	--	--
5.	Communications and Electronics	--	--	--	--
6.	Program-Wide Management and Support	--	--	--	--
	Total RDT&E - Direct	259407	315000	330500	385470
	Reimbursements	2876	9000	9100	10050
	TOTAL PROGRAM	262283	324000	339600	395520

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE NUCLEAR AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES

SUMMARY BY PROGRAM CATEGORY
($ in thousands)

		FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
6.1	Research	--	--	--	--
6.2	Exploratory Development	259407	315000	330500	385470
6.3	Advanced Development	--	--	--	--
6.4	Engineering Development	--	--	--	--
6.5	Management and Support	--	--	--	--
	Total Research and Development (Program 6)	259407	315000	330500	385470
	Total Operational Systems Program	--	--	--	--
	Total RDT&E - Direct	259407	315000	330500	385470
	Reimbursements	2876	9000	9100	10050
	TOTAL PROGRAM	262283	324000	339600	395520

DEFENSE NUCLEAR AGENCY
DEPARTMENT OF DEFENSE, MILITARY

MAJOR IMPROVEMENTS TO AND CONSTRUCTION OF GOVERNMENT-OWNED FACILITIES
FUNDED BY RDT&E

PART 1. UTILIZATION OF SECTION 2353, TITLE 10 AUTHORITY:

NONE

PART 2. UTILIZATION OF RDT&E APPROPRIATION FOR FACILITIES AT GOVERNMENT-OWNED/GOVERNMENT-OPERATED INSTALLATIONS

	Facility/Equipment	RDT&E Project Number	Contractor/Location	($ in Thousands) Total Obligational Authority			
			SECTION I	FY 1982	FY 1983	FY 1984	FY 1985
a.	Satellite X-ray Test Facility (SXTF)	G37L	Arnold Engineering Development Center (AEDC), Tullahoma, Tennessee	746.0			
b.	DoD Operational Test Site	B99QAXRE	Ft. McClellan, AL	510.0			
		B99QMXPE	Ft. McClellan, AL		2900.0		
			SECTION II				
			Projects Planned or Projected - NONE				

MAJOR IMPROVEMENTS TO AND CONSTRUCTION OF GOVERNMENT-OWNED FACILITIES
FUNDED BY RDT&E

PART 3. UTILIZATION OF RDT&E APPROPRIATION FOR MINOR CONSTRUCTION:

SUMMARY OF MINOR CONSTRUCTION FUNDED BY RDT&E DEFENSE AGENCIES

($ in thousands)

	FY 1982	FY 1983	FY 1984	FY 1985
TOTAL, PART 3	530.0	164.0	86.0	198.0
GRAND TOTAL, Major Improvements to and Construction of Government-Owned Facilities Funded by RDT&E	1,786.0	3,064.0	86.0	198.0

RDT&E INSTALLATION PROJECT FACT SHEET

I. Facility/Equipment: DoD Operational Test Site

II. R&D Program Elements: 6.27.15.H

III. R&D Project Number: B99QAXRE and B99QAXPE

IV. Location: Ft. McClellan, Alabama

V. Summary of R&D Funds: ($ in thousands)

	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	TOTAL
6.27.15.H (B99QAXRE)	510							510
6.27.15.H (B99QMXPE)		2900						2900
R&D Total	510	2900						3410

VI. Summary of Other Funds:

MILCON				1000				1000

VII. Relationship to R&D Program:

The DoD Operational Test Site will fill an existing void in doctrinal test and evaluation of physical security systems with emphasis on the protection of nuclear weapons.

VIII. Rationale for funding in R&D rather than MILCON or O&M appropriation:

The DoD Operational Test Site is being designed to be a reconfigurable prototype facility integral to physical security research efforts. Accordingly, it is to be funded from the RDT&E appropriation.

RDT&E INSTALLATION PROJECT FACT SHEET

I. Facility/Equipment: Satellite X-ray Test Facility

II. R&D Program Elements: 6.27.15.H

III. R&D Project Number: T99Q and G37L

IV. Location: Site selection was narrowed to either National Aeronautics and Space Administration (NASA), Houston, Texas, or Arnold Engineering Development Center (AEDC), Tullahoma, Tennessee; selection would have been made in 1981.

V. Summary of R&D Funds: ($ in thousands)

	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988	TOTAL
6.27.15.H (G37L)	746							27446
6.27.15.H (T99Q)								10500
R&D Total	746							37946

VI. Summary of Other Funds: None

VII. Relationship to R&D Program:

This installation project would have provided a major laboratory simulation capability to determine the system generated electromagnetic pulse (SGEMP) effects induced in satellite systems by X-rays from nuclear weapons. This program was terminated at the direction of the Under Secretary of Defense for Research and Engineering (USDRE).

VIII. Rationale for funding in R&D rather than MILCON or O&M appropriation:

The developmental nature of the photon (X-ray) source and the environmental test chamber dictated that these items be funded in the R&D appropriation.

DEFENSE NUCLEAR AGENCY

Minor Construction Projects
Funded by RDT&E

Activity	Building	Brief Description of Work	($ in Thousands) Cost FY 1982	FY 1983	FY 1984	FY 1985
Armed Forces Radiobiology Research Institute (AFRRI) Bethesda, Maryland	Bldg #42 Medical Center Bethesda, MD	Repair & Installation of Equipment Rooms 3149-3150-3145-3130-3132	100			
		Upgrade fume hood, Rm. 3136-3138	10	10		
		Install emergency shower & eye wash stations	5	5		
		Repair & Installation of Equipment Rm. 3416-3421		65		
		Repair & Installation of Equipment Rm. 1125-1126	3	3		
		Repair & Installation of Equipment Rm. 3115-3120	4			
		Installation of still - Bldg. #45	4	4		
		Rerun sewage line from Bldg. #45		30		
		Re-engineer and upgrade cooling water tower				50
		Modification to accommodate handicapped personnel			35	
		Replace warm waste holding tanks				100

DEFENSE NUCLEAR AGENCY

Minor Construction Projects
Funded by RDT&E (Cont'd)

($ in Thousands)

Activity	Building	Brief Description of Work	Cost FY 1982	FY 1983	FY 1984	FY 1985
		Upgrade existing fire alarm system	20			
		Repair & Installation of equipment Rm. 1441-1439-1437-1435	26			
		Repair & Installation of Equipment Rms 3120-3117-3118-3115	15			
		Repair & Installation of Equipment Rm 3421	20			
		Repair & Installation of Equipment Rm 2112-2114	5			
		Repair & Installation of Equipment 2421-2425	3			
		Alternations to Bldg. #43	100			
		Maintanence & repair Bldg. #43	171			

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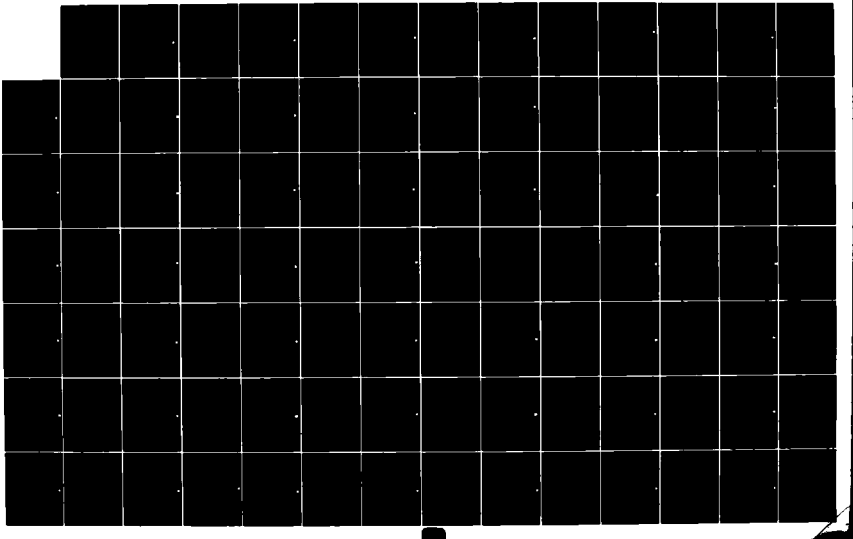

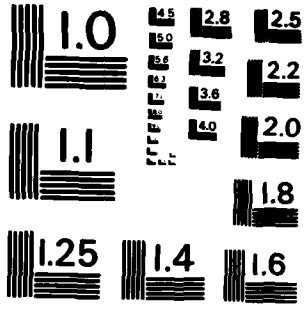

DEFENSE NUCLEAR AGENCY
Minor Construction Projects
Funded by RDT&E

($ in Thousands)

Activity	Building	Brief Description of Work	Cost FY 1982	FY 1983	FY 1984	FY 1985
Field Command Defense Nuclear Agency (FCDNA) Kirtland AFB, New Mexico	Bldg #210 Test Construction Division Nevada Test Site Mercury, Nevada	Resurface motor pool area		47.0		
	Bldg #211 Test Construction Division, Nevada Test Site Mercury, Nevada	Resurface roadway around the building & loading docks	44.0			
		Procure Kelly closure building for use at cable yard for purpose of crating & shipping of supplies				48.0
	Bldg #600, #211, #210, Test Construction Division, Nevada Test Site, Mercury, Nevada	Repair offices and building			41.0	
	Bldg #364, Test Construction Division, Nevada Test Site, Mercury, Nevada				10.0	
	Total Minor Construction Funded in RDT&E		530.0	164.0	86.0	198.0

PROGRAM ELEMENT	REMARKS
BUDGET ACTIVITY 1: - TECHNOLOGY BASE	
62715H Defense Nuclear Agency	Existing program element, Defense Nuclear Agency only has one program element for RDT&E funds.

PROGRAM ELEMENT DESCRIPTIVE SUMMARY

INTRODUCTION AND EXPLANATION OF CONTENTS

1. General. This section has been prepared for the purpose of providing information concerning the Defense Nuclear Agency's (DNA) Research, Development, Test and Evaluation (RDT&E) Program. The program element listing is preceded by the program element summary and the project summaries.

2. Comparision of FY 1982 and FY 1983 Data. The growth in FY 1983 is attributable to the increased emphasis on revitalization of DNA's nuclear weapons effects technology base and testing activities.

3. Relationship of FY 1984 Budget Structure to the FY 1983 Budget Approved by Congress. The project and program element structure contained in the DNA's FY 1984 budget request is consistent with the guidance provided by the Congress in its action on the FY 1983 DoD Budget Submission to Congress.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 Defense Nuclear Agency

Budget Activity: #1 Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
6.27.15.H	*DEFENSE NUCLEAR AGENCY (DNA)*	259407	315000	330500	385470	Continuing	N/A
A	Aerospace Systems Vulnerability and Hardening	11732	11667	12000	14700	Continuing	N/A
B	High Altitude Phenomenology and Applications	8151	8944	8800	10500	"	"
C	Command, Control and Communications (C^3)	6422	7378	11800	15700	"	"
D	Effects/Vulnerability Assessment & Data Evaluation	15449	25956	24600	25570	"	"
F	Theater Nuclear Forces Survivability Security and Safety ($TNFS^3$)	8909	5131	6300	6900	"	"
G	Effects Simulation Using Simulators	19511	20905	29000	25800	"	"
H	Effects Simulation Using High Explosives	7658	7250	4900	9400	"	"
I	Effects Simulation Using Natural Disturbances	11010	12426	13300	15200	"	"
J	Underground Nuclear Tests	66756	94265	99500	122300	"	"
L	Laboratory Radiation Simulator Development	12534	19012	17400	20300	"	"
M	Biomedical Effects Research	14423	15938	16700	17500	"	"
N	Tactical Systems Vulnerability and Hardening	22709	24548	21900	21000	"	"
O	Strategic Nuclear Implications and Assessments	4842	3588	3500	3600	"	"
P	Physical Security	7838	8600	9200	9700	"	"
S	Strategic Structures Vulnerability and Hardening	21603	21229	21200	31200	"	"
V	Nuclear Effects on Electronics	19860	28163	30400	36100	"	"

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Program Element: #6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 Defense Nuclear Agency Budget Activity: #1 Technology Base

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Defense Nuclear Agency conducts the Department of Defense (DoD) nuclear weapons effects research program. The mission is to assess the survivability of our military systems in a nuclear environment, predict lethality thresholds for destruction of enemy assets and develop the technological capability to enhance the survivability and security of our forces. Results are obtained through underground nuclear weapon effects and above-ground high explosives test programs; extensive use of nuclear weapons effects simulators and computer models; exoatmospheric experiments; analyses and evaluations of the results of these tests and experiments; and examination of U.S. versus enemy nuclear war fighting capabilities.

C. BASIS FOR FY 1984 RDT&E REQUEST: The nuclear weapons effects needs of systems developers continue to rise due to an increase in weapon sophistication in the U.S. and the U.S.S.R. These driving forces result in increased emphasis on testing and evaluating nuclear weapons effects on strategic and theater nuclear forces to determine and enhance their ability to survive an enemy attack. A primary goal will be the refinement of nuclear weapons effects phenomenology in areas affected by the increased sophistication of weapons systems. Efforts will be directed toward programs which contribute to the effectiveness and survivability of land based intercontinental ballistic missile and associated advanced ballistic missile systems; the TRIDENT II submarine launched ballistic missile; the air launched cruise missile; advanced strategic aircraft; satellites; surface ships and submarines; command, control and communications; and ground combat forces. Increased emphasis will be dedicated to provide data and guidance for the education and training of forces that may encounter a nuclear environment. To this end, better simulation of nuclear effects for Service operational field exercises will be developed as will nuclear effects modules for computerized classroom training. Directed energy effects on satellite, missile and space-base laser systems will be evaluated and vulnerability models developed. A large-scale demonstration of dispersed C^3 systems in Europe will be accomplished which will illustrate the feasibility of battlefield management by command elements in a nuclear survivable posture. The underground nuclear test will be executed In addition, DNA will have completed reporting of the FY 1983 large scale height-of-burst DIRECT COURSE event and initiate planning for the FY 1985 MINOR SCALE High Explosive event to support service requests for a large yield air blast test. Behavioral assessments for the Air Force will be initiated involving physical security personnel reliability programs. The development of a Comprehensive Personnel Nuclear Weapons Effects Model (CPNWEN) will be initiated. The construction of the DoD Security Operational Test Site will be completed and the site will be operational.

Program Element: #6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 Defense Nuclear Agency

Budget Activity: #1 Technology Base

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:

1. The minimal growth in FY 1984 funding will emphasize revitalization of DNA's nuclear weapons effects technology base and testing activities. In addition the FY 1984 program is designed to encompass support for all major stategic systems (i.e., TRIDENT II, MILSTAR, B-1B, M-X, etc.,) scheduled to be introduced in the near future, C^3 and key tactical systems.

2. Specific and detailed descriptive summaries, by project, follow the summary of this program element.

E. OTHER APPROPRIATIONS:

	($ in Thousands)			
	FY 1982	FY 1983	FY 1984	FY 1985
Military Construction	500	200	10900	3000

(a) FY 1982 - Wall and roof insulation for the Armed Forces Radiobiology Research Institute (AFRRI)

(b) FY 1983 - Construct a storage building for the AURORA facility.

(c) FY 1984 - Upgrade mechanical and electrical system at the AFRRI.

(d) FY 1985 - Construct an administration building at the DoD Operational Test Site ($1M) and modify the computer center at DNA, Field Command, Kirtland AFB, NM. ($2M).

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: A Title: Aerospace System Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION:

1. Provides for research into nuclear and directed energy weapons effects on planned and operational strategic and tactical missiles, aircraft, and ground systems. The objectives are to develop effects data on state-of-the-art and emerging technology materials and systems. These data in the form of codes, handbooks, data packages and prototype hardened components are furnished to missile, aircraft, and tactical equipment designers, developers and operational planners. By a combination of modeling and scaled simulation and underground tests, this program develops and validates the technology needs of the Services to:

a. Predict, with confidence, the blast, thermal, X-ray, dust and hydrometeor effects resulting from the detonation of strategic and tactical nuclear weapons.

b. Analyze and identify the catastrophic effects of nuclear and directed energy environments on mission critical missile, aircraft, and tactical ground systems, components, structures and personnel.

c. Develop materials, components and procedures which provide enduring survivability and mission completion for nuclear capable systems.

2. The program is accomplished through evaluation of existing systems and through development and evaluation of new materials and design concepts in response to the projected needs of operational commanders and tasking from the Office of the Secretary of Defense; by characterizing, modeling, and simulating the nuclear and directed energy threat environments of interest; by evaluating the operational degradation of vital national defense systems operating in these environments; and by

Project #: A Title: Aerospace System Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

providing hardness verification through data obtained from laboratory simulations, high explosive tests and underground nuclear tests. Success is measured by the extent to which the products of this research continue to be used in the design, development and operational employment of survivable national defense systems.

G. RELATED ACTIVITIES: The results of this research are applied directly to such existing systems as the

This program provides technical inputs for the programming of strategic nuclear engagement scenarios, feasibility, utility and protection of special interpretations of intelligence data based on nuclear weapons effects applications, and national policy formulation for use in defining the strategic arms reduction talks (START).

H. WORK PERFORMED BY:

1. Principal Department of Defense (DoD) and agencies include the Air Force Space Division; Air Force Materials Laboratory; Air Force Weapons Laboratory; Air Force Rocket Propulsion Laboratory; Air Force Holloman Test Center; Air Force Arnold Engineering Development Center; Army Nuclear and Chemical Agency; Army Ballistic Research Laboratories; Army Ballistic Missile Defense Systems Command; Army Harry Diamond Laboratories; Naval Surface Weapons Center; Naval Weapons Evaluation Facility, and Naval Research Laboratory.

2. Contractors include Acurex Corp.; the Boeing Military Aircraft Co.; Effects Technology, Inc.; General Electric Co.; JAYCOR; Kaman Science Corp.; R&D Associates; Science Applications, Inc.; TRW, Inc.; Calspan Corp.; California Research and Technology, Inc.; S-Cubed; Maxwell Laboratories, Inc.; General Research Corp.; PDA Engineering, Inc.; Physics International Co.; McDonnell Douglas Astronautics Co.; APTEK, Inc.; Martin-Marietta; Toyon Research, Inc.; Turbomac, Inc.; Northrop Corp.; and Sandia Corp.

3. Nonprofit organizations include SRI International and Aerospace Corporation.

4. Educational institutions include Los Alamos National Laboratory and Lawrence Livermore National Laboratory.

Project #: A Title: Aerospace System Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (SFRD) FY 1982 AND PRIOR ACCOMPLISHMENTS: Advances over the past ten years have resulted in improved definition of nuclear environments and their effects on military systems; the development of simulation test techniques/facilities; the establishment of x-ray damage prediction methods; the development of hardened material and design concepts for application to strategic and tactical missiles and aircraft systems; and the establishment of aboveground testing and analysis techniques to augment underground tests for verifying the nuclear hardness of strategic missiles. These results have been applied to meet the required nuclear hardness and accuracy goals for United States intercontinental ballistic missiles and submarine launched ballistic missiles; to improve the survivability of strategic aircraft; and to assess aerospace systems capabilities. Recent accomplishments include: Materials for flyout survivability; nuclear hardness evaluation methodology using aboveground experiments; codes for aircraft gust loading and thermal vulnerability; development and proof-test of a canopy for nuclear fireball protection; demonstrated reentry vehicle X-ray hardening initiation of a directed energy effects program to make strategic systems survivable to both X-ray and laser effects; completed cruise missile airframe and engine blast response tests; initiated a fireball and blast effects program on resinous composite conducted HURON LANDING underground test experiments on antenna windows and M-X external protection material and shroud; tested an alternate fuse for the reentry vehicle; provided by flight test a reentry vehicle for the radar; conducted full size reentry vehicle (RV) impact fuse tests on rocket sleds at velocities up to 9000 feet per second; Assessed the vulnerability of developed hardening methods for protection of the booster against nuclear and directed energy weapons effects; and conducted experiments for development of a materials response code for

2. FY 1983 PROGRAM:

a. Modest new programs are being initiated in directed energy in response to Office of the Under Secretary of Defense for Research and Engineering (OUSDRE) request for Defense Nuclear Agency (DNA) support to EXCOM for directed energy; OUSDRE request to DNA for information on

Project #: A Title: Aerospace System Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

a DNA perceived need for additional efforts which will give a technology base for enduring survivability and improved employment of army integrated battlefield equipment; an expanded effort to develop hardened reentry vehicle; and a dedicated effort to improve the acceptance of X-ray effects simulators as a means for cost reduction and improved confidence in hardness validation of new systems.

b. The directed energy programs will conduct single pulse laser effects tests A program will be initiated to develop the preliminary design techniques and codes for A program will be initiated to determine aircraft wing structure response to The M-109 8-inch shell, LANCE and PERSHING II missile will be evaluated Through the Office of the Under Secretary of Defense for Research and Engineering (OUSDRE) EXCOM, Defense Nuclear Agency (DNA) will continue to support the Air Force Red Team/Blue Team exercise Systems engineering and planning will be initiated in preparation for the FY 85 Laser Effects Test bed Support Program.

c. The flight systems vulnerability and hardening program will complete laboratory tests and define nuclear induced dust particle size spectra for engine testing. A program will be initiated to develop a nuclear cloud warning sensor for cruise missiles and aircraft; first order estimates of nuclear hardness will be completed for generic An independent assessment will be initiated for the hardness. Thermal mechanical data base will be developed for graphite epoxy airframe. Work will be completed on blast response, and a new program will be initiated to develop a preliminary design code for air frames. An effort will be initiated on imprecisely located targets at the request of OUSDRE. The nuclear vulnerability assessment handbook for helicopters will be completed.

d. For Missile Systems, reentry vehicle have proven in underground tests to be one of the A hardened program will be conducted with the Air Force Ballistic Missile Office (AF/BMO) and the Navy Strategic Systems Project Office (Navy/SSPO) participation. Included are new materials, a better understanding of shock wave and response failure modes and improved test procedures. Output will be a high confidence, hardened design applicable to reentry body. Data from will be used as

Project #: A Title: Aerospace System Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

the basis for the renewed efforts. data on the will be analyzed and provided to AF/BMO. technology analytical investigations will be continued and programs initiated to develop

e. "Safe-to-launch" environments and sensors. An ablation-erosion fratricide assessment will be made Experiments will be continued with advanced materials, and structures in the underground test. A new effort will be initiated for the correlation and validation of aboveground and underground test data to ensure that aboveground simulation facilities produce data which meet hardness validation criteria set by missile system designers. A steering group of user experts in the simulation field will closely monitor this effort to assess simulation facilities capabilities and formulate recommendations for upgraded/new facilities.

f. Ground Mobile Systems. The use of computer generated imagery and terrain tables will be explored as a means for fulfilling the Army's need for true integrated battlefield imagery to supplement the Combined Arms Tactical Training System (CATTS). A comprehensive program will be developed by the end of FY 83 to pursue the best approaches for supporting Army requirements for enduring combat capability. Efforts will continue on the design, construction and testing of optimum shelter panels in support of the Air Force Tactical Shelter Program.

3. FY 84 PLANNED PROGRAM:

a. The Directed Energy Program will include underground test experiments on The ability to predict materials and structures response to ll be validated and initial systems hardness estimates will be developed for Intercontinental Ballistic Missiles (ICBM's). Underground test experiments will evaluate the effects of Preliminary design codes and handbooks of laser effects response will be completed and a code validation phase initiated. Systems engineering on the Laser Effects Test bed for the three services will continue to support first tests in November 1984. The single pulse laser effects program will be completed with final data supplied to the for evaluation. The aircraft structural response to laser effects will be expanded to include testing of

Project #: A Title: Aerospace System Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

b. The flight systems vulnerability program will include completion of engine response tests using the engines to assess the effects of Nuclear sensors for aircraft operations will be evaluated. The correlation of blast and fireball codes with test data will continue as will the designs and components to nuclear blast, thermal and environments.

c. The Missile System Vulnerability and Hardening program will continue to investigate materials and structural designs for the through a comprehensive materials, design, test and modeling effort using laboratory simulation and the underground test. The canister technology program will begin a testing program with the Silo Test Program. The simulator validation program will be continued. and environment definition efforts will be completed. For Ground Mobile Systems, the program to provide battlefield imagery in support of the Army's Combined Arms Tactical Training System will be completed, and support to the Air Force Tactical Shelter program will continue. In collaboration with Defense Advanced Research Projects Agency (DARPA) the utility of light weight armor on the integrated battlefield will be evaluated. A program will be initiated to evaluate the blast vulnerability and loads on equipment.

4. FY 1985 PLANNED PROGRAM: The Directed Energy Program will continue to evaluate effectiveness through underground test experiments. Research will continue to document the lethality levels of Soviet systems and weapon parameters will be varied to optimize kill effectiveness. U.S. systems vulnerability to potential Soviet threats will continue to be assessed. The Defense Nuclear Agency (DNA) Laser Effects Test Bed Support Program will be initiated with a series of tests in medium and high energy lasers at the White Sands High Energy Laser Test Facility with the primary users being the Air Force Red Team/Blue Team exercise and the services laboratories. The initial laser effects preliminary design code, military handbook and evaluation procedures will be updated in preparation for The flight systems vulnerability and hardening program, development of the nuclear response data base on low observable air frames will continue. The thermal, blast, and vulnerability of advanced high temperature composite materials including will be assessed. A nuclear vulnerability prediction model for turbine engine transient blast response will be validated with existing test data. Advanced missile systems including reentry vehicles will continue to be assessed in underground nuclear tests and data will be correlated. Assessments of equipment vulnerability will continue throughout FY 1985. The hardened program will be completed; the above ground test (AGT)/under ground test (UGT) validation program will be continued. A comprehensive ground mobile system tech base program will be initiated in support of the Theater Nuclear Warfare program.

Project #: A Title: Aerospace System Vulnerability nd Hardening

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USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

5. PROGRAM TO COMPLETION: Continuing program. The assessment and application of nuclear weapons effects information will be adjusted to meet current and new development needs as they occur.

6. MILESTONES:

FY 1983 a.

b.

c.

d. Complete engine and air frame blast effects tests and modeling.

e. Complete preliminary assessment of composite air frames to fireball/blast effects.

f. Complete road mobile antiintercontinental ballistic missile (AICBM) survivability assessment.

g. Complete post test data correlation of HURON LANDING underground test (UGT) experiments.

h. Field missile and vehicle

i. Initiate development of archival tutorials on X-ray effects on RV's, missiles and aircraft.

j. Assessment of critical nuclear battlefield components as a guide for developing a ground systems technology base. Determine the feasibility of developing nuclear effects visual training aides.

k. Initiate comprehensive hardened materials/design/performance program.

Project #: A Title: Aerospace System Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

FY 1984 a.

b.

c. Assess and standardize experimental laser test procedures used to develop the vulnerability data base.

d. Initiate aircraft testbed for blast, and thermal effects on aircraft and cruise missiles.

e. Complete the response test series. Develop test specifications and damage criteria.

f. Complete feasibility assessment of onboard aircraft nuclear sensors.

g. Complete nuclear effects assessment for all generic types of military helicopters.

h. Develop substantiating data base for and simulator validation experiments to be fielded in the

i. Complete development of improved UGT instrumentation.

j. Integrate battlefield nuclear damage effects imagery into the CATTS program.

k. Define technology requirements for enduring survivability of critical combat components. Initiate RDT&E program.

l. Conduct vulnerability assessment of mobile ground shelters.

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Project #: A Title: Aerospace System Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

m. Initiate test and code development program to give acurate data base for blast vulnerability of Soviet ground equipment.

FY 1985 a. Update continuous wave (C-W) laser effects design and analysis codes.

b. Complete standardization of experimental procedures for laser effects testing.

c. Conduct missile booster C-W laser demonstration test at White Sands Missile Range.

d. Develop space based laser (SBL) effectiveness tool and decision points.

e. Develop nuclear weapon effects hardness assessment methodology.

f. Complete assessment of thermal vulnerability of advanced composite aircraft design material and establish preliminary failure criteria.

g. Complete development and validation of a

h. Conduct lecture series on X-ray effects on missiles for educators and designers.

i. Evaluate, by peer group, progress on validating simulators for X-ray effects.

j. Complete effects program and recommend revised engine test procedures to the services.

k. Brief Services and industry on in-flight performance of nuclear avoidance sensor.

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Project #: A Title: Aerospace System Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

l. Prepare nuclear effects design handbook for designers.

m. Provide new blast effects preliminary design code for air frame designers and educators.

n. Prepare revised codes for blast effects on Soviet Army equipment, including accurate blast loads.

		($ in Thousands)				
		FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7.	RESOURCES: Aerospace Systems Vulnerability and Hardening	11732	11667	12000	14700	Continuing

a. Basis for FY 1984 Request: Supports a comprehensive program in the directed energy, flight systems vulnerability, missile nuclear hardening and survivability and ground systems enduring survivability programs. These programs are vital for the assessment of the vulnerability of existing systems to hostile nuclear and directed energy environments; for exploring technological improvements that would enhance the survivability of these systems; and for the development of advanced technology to ensure survivability of future systems against current and projected threat environments. The programs outlined herein seek to support all the Services strategic and tactical missile, aircraft, directed energy and ground systems hardening requirements. Specific tasks this request supports are: (1) and satellite components, effects materials and structural designs; (2) completion of preliminary design codes and military handbooks on laser effects; (3) systems engineering and tri-service test support through the laser effects test bed beginning in early 1985; (4) (5) completion of effects testing to assess and engine performance degradation; (6) assessment of nuclear blast, thermal and effects on components and advanced designs; (7) development of methods for protecting nuclear capable systems against the nuclear and directed energy threats; (8) completion of battlefield imagery studies in support of the Combined Arms Tactical Training System; (9) continued support to the Air Force Tactical Shelter program; and (10) initiation of a comprehensive ground systems enduring survivability program.

Project #: A

Title: Aerospace System Vulnerability and Hardening

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

b. Basis for Change in FY 1984 from FY 1983: Significant changes in the structure of the FY 1983 program are made in the 1984 request. Tri-service laser effects test bed support begins in 1984; flight systems engine begins in 1984; testing of begins; the above ground test/underground test (AGT/UGT) X-ray simulator validation program is expanded; and the ground systems enduring survivability begins exploratory testing.

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DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: B Title: High Altitude Phenomenology and Applications

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION:

1. Objective is to provide the capability to evaluate the performance of and to develop mitigation techniques for communication, navigation, radar, optical and infrared systems in a nuclear environment. The nuclear disturbed atmosphere is defined and interaction of systems with that medium is assessed. Nuclear weapon debris motion and distribution and the resultant atmospheric ionization, striation, and infrared emission phenomena as a function of time are calculated. The results are compared with experimental data.

2. Objective is accomplished through a series of theoretical and modeling programs that are coordinated with the experimental programs of other projects, e.g., Effects Simulation Using Natural Disturbances, Project I, where experimental data are obtained from past nuclear events, nuclear weapons effects simulation events and subsequent laboratory investigations and field measurement experiments. The results are applied to system design specifications, nuclear mitigation technique development, and models to determine system performance in various nuclear scenarios.

G. RELATED ACTIVITIES: Supports Service activities by providing predictions of the effects of endoatmospheric and exoatmospheric nuclear explosions. This effort includes the use of phenomenology application codes, monitoring research in atmospheric phenomena, reporting on potential defense related problems and applications, and maintaining generic handbooks and reference documents pertaining to atmospheric nuclear effects. Data provided are necessary to determine the effectiveness, to assist in the design of, and to develop mitigation techniques for:

Project #: B Title: High Altitude Phenomenology and Applications

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

1. Command, control and communications (C^3) activities conducted in support of the National Command Authorities and strategic and theater nuclear forces.

2. Satellite borne sensors which give early warning of enemy missile attack. Future systems might provide damage assessment following strategic nuclear exchanges and/or other surveillance applications.

3. New communications concepts employing adaptive high frequency, ground wave, and meteor burst techniques.

4. Modulation techniques that provide nuclear propagation effects mitigation without compromising electronic countermeasures of advanced communication and surveillance systems.

5.

6. Precursor nuclear weapon detonations which may be used by strategic missiles as a penetration aid against defended targets.

H. WORK PERFORMED BY:

1. Principal Department of Defense agencies include Air Force Geophysics Laboratory; Naval Research Laboratory; Air Force Weapons Laboratory; and Naval Ocean Systems Center.

2. Other United States Government agencies include National Oceanic and Atmospheric Administration; National Aeronautics and Space Administration; and the Institute for Telecommunications Sciences.

3. Contractors include ESL, Inc.; General Research Corp.; Kaman Tempo; Lockheed Missile and Space Co.; Mission Research Corp.; Science Applications, Inc.; Pacific Sierra Research Corp.; Physical Research Corp.; Physics Dynamics, Inc.; JAYCOR; PDI; Berkeley Research Associates; KAMAN Sciences Corp.; IRT Corp.; MILCOM, Inc.; Nichols Research Corp.; SANDIA

Project #: B Title: High Altitude Phenomenology and Applications

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

Laboratory; Toyon Research; and United Technologies Research Center.

4. Nonprofit organizations include SRI International.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS: Supported the development and exploitation of theoretical techniques designed to provide an understanding of the processes that follow atmospheric nuclear detonations. The performance of communication, performance (especially communication links and infrared (IR) missile surveillance systems) for extended periods of time were emphasized. Computer codes developed in previous years to provide predictions of nuclear environmental data were revised, upgraded and extended in both time, spatial, and spectral capability.

2. FY 1983 PROGRAM: Three-dimensional extremely low frequency (ELF) code will be further refined. Modeling of transverse electric (TE) very low frequency (VLF) propagation is being made to support TE mode capability for present and future airborne systems. Assessment of various adaptive high frequency (AHF) trans and post attack communication systems will continue to include candidate very high frequency (VHF) systems of interest to the Defense Communications Agency (DCA), the Minimum Essential Emergency Communications Network (MEECN), and the World Wide Military Command and Control System (WWMCCS). Evaluation of data from field experiments and nuclear tests will proceed. The results will be used to develop techniques

environment prediction capabilities will be upgraded for continental sized multiburst scenarios with emphasis on lower ionospheric and/or high latitude scenarios. Radar and optical systems codes for nuclear effects will be improved to include state-of-the-art radar propagation and systems models for ballistic missile defense and surveillance system applications. Theoretical research and analysis of field measurements of IR structure will continue. A program will continue to understand and predict plasma structure in the first minutes after a high altitude nuclear explosion. This structure may influence later time signal scintillation producing structure and change current effects predictions. A "Reasonable Worst Case Specification of Nuclear Disturbed Radio Signals" has been published which defines, within present environment uncertain-

Project #: B Title: High Altitude Phenomenology and Applications

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

ties, the degradation radio signals will experience in nuclear environments. This report is the basis of the Air Force's nuclear survivability criteria for radio links and is the source document for the MILSTAR propagation specification.

3. FY 1984 PLANNED PROGRAM: Effects of off-path ionospheric irregularities will be evaluated using the three-dimensional extremely low frequency (ELF) propagation code. Results of propagation experiments during solar flare disturbances of the ionosphere will be compared with code predictions. Link performance investigations of selected satellite systems in nuclear scenarios will be assessed and mitigation techniques will be evaluated. Detailed comparison of field experiments and performance data will continue. Nuclear prediction programs will be extended to include a capability to calculate the effects of a burst at high magnetic latitute. Experimental data will be evaluated. Early time plasma structure evaluation will proceed as will support of early time experiments. Multiple burst interactions will be investigated. Emphasis on spatial, spectral, and temporal aspects of infrared (IR) emissions will increase as data from IR field and laboratory experiments become available during this time period. Nuclear induced emissions in the long wavelength IR (LWIR) regions between micrometers will receive prime emphasis. Measurements of a few critical atmospheric reaction rates will continue.

4. FY 1985 PLANNED PROGRAM: Incorporation of field simulation results into the data base will continue. This effort will result in an improved and comprehensive prediction capability for assessing communications systems. Emphasis will be on ionospheric propagation from extremely low frequency (ELF) through very high frequency (VHF), satellite communications, navigation systems, and space based radar, as well as on long wavelength infrared (LWIR) systems. Emphasis will be placed on transfer of technology to systems program offices. Mitigation techniques will be tested against predictive codes and data processing algorithms intended to be resistant to perturbations produced by nuclear effects will be devised.

5. PROGRAM TO COMPLETION: Continuing program.

6. MILESTONES:

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Project #: B

Title: High Altitude Phenomenology and Applications

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

FY 1983: Predictive code refinements include addition of dust, improved algorithms, long wave infrared (LWIR) effects, multiburst effects on satellite communications, initial incorporation of high altitude and high magnetic latitude bursts. Assessment of network degradation of low altitude air defense radars, MILSTAR, Defense Support Program Mobile Ground Terminals and adaptive high frequency (AHF) communications systems. Testing of AHF systems and calculation of nuclear effects on millimeter wave radars.

FY 1984: Provide radar propagation degradation and vulnerability assessment to the ballistic missile defense (BMD) radar and infrared system concepts. Complete preliminary long wave infrared (LWIR) assessment capability and incorporate results of field experiments in predictive codes and system models. Complete Spatial and Spectral Infrared Experiment (SPIRE) data assessment and apply results to earth limb-viewing infrared systems. Calculate mission performance of selected satellite systems in multiple burst nuclear scenarios. Evaluate space based radar links in nuclear environments methods to improve performance. Refine very low frequency (VLF) extremely low frequency (ELF) spherical wave code to include a scatter model for ionization patches at D and E region altitudes. Perform follow-on calculations for adaptive high frequency (AHF) systems, based on actual performance of airborne units operating in ambient environments (New Look). Complete evaluations of AHF systems field test program showing most relevant aspects for stressed propagation environment and suggested mitigation measures. Incorporate results of metal oxides experiments into LWIR system codes.

FY 1985: Design, evaluation, and mitigation of selected satellite command, control and communications (C^3) and radar systems will continue. Integrate results of early time structure investigations into high altitude nuclear scintillation effects codes if necessary. Complete assessment of rocketborne electron accelerator spectral data and apply results to prediction of infrared (IR) emission from heavily dosed regions. Update modeling of spectral, spatial, and temporal character of LWIR processes based upon data from satellite and rocket measurements. Perform follow-on calculations of AHF systems, to assess mitigation techniques in signal structure.

Project #: B

Title: High Altitude Phenomenology and Applications

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

7. RESOURCES: High Altitude Phenomenology and Application	($ in Thousands) FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
	8151	8944	8800	10500	Continuing

a. BASIS FOR FY 1984 REQUEST: Data from experimental programs will be available and will be applied to the validation of techniques used to predict nuclear weapons effects on satellite communication links, radar, infrared (IR) and other strategic and theater communications/surveillance systems essential to nuclear attack assessment and command coordination.

b. BASIS FOR CHANGE IN FY 1984 FROM FY 1983: Added emphasis has been placed on theoretical efforts to define the environment for communications, space based radar, operations in polar/high latitude regions, and long wavelength infrared (LWIR) areas. Having demonstrated that propagation effects through a known environment are accurately predicted, such activities have been terminated. This theoretical work, combined with the experimental data from Project I, Effects Simulation Using Natural Disturbances, will permit the prediction of nuclear effects on developing communications and surveillance systems as well as space and ballistic missile defense systems. The predictions will aid in system design, nuclear capability assessment and nuclear mitigation development.

DEFENSE NUCLEAR AGENCY

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Project #: C

Title: Command, Control, and Communications (C^3)

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: Support and assist the Services, Commanders-in-Chief, and agencies of the Department of Defense in the implementation of nuclear weapon effects protection for all C^3 assets, by development of protection technology, procedures and tests for validation and maintenance of protection. The results will be used to determine the best mix of C^3 assets to assure survivability.

a. Assimilating the nuclear survivability assessment methods and technology, evaluating their effectiveness and discarding those that do not contribute to survivability enhancement.

b. Developing new methods and technology and exercising them on representative C^3 systems.

c. Incorporating results into a data base supporting survivability enhancement standards and practices.

d. Maintaining the data base for the use of Department of Defense activities.

e. Supporting the Theater Commanders-in-Chief in applying the technology to their programs.

The technology, procedures, practices, and standards will be shared, as appropriate, with the North Atlantic Treaty Organization (NATO) and other United States Allies. The results of this program provide a direct input into the design of future C^3 systems and facilities and will provide guidelines and practices for enhancing the survivability of existing assets.

G. RELATED ACTIVITIES: Support the Department of Defense, Defense Agencies, NATO and Service-funded activities in determining the effectiveness of tactical and strategic communications systems when stressed with environments produced by nuclear weapons detonations.

Project #: C

Title: Command, Control, and Communications (C^3)

Program Element: #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

H. WORK PERFORMED BY:

1. Civilian contractors include R&D Associates; Boeing Aerospace Corp.; Mission Research Corp.; Kaman Sciences (TEMPO); IRT Corp.; Booz-Allen & Hamilton; Rockwell International; Science Applications, Inc.; BDM Corp.; EOS Technologies, Inc.; Horizons Technology, Inc.; JAYCOR, Inc.; Palmer-Smith Corp.; GTE Sylvania, Inc.; and TRW Systems Group.

2. Educational institutions and nonprofit organizations include George Institute of Technology's Engineering Experimentation Center and SRI International.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS: Past programs developed techniques and test equipment to perform nuclear weapons effects vulnerability assessments of continental United States and Pacific Command (PACOM) communications networks. Basic electromagnetic pulse (EMP) assessment technology and network end-to-end evaluation techniques were developed under these programs. Facility vulnerability data were obtained as well as information on the wide variation in configurations and installation practices that exist and which complicate the development of uniform protection criteria. An evaluation of the nuclear survivability of the communications supporting the release and employment of theater nuclear weapons was completed. A program to assist the North Atlantic Treaty Organization (NATO) in the development of a survivability program for their C^3 systems was initiated focusing principally on protection technology for EMP. A program to develop EMP life cycle protection costs for communications facilities supporting the Worldwide Military Command and Control System was initiated. Programs in support of the Theater Nuclear Forces C^3 Improvement Program (TNFC^3I) were initiated.

2. FY 1983 PROGRAM: Efforts in FY 1983 will concentrate on two main areas; (1) continued development and evaluation of EMP protection validation assessment and test procedures (protocols) to be used for demonstration of the achievement of protection, and (2) the acquisition of data relating to the performance and cost of alternative protection concepts installed at C^3 facilities. These activities provide data to support development of hardness assurance maintenance and surveillance programs necessary to maintain integrity of protection, and identify operational constraints which degrade protection or impact cost of maintenance, and provide opportunities for certification of protocols on protected facilities. Life cycle cost data are being collected at four PACOM facilities protected as part of the DNA project and additional facilities protected by PACOM. Protection and initial evaluations will be completed in FY 1983. Protection validation protocols, initiated during Fiscal Year 82, are being tested by applications to these facilities and requirements for improvement and refinements will be identified. Data are being

Project #: C Title: Command, Control, and Communaications (C^3)

Program Element #1: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

collected on performance, maintainability, reliability, and completeness of protection measures as well as costs to maintain and refine protection as it degrades. These data will serve as valuable inputs to a protection handbook for new facilities to be initiated this year (as a forerunner to a Military Standard for electromagnetic pulse (EMP) Protection), and the collective results of the project support DNA's technical management of a National Communications System program to evaluate feasibility of EMP protection of the Nation's common carrier telecommunications, an initiative undertaken to support the National Security Council/ Presidential Directive-53 (NSC/PD-53). A program examining potential conflicts between existing military standards and EMP protection requirements will be completed and will identify issues that will need to be addressed by the electronics community before an EMP protection military standard is developed. Data from Service agencies and government contractors are being collected and organized to provide a single reference point for information concerning threshold levels for upset and damage of communications piece parts and equipment. The High Technology Test Bed (HTTB) and the 9th Infantry Division are being used to evaluate modular dispersed communications. The use of fiber optics technology to achieve EMP survivable communication systems is under study.

3. FY 1984 PLANNED PROGRAM: Evaluation of the adequacy of assessment and testing methods will continue, through application to the Pacific Command (PACOM) protected facilities, and will be refined and modified as needed. Planning for final certification of the protocol will be initiated to ensure technical issues are addressed in threat level testing to be conducted as part of DNA's support to the NSC/PD-53 program. EMP Protection Handbook for C^3 facilities will be completed for use for new construction, and initial frameworks for military standards will be developed. Initial evaluation of potential EMP vulnerabilities in alternative methods for installing shielding in new and existing communications facilities will be collected and published. Examinations of the feasibility and practicality of simple EMP C^3 test bed will continue with emphasis on testing requirements. Work with the HTTB and the 9th Infantry Division will continue. Fiber optics communications technology susceptibility to EMP will be further evaluated.

4. FY 1985 PLANNED PROGRAM: Emphasize development and certification of protection technology and verification methods for EMP protection of vital C^3 facilities. Technology developed will be used by Services and agencies to develop EMP protection strategies, cost estimates, and develop hardness assurance and surveillance operational and maintenance requirements necessary to maintain protection. This evaluation of technology will be applied as required to existing facilities and equipment to gain information relating to adequacy and applicability, to assist operators in understanding vulnerabilities, and in the development of protection programs. Increased emphasis will be placed on the evaluation of dispersed communications and the use of fiber optics.

Project #: C

Title: Command, Control, and Communications (C^3)

Program Element #1: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

5. PROGRAM TO COMPLETION: This is a continuing program. The level of effort will be programmed to obtain nuclear vulnerability data, to incorporate refined nuclear vulnerability tools, and to refine practices, procedures, and standards to maintain the survivability of C^3 supporting the Nation's Armed Forces.

6. MILESTONES: Changes from the January 1982 submission are attributable to a maturing of the program based on data received since January 1982. Changed milestones more clearly define the program in follow-on years and reflect re-emphasis.

FY 1983 Initiate military standard for electromagnetic pulse (EMP) protection specifications. Evaluate efficiency and effectiveness of hardness assurance methods. Assist Services, Department of Defense agencies and others in applying EMP protection strategies. Acquire EMP protection data, life cycle cost data. Refine and test validation protocols. Continue technology transfer with the North Atlantic Treaty Organization (NATO) allies.

FY 1984 Complete assessment of EMP vulnerabilities of national power grid facilities. Publish first verion of EMP protection military standard. Assist Services, Department of Defense agencies and others in applying EMP protection strategies.

FY 1985 Refine and finalize EMP protection military standard. Assist Services, Department of Defense and other government agencies in applying EMP protection strategies.

	($ in Thousands)				COST TO
	FY 1982	FY 1983	FY 1984	FY 1985	COMPLETION
7. RESOURCES: Command, Control, and Communications (C^3)	6422	7378	11800	15700	Continuing

a. BASIS FOR FY 1984 REQUEST: Increasing emphasis on the development and fielding of nuclear survivable C^3 systems dictates the requirement to obtain data upon which designs may be based. The FY 1984 request will provide funds for the further refinement and application of the C^3 assessment methodology, and the development of EMP protection handbooks and specifications or military standards. Programs were developed through analysis of agency and Service needs for technology development. The methodology and tools for C^3 EMP protection validations will be refined as data become available and as they are applied to perform system level assessments. Work toward the development of EMP protection concepts and specifications will be continued with the goal of developing appropriate military standards and configuration management practices.

Project #: C

Title: Command, Control, and Communications (C^3)

Program Element #1: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

b. BASIS FOR CHANGE IN FY 1984 FROM FY 1983: The need for nuclear survivable C^3 requires the translation of nuclear effects information into engineering specifications for use by equipment designers. Techniques for the assurance of hardness maintenance and surveillance must be developed, disseminated to operators, and implemented. DNA will evaluate and refine the use of dispersed command posts and C^3 systems to achieve survivability, as well as expanding effort in protracted war battle management. Added emphasis will be placed on the development and refinement of standards for protection, and life cycle costing of protection of C^3 systems. Technology transfer with our allies will contribute significantly to broadening of the data base.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: D Title: Effects/Vulnerability Assessment and Data Evaluation

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION:

1. This program is concerned with collecting, assessing and disseminating the results of the DNA RDT&E program using the Department of Defense Nuclear Information and Analysis Center and developing nuclear weapons storage site survey reports for integration of the Department of Energy's Atmospheric Release Advisory Capability into response plans for potential nuclear weapon accidents.

2. This is a key element in the technical direction of a balanced Research, Development, Test and Evaluation (RDT&E) program that is responsive to current Service requirements and anticipated future needs. New ideas and advanced theoretical nuclear weapons and radiation effects concepts are developed for application to theater and strategic policies and for enhancement of systems survivability and effectiveness in a nuclear environment.

G. RELATED ACTIVITIES: This project supports a broad spectrum of Department of Defense activities concerned with nuclear weapons effects. It supports the various Military Services' requirements for nuclear weapons effects information and is being expanded to address the acquisition of nuclear survivable and enduring systems.

H. WORK PERFORMED BY:

1. Department of Defense (DoD) and other Government Agencies include: General Services Administration; National Security Agency; Defense Communications Agency; U.S. Naval Research Laboratory; U.S. Air Force Weapons Laboratory; and U.S. Air Force Systems Command.

Project #: D Title: Effects/Vulnerability Assessment and Data Evaluation

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

2. Contractors include: Control Data Corporation; The BDM Corporation; Pacific-Sierra Research Corporation; Science Applications, Inc.; R&D Associates; S-Cubed; Mountain Bell; Kaman Sciences; Kaman (Tempo); Energy Systems, Inc.; Mission Research Corporation; Sy Corporation and Data Communications System Corporation; Oak Ridge National Laboratory.

3. Educational institutions and nonprofit organization include Lawrence Livermore National Laboratory; George Washington University; U.S. Naval Post Graduate School and SRI International.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS:

a. Determined likely failure modes, nuclear hardening technology requirements, and hardness validation methods for the proposed Low Altitude Defense System (LoADS) design and booster.

b. Identified nuclear survivability issues (electromagnetic pulse and transient radiation effects on electronics) and developed a comprehensive simulation development and technology program for the M-X design review and full-scale development.

c. The Department of Defense Nuclear Information and Analysis Center (DASIAC) supported the Nuclear Test Personnel Review--a nationwide study of the lasting effects of nuclear radiation on humans, and correlated the Mt. St. Helens volcano energy release to nuclear explosions.

d. Determined aircraft hardening requirements and developed methods to test aircraft vulnerability to blast and thermal radiation.

e. Improved nuclear planning capabilities, especially in the Supreme Headquarters Allied Powers Europe by exploiting automatic data processing and a solid-state hand-held calculator.

Project #: D Title: Effects/Vulnerability Assessment and Data Evaluation

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

f. Targeting methodologies to increase deterrence of strategic forces were developed. Specific efforts included developing blocks of facilities which can be targeted to meet specific, limited objectives, and developing a means of rapid weapon retargeting and reallocation.

g. Developed techniques to predict the response of command, control, and communications facilities to the electromagnetic pulse (EMP) produced by high-altitude nuclear detonations.

2. FY 1983 PROGRAM:

a. Evaluate effect of nuclear weapons on, and mitigation, techniques for, emerging communications and intelligence systems (e.g., space-based synthetic aperture radars, and reconstitutable satellite systems).

b. Determine the effects of atmospheric nuclear detonations on the signal propagation of very low frequency phased-array, reconstitutable extremely low frequency technologies, and infrared surveillance systems.

c. The Department of Defense Nuclear Information and Analysis Center (DASIAC) will continue to analyze and disseminate information from underground and high explosive tests and laboratory simulations.

d. Develop technical approaches aimed at electromagnetic pulse hardening and hardening validation for fixed and mobile ground command, control, and communications systems.

e. Complete nuclear weapons site survey reports and capability to plot and rapidly display nuclear accident effects tailored to site-specific topography, demography and geography.

f. In support of the Air Force, formulate comprehensive nuclear weapons effects technology and hardness validation programs to support M-X decisions and identify nuclear vulnerabilities of candidate M-X command, control, and communications systems.

Project #: D Title: Effects/Vulnerability Assessment and Data Evaluation

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

g. Develop concepts to resolve the uncertainties in the ground shock and cratering effects of nuclear weapons.

h. Recommend techniques for aircraft electromagnetic pulse hardening and hardness validation, and identify penalties for hardening new configurations (low radar cross-sections) and materials (composites).

3. FY 1984 PLANNED PROGRAM:

a. Complete preliminary investigation of the acquisition process for incorporation of nuclear weapons effects hardening. Publish procedures guide to assist program managers.

b. Continue the analysis and dissemination of information from underground and high explosive tests and laboratory simulations.

c. Assist in the development of a Nuclear Weapons Effects training course to produce qualified Nuclear Weapons Effects Engineers.

d. Initiate new research based on results from the outgrowth of prior year efforts and new developments in nuclear weapons effects with particular emphasis on investigation of foreign nuclear weapons developments.

4. FY 1985 PLANNED PROGRAM: Increase efforts to disseminate the results of nuclear weapons effects development. Initiate new research efforts to investigate areas of interest that result from the outgrowth of prior year efforts and new developments in nuclear weapons effects to include investigation of foreign nuclear weapons developments.

5. PROGRAM TO COMPLETION: Continuing program.

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(331)

Project #: D Title: Effects/Vulnerability Assessment and Data Evaluation

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

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6. MILESTONES:

FY 1983 Investigate areas that result from an outgrowth of prior efforts, breakthroughs in related technologies and new developments in nuclear weapons effects. Initiate a program to standardize incorporation of hardening against nuclear weapons effects in the systems acquisition process.

FY 1984 Expand the efforts to standardize incorporation of hardening techniques in the systems acquisition process. Increase efforts to disseminate results of nuclear weapons effects development through education and training programs in cooperation with the Services. Develop improved design concepts for flexible response options.

FY 1985 Expand efforts to initate new research efforts to investigate areas of interest that result from the outgrowth of prior year efforts and new developments in nuclear weapons effects with particular emphasis on investigation of foreign nuclear weapons developments.

	($ in Thousands)				
	FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7. RESOURCES: Effects/Vulnerability Assessment and Data Evaluation	15449	25956	24600	25570	Continuing

a. BASIS FOR FY 1984 REQUEST: This program supports efforts in the application of nuclear weapons effects technology to weapon system development and force deployment. A growing portion of the effort is applied to dissemination of the results of nuclear weapons effects development and to the incorporation of nuclear weapons effects hardening criteria into the system acquisition process.

b. BASIS FOR CHANGE IN FY 1984 FROM FY 1983: Programmatic progress and adjustments in support for the scientific computer have resulted in minor funding changes in this program for FY 1984 and beyond.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: F Title: Theater Nuclear Forces Survivability, Security and Safety

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION:

1. Objective is to conduct a broad, balanced research program to assist the Services in ensuring that the theater nuclear forces (warheads; delivery systems; command, control and communications; and logistics) are sufficiently survivable, safe and secure to serve as a credible nuclear deterrent and, if deterrence fails, to serve as a retaliatory counterbalance to numerically superior forces. Examines current and future vulnerabilities of theater nuclear forces, and recommends improvements. Oriented to ensure the proper balance between safety, security and survivability and military effectiveness.

2. Objective is accomplished by working in close cooperation with the Army, Navy, Air Force, theater commanders, Joint Chiefs of Staff and Department of Defense agencies throughout each project cycle, from problem identification to solution implementation. Support is provided for new materiel development, equipment modifications, and procedural changes.

G. RELATED ACTIVITIES: Supports Service activities by recommending enhancements to the theater nuclear forces. Managed under the direction of an Office of the Secretary of Defense Steering Committee, with representatives from the Office of the Secretary of Defense, the Services, Defense Agencies, Joint Chiefs of Staff, and Commanders-in-Chief.

H. WORK PERFORMED BY:

1. Principal Department of Defense agencies include Naval Ship Research and Development Center; Naval Surface Weapons Center; Army Waterways Engineering Center; Army Ballistic Research Laboratory; Army White Sands Missile Range; U.S. Army Missile Command.

Project #: F Title: Theater Nuclear Forces Survivability, Security and Safety

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

2. Contractors include JAYCOR; The BDM Corp.; California Research and Technology, Inc.; Kaman Sciences Corp.; R&D Associates; Science Application, Inc.; CALSPAN, Inc.; and Sandia Laboratories.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS: Development and testing of a prototype weapon storage vault, to be installed below ground in aircraft hangarettes. This vault improves peacetime security, wartime conventional survivability, and reduces key indicators of dual capable aircraft nuclear alert status. A continental U.S. vault was tested in FY 1982 and a vault has been installed at Ramstein Air Force Base, West Germany, for in-theater evaluation. In a joint program with the Air Force, the Defense Nuclear Agency sponsored field exercises to evaluate Ground Launched Cruise Missile dispersal operations, with emphasis on security and survivability. Initiated development of advanced nuclear weapon storage concepts and equipment and procedures for nuclear weapons dispersal by Navy antisubmarine aircraft. Supporting survivable command, control and communications (C^3) systems was a major area of investigation, including distributed C^3 headquarters command posts, alert and response of the positive control nets, and high frequency ground wave communications studies. Conducted to reduce the acoustic signature of generators used by dispersed theater nuclear forces systems so as to preclude enemy location and targeting of the units. Evaluation of nuclear survivability of key naval systems, including Terrier, Aegis, and Tomahawk was conducted. Initiated to develop a Survivability Evaluation and Verification Exercise (SAVE) plan for the Pershing II to ensure periodic and reliable evaluation of the deployed system survivability. The Improving Theater Survivability (ITS) program focused on developing concepts for incorporating survivability from the initiation of system/concept development. A computer model (Savage) to evaluate ground launched cruise missile (GLCM) prelaunch survivability was developed and turned over to the Air Force.

2. FY 1983 PROGRAMS: Programs continue involving generator noise reduction, Pershing II SAVE, GLCM dispersed operations, underground storage concepts, and antisubmarine aircraft operations. The GLCM survivability model is being expanded to evaluate the Corps Support Weapon System. A multipart program to ensure survivability of dual capable aircraft, including warning and dispersal options, is being developed. A program to evaluate the survivability of the theater nuclear forces as a whole rather

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than as isolated systems was initiated in the manner used to evaluate the survivability of the strategic Triad. A modeling tool to evaluate nuclear survivability of naval systems is being developed. Survivability of command, control and communications (C^3) supporting the theater nuclear forces will continue to be a major effort, with specific emphasis on field exercises of survivable command information systems, ground wave propagation measurements, and requirements/operations concepts.

3. FY 1984 PROGRAM: Continuation of the Pershing II Survivability Evaluation and Verification Exercise (SAVE) and extension of the concept to the ground launched cruise missile (GLCM), C^3 survivability emphasis will be on operations in a nuclear environment with specific projects in testing of ground wave propagation, second echelon attack capability, and dispersed command posts improvements. Field testing of acoustic reduction techniques is planned in a joint program with the Army. Support to Pacific Command, and potentially Alaska Command, will be initiated with emphasis on extension of work previously accomplished for European Command. Possible adverse effects of peacetime safety and security standards on wartime survivability will be initiated. Emphasis will be to develop concepts for enduring survivability, to raise the nuclear threshold and to increase deterrence during lower level conflicts. Projects will focus on institutionalizing survivability concepts by developing standards, periodic field evaluations (i.e., Pershing SAVE, etc.) to ensure that deployed systems remain survivable during peace, transition and war.

4. FY 1985 PROGRAM: The Pershing II SAVE program will culminate with a major U.S. Army-Europe exercise. Other programs related to the shift in emphasis to survivability will be accomplished, derived from the earlier study of safety and security regulations and their impact on survivability.

5. PROGRAM TO COMPLETION: In conjunction with the Services, the project will coordinate the development of selected survivability, security and safety enhancements. It will provide direct support to the weapons program offices for systems involving nuclear capabilities. Support will also be provided to the Services to ensure that the improvements identified, developed and tested are properly integrated in the overall nuclear force modernization program. In addition, the Defense Nuclear Agency will ensure the Services are aware of the technology base and analytical tools which are available to ensure survivability, security and safety of the theater nuclear force.

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6. MILESTONES:

FY 1983 a. Complete tests of advance storage concepts.

b. Complete Navy dispersal concept development for antisubmarine aircraft.

c. Complete ground launched cruise missile (GLCM) dispersal operations evaluation.

d. Develop concepts for dual capable aircraft dispersal options.

e. Complete concepts and requirements for theater nuclear force command, control and communications survivability improvements.

f. Initiate Pacific Command theater nuclear forces survivability, security and safety efforts.

FY 1984 a. Complete aircraft dispersal options development.

b. Complete survivability exercise planning for Pershing Survivability Evaluation and Verification Exercise (SAVE).

c. Initiate GLCM SAVE planning.

d. Complete ground wave propagation testing.

FY 1985 a. Conduct Pershing II Survivability Exercise.

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b. Complete support of U.S. Defense Research and Engineering tasking on "Acquisition of Nuclear Survivable and Enduring Systems."

c. Complete "Theater Nuclear Forces as a Deterrent" study.

	($ in Thousands)				
	FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7. RESOURCES: Theater Nuclear Forces Survivability, Security and Safety	8909	5131	6300	6900	Continuing

a. BASIS FOR FY 1984 REQUEST: The work accomplished in FY 1979 through FY 1983 was part of the baseline, prioritized program, developed in conjunction with the Services, the commanders-in-chief and the Office of the Secretary of Defense. In FY 1984 the prioritized program will continue, based on updated requirements and priorities from the Services. The changing peacetime threat, when balanced with operational (wartime) requirements, calls for new studies related to a survivable and enduring theater nuclear force. Critical survivability studies related to the deployment of both Pershing II and ground launched cruise missiles will continue, as these systems are fielded. Also, high priority Air Force studies (e.g., Dual Capable Aircraft) and Navy studies (Ship Hardening/Survivability) will progress towards Service implementation.

b. BASIS FOR CHANGES IN FY 1984 FROM FY 1983: In FY 1983, several key programs were directed toward transition to Service implementation. The emphasis of the overall program will begin to shift from safety and security to survivability. New studies related to the weapon storage vault (deployment planning), ship hardening, and support for weapon dispersal planning will be implemented. Support to the continuing development of the Corps Support Weapon System and related target acquisition system will be intensified.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: G — Title: Effects Simulation Using Simulators

Program Element #: 6.27.15.H — Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency — Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: Objective is to obtain nuclear weapons effects data by testing strategic and tactical weapons systems and their major components in laboratory simulation facilities. These effects include high-altitude electromagnetic pulse (EMP), system generated EMP (SGEMP), dispersed EMP (DEMP), transient radiation effects on electronics (TREE), thermomechanical shock (TMS), thermal radiation and fire. Where applicable, these simulators provide information for vulnerability assessments and nuclear hardness validations for a fraction of the cost of underground nuclear testing.

G. RELATED ACTIVITIES: Supports service requirements for nuclear weapons effects data to evaluate the nuclear survivability and hardness of all strategic, tactical and command, control, and communications (C^3) systems.

H. WORK PERFORMED BY:

1. Principal Department of Defense agencies include Field Command, Defense Nuclear Agency; Defense Communications Agency; United States Army Ballistic Research Laboratory; United States Army Harry Diamond Laboratories; United States Army Engineer Waterways Experiment Station; United States Army Natick Laboratories; Headquarters, United States Air Force; Air Force Ballistic Missile Office; Air Force Strategic Air Command; Air Force Logistics Command; Air Force Space Division; Air Force Weapons Laboratory; Naval Research Laboratory; Naval Surface Weapons Center; Navy Strategic Systems Project Office; Naval Air Systems Command; and Naval Electronics Command.

2. Contractors include Advanced Research Applications Corp.; The BDM Corp.; BENDIX Field Engineering; Boeing Aerospace Co.; Computer Sciences, Inc.; Digital Equipment Corp.; EG&G, Inc.; Electro-Magnetic Applications, Inc.; General Electric Co.;

Project #: G

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Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

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Grumman Aerospace Corp.; IRT Corp.; JAYCOR; Kaman Sciences Corp.; Los Alamos Technical Associates; Maxwell Laboratories, Inc.; Mission Research Corp.; ORI; Physics International Co.; Sandia Corp.; Science and Engineering Associates; Science Applications, Inc.; S-Cubed; Tech Rep, Inc.; and TRW Electronics and Defense Sector.

3. The educational institutions and non-profit organizations include the University of California, Lawrence Livermore National Laboratory, and Stanford Research Institute International.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS:

a. The advanced research electromagnetic simulator (ARES) provides a threat-level, electromagnetic pulse (EMP) environment. Users have included small to medium-sized aircraft, tactical and strategic missiles, and satellites. All major missile systems (e.g., MINUTEMAN, POSEIDON, and TRIDENT) have been successfully tested at ARES. An upgrade of the facility instrumentation system was completed in FY 1982 to prepare for upcoming M-X missile testing, scheduled for January-July 1983.

b. The AURORA gamma ray facility provides ionizing radiation over an approximate one cubic meter volume and lower intensities over larger volumes. This permits the testing of complete electronic subsystems. Users have included virtually every major weapons system requiring gamma ray testing of large areas. Major tests in FY 1982 were performed on M-X, Mark 11c, Defense Satellite Communications System (DSCS) II, as well as on several pieces of Army tactical army equipment. Planning began in FY 1982 to upgrade obsolete AURORA instrumentation.

c. The CASINO facility produces a X-ray environment for testing of small reentry vehicle electronic or material components to thermomechanical shock effects. Major tests conducted at CASINO in FY 1982 included TRIDENT I, M-X, and the Navy Standard Missile (SM-2) components. Efforts to increase the dose-area product to meet current and future requirements for higher fidelity testing was continued in FY 1982.

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d. The DNA Aircraft Electromagnetic Pulse (EMP) technology development program is refining an Assessment Methodology/ Technology procedure for DoD use. In FY 1982, preliminary assessment of the FB-111A aircraft, consisting of analytical evaluation, direct-drive current injection testing (black boxes) and Skin Current Injection Technique (SCIT) testing of the entire aircraft, was completed. Full-system testing of the Navy F-14A and AF FB-111A was also accomplished. Additionally, DNA initiated an Office of the Under Secretary of Defense for Research and Engineering (OUSDRE) tasked program, the DNA/Multi-Agency Cooperative EMP Hardening and Validation Technology Program, to address the issues associated with hardening strategic aircraft.

e. A continuous wave radiated test system was used in the baseline EMP assessment of three Hawaiian telecommunications facilities and in support of the Navy's TACAMO aircraft maintenance surveillance program.

f. Thermal radiation effects simulation (TRS) thermochemical source development was completed in FY 1981. This source was used on high explosive testing of the Army's Hardened Shelter, the Navy's model deckhouse and antennas, and a variety of equipment from the United Kingdom. A "22-lamp" nuclear pulse thermal simulator employing flashlamps was completed in FY 1982. Development of the Phase II system commenced in July 1982.

g. A parameter sensitivity study and development of a quasi-analytic firestorm model and compilation of a data base have been completed. Work on the framework for a computer simulation and the development of a fire vulnerability-numbers (VN) system was initiated.

h. Both the BLACKJACK 5 and PITHON laboratory X-ray radiation simulators were upgraded to accommodate anticipated user testing needs. Extensive instrumentation systems and facility modifications were retrofitted into existing facilities.

2. FY 1983 PROGRAM:

a. Final integration and operational checkout of the advanced research electromagnetic simulator (ARES) upgraded instrumentation system will be completed in the first quarter of FY 1983. The M-X missile is scheduled to arrive on-site November 1982, and the M-X missile test will be conducted from January-July 1983.

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b. The major users of the AURORA facility will be the Air Force Ballistic Missile Office (M-X) and the United States Army Harry Diamond Laboratories (tactical system generated electromagnetic pulse experiments). AURORA will be modified to produce ion and electron beams. The instrumentation upgrade program will be completed in January 1983.

c. The CASINO facility will continue to be used for testing M-X, TRIDENT I and II, and the Navy Standard Missile (SM-2) electronic and material components for thermomechanical shock effects.

d. Electromagnetic pulse (EMP) testing of the F/A-18 (pre-system level) aircraft and selected Marine and Army helicopters in the horizontal polarized dipole (HPD) simulator supplemented by direct-drive current injection will be completed. The refined assessment methodology will be expanded to include the latest state-of-the-art aircraft. The Joint Technology Program begun in FY 1982 will address issues associated with strategic aircraft hardening and develop plans for a test bed demonstration hardening program.

e. The software package supporting the continuous wave measurement system will be upgraded and finalized to facilitate analysis of EMP protection assessments.

f. The thermal radiation effects simulation (TRS) liquid oxygen (LOX) source at Kirtland Air Force Base will be used to expose various materials and equipment of the three Services and other government agencies as requirements are presented. Phase II Flash Lamp development will be completed in July 1983.

g. The development of fire vulnerability-numbers (VN) methodology and computer simulation structure will continue. A fuel bed survey and detailed experimental planning will be initiated. The application of tactical woodlands and collateral damage will commence.

h. Both the BLACKJACK 5 and PITHON laboratory radiation simulation facilities will be extensively used to support box-level X-ray radiation testing for M-X, TRIDENT, and MILSTAR programs. Materials and electronics components requiring high-dose

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and large-area output will be tested in these simulation facilities.

i. Action to assist the Navy in the development and implementation of its surface ship electromagnetic pulse (EMP) hardening program will be initiated. This effort will begin with environmental studies and continue through preliminary pulser design for the Navy's EMPRESS II simulator.

3. FY 1984 PLANNED PROGRAM:

a. No major users are positively identified for the advanced research electromagnetic simulator (ARES). If a test is not forthcoming, the pulser and antenna will be refurbished and the facility deactivated.

b. The major users of the AURORA facility will be the Harry Diamond Laboratories (tactical system generated EMP and source region EMP experiments) and a system-level ionization test on MILSTAR.

c. Major system users at CASINO are anticipated to be M-X and TRIDENT II for effects testing of inertial guidance subsets.

d. Full-system-level EMP testing of the state-of-the-art F/A-18 will be completed. Comparison of skin current injection technique (SCIT), large-scale model, and horizontal polarized dipole (HPD) test results of the FB-111A will be completed. Assessment methodology verification will be accomplished utilizing the F/A-18 test results.

e. The Phase II Flash Lamp facility will be moved to DNA's permanent Tri-Service Thermal Radiation Test Facility at Wright-Patterson Air Force Base.

f. The development of the vulnerability-numbers methodology will be completed and experiments conducted to test ignition and firespread models. Detailed computer simulations will be performed and generic test classification initiated. Tactical

Project #: G Title: Effects Simulation Using Simulators

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and collateral damage minimization application models will be completed.

g. Both the BLACKJACK 5 and PITHON laboratory radiation simulation facilities will continue to be made available to support M-X, TRIDENT and MILSTAR programs.

h. During FY 1984, the EMPRESS II pulser design will be finalized and the first pulser designed for the Navy.

4. FY 1985 PLANNED PROGRAM:

a. The ARES facility will be reactivated in the last quarter of FY 1985 to begin a low-level facility checkout. Full facility operation is planned for January 1986 to support an M-X missile operational in-flight test from April-September 1986.

b. AURORA, CASINO, and other radiation simulation facilities will continue to support users requiring gamma, X-ray, and electron-beam environments.

c. The aircraft electromagnetic pulse (EMP) assessment methodology will be completed and documented for all Department of Defense (DoD) users. Skin current injection technique (SCIT), as an alternate means of simulation for assessment/ methodology, hardness maintenance/surveillance and fleet verification, will be finalized. The joint technology program will continue to address issues associated with hardening strategic systems.

d. Specific target vulnerability numbers (VNs) will be developed, and detailed computer simulations to test integrated firestorm models will be performed. The thermal effects on sections of the EM-1 effects manual will be revised.

e. Support of the Navy surface ship EMP hardening program will continue by assisting as required in initial pulser integration into a barge-deployed simulator system.

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5. PROGRAM TO COMPLETION: Continuing program.

6. MILESTONES: There are no significant changes in milestones from the January 1982 submission except for those associated with the new ship systems EMP program and the alterations in the M-X basing mode.

FY 1983 Perform final acceptance checkout of instrumentation system and conduct an extensive six-month EMP test on the M-X missile at the advanced research electromagnetic simulator (ARES). Operate the AURORA and CASINO facilities to support user testing. Complete the upgrade of the AURORA instrumentation by providing new transient digitizers. Complete the FB-111A full-system-level testing in the vertical polarized dipole (VPD). Perform SCIT direct-drive and large-scale model measurement tests of the F/A-18. Start full-system-level test of the F/A-18. Field the Thermal Radiation Effects Simulation (TRS) liquid oxygen (LOX) on the DIRECT COURSE high explosive test in September 1983. Complete firestorm characterization and continue development of fire vulnerability-numbers (VN) methodology. Complete initial modifications at two existing laboratory radiation simulation facilities. Begin preliminary design of a pulser for a Navy ship system EMP and simulator.

FY 1984 Operate the advanced research electromagnetic simulator (ARES), AURORA, and CASINO in support of Service users. Complete F/A-18 full-system-level test on the horizontal polarized dipole (HPD) simulator. Complete and document the aircraft electromagnetic pulse (EMP) assessment methodology. Complete acquisition of hardware and integration at the two DNA West Coast laboratory radiation simulation facilities. Complete development of firestorm VN methodology and implement experiments to test firespread models. Complete final design and begin procurement of an electrical pulse generator for the Navy ship system EMP simulator.

FY 1985 Operate ARES, AURORA, CASINO, and the radiation research facility in support of Service users. Continue the joint technology program for EMP hardening of strategic systems. Initiate revision of the EM-1 effects manual. Continue detailed computer simulations and complete experimental phase of firestorm program. Deliver and integrate pulser into EMPRESS II barge-deployed simulator.

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		($ in Thousands)				
		FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7.	RESOURCES: Effects Simulation Using Radiation Simulators	19511	20905	29000	25800	Continuing

a. BASIS FOR FY 1984 REQUEST: These funds will be used both to operate and maintain existing simulators for nuclear weapons effects testing (50%) and to develop new capabilities and test methodologies for hardness assessment (50%).

b. BASIS FOR CHANGE IN FY 1984 FROM FY 1983: The increase in funding in FY 1984 is principally due to the start of hardware procurement to support the ship system EMP program. This is a major initiative undertaken in support of the Navy's new surface ship hardening program. DNA support through design and procurement of the EMPRESS II simulator, as well as development of methodology and criteria for surface ship hardening and assessment, are integral parts of the Navy program.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: H — Title: Effects Simulation Using High Explosives

Program Element #: 6.27.15.H — Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency — Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION:

1. Obtain nuclear weapons effects data through the use of large-scale high explosive field tests. Provides information which either cannot be obtained from underground nuclear tests or which would be more costly to obtain in that manner. High explosives can be used effectively to simulate certain aspects of nuclear phenomenology including airblast, ground and water shock, water waves, craters, ejecta, some aspects of dust clouds, and multiburst interaction effects.

2. High explosive simulations provide data necessary for evaluating the hardness of existing systems (both United States and foreign) and for the development of advanced design techniques for future systems such as the M-X system.

G. RELATED ACTIVITIES: Supports Service requirements for nuclear weapons effects data necesssary for both hardening and utilization of a number of strategic and tactical weapons systems and support systems.

H. WORK PERFORMED BY:

1. Principal Department of Defense (DoD) Agencies include Naval Sea Systems Command; Office of Naval Research, Naval Surface Weapons Center, Air Force Weapons Laboratory, Air Force Space Division, Army Ballistic Research Laboratories, U.S. Army Engineer Waterways Experiment Station, David W. Taylor Naval Ship R&D Center, and Army White Sands Missile Range.

2. Contractors include H-Tech Laboratories, Inc.; Geo-Centers, Inc.; Weidlinger Associates; Williamson Aircraft Company; Physics International Co.; S-Cubed; Kaman Sciences Corp.; Science Applications Inc.; Sandia Laboratories; Applied Theory, Inc.; Electromechanical Systems of New Mexico.

3. Educational institutions and non-profit organizations include University of California; University of New Mexico; Los Alamos National Laboratory/Lawrence Livermore National Laboratory; SRI International; and ITT Research Institute.

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Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS: Since the early sixties, DNA has maintained a large yield high explosives (HE) test program that has provided the Services with an HE-generated, 1 kiloton (KT) nuclear airblast equivalence series of tests. Through the years, prior to FY 1981, various experiments have been conducted for many major systems, among which have been MINUTEMAN, SANGUINE, M-X and SAFEGUARD. Army tactical vulnerability experiments have been fielded, as have experiments for agencies such as the Federal Emergency Mangement Agency (FEMA), the Defense Communications Agency (DCA) and the Defense Intelligence Agency (DIA). In September 1981, MILL RACE, the first major HE test in the MISTY CASTLE series, took place. This test was an HE simulation of a 1 KT nuclear airblast and supported requirements from all three Services, FEMA, and two allied countries. Preparations for PRE-DIRECT COURSE, a 25 ton height-of-burst (HOB) test, were completed in FY 1982. This test will provide a proof of capability test prior to the execution of the 600 ton HOB test DIRECT COURSE. Both PRE-DIRECT COURSE AND DIRECT COURSE support tactical systems requirements and will investigate the complex interaction of the airblast and the ground surface.

2. FY 1983 PROGRAM: PRE-DIRECT COURSE will be executed very early in FY 1983. Information will be obtained on airblast, ground motion and dust phenomenology specifically relating to the Mach and double Mach airblast region. Field construction for DIRECT COURSE (second large scale HE event in the MISTY CASTLE series) will be accomplished during February-August 1983. This will be a height-of-burst event with the 600 tons of ANFO being detonated at a height of 166 ft. DIRECT COURSE currently supports 150 Service and DoD experiments, plans for 1600 data channels and 150 technical cameras. The event is scheduled for September 1983.

3. FY 1984 PLANNED PROGRAM: Final reporting will be accomplished for the DIRECT COURSE event. Planning initiation for the 1985 MINOR SCALE HE event will be accomplished together with long-lead time items procurement. Continue instrumentation development for HE testing and provide instrumentation for the closely spaced basing testing program.

4. FY 1985 PLANNED PROGRAM: The MINOR SCALE event is scheduled for September 1985. This will be a larger than 1 KT simulation. Planning will commence for the September 1986 HE event.

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

Project #: H

Title: Effects Simulation Using High Explosives

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

6. MILESTONES:

FY 1983 DIRECT COURSE - Field construction April-August 1983. Detonate in September 1983.

FY 1984 MINOR SCALE - Institute field efforts September 1984.

FY 1985 MINOR SCALE - Field construction April-August 1985. Detonate in September 1985.

			($ in Thousands)		
	FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7. RESOURCES: Effects Simulation Using High Explosives	7658	7250	4900	9400	Continuing

a. BASIS FOR FY 1984 REQUEST: The FY 1984 request will evaluate the DIRECT COURSE event and initiate planning for the MINOR SCALE event. The DIRECT COURSE event is expected to provide data on non-ideal airblast with direct application to strategic targeting, provide information to the Army on the synergistic effects of blast and thermal on tactical targets such as the M1 tank and to provide specific blast damage information to the Services and other agencies such as FEMA and DOE.

b. BASIS FOR CHANGE IN FY 1984 FROM FY 1983: The funding decrease is due to no major high explosive test being conducted in FY 1984.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: I

Title: Effects Simulation Using Natural Disturbances

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION:

1. Objective is to use natural and artificial phenomena such as aurora and metal releases in the atmosphere as well as laboratory experiments to simulate important aspects of atmospheric conditions following nuclear detonations. The understanding gained of the plasma, infrared (IR) and other processes is applied to our models of nuclear weapons effects for system design and mitigation in High Altitude Phenomenology and Applications, Project B. In the absence of atmospheric nuclear testing, this approach is an essential source of critical data.

2. Objective is accomplished primarily through a series of atmospheric experiments. Solar induced disturbances are probed with satellite, space shuttle, rocket and ground based instrumentation to discern the IR chemistry processes and the effects on propagation of radio signals. Barium releases permit insight into the processes which create discontinuities or structure in the plasma created by an exoatmospheric nuclear detonation. This structure degrades radio signals and IR target acquisition. A planned uranium release into near space will permit the measurement of the spectra and brightness of its long wave IR emissions. Such emissions from weapon debris are predicted to create a severe infrared environment for numerous weapons systems. Similarly, high explosive tests lend insight into the propagation of radar signals through dust clouds lofted by surface or near surface nuclear detonations.

G. RELATED ACTIVITIES: Program supports service requirements for nuclear weapons effects data for application to a number of strategic weapons, communications, surveillance, and support systems:

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Project #: I Title: Effects Simulation Using Natural Disturbances

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

1. Systems whose communications performance in a nuclear environment have been evaluated using these data include Advanced Airborne Command Post (AABNCP), MILSTAR, Global Positioning System (GPS), and the Integrated Operational Nuclear Detection System (IONDS), the Defense Satellite Communications System (DSCS) and candidate adaptive high frequency (AHF) systems.

2. The in nuclear scenarios is assessed using infrared (IR) predictions based upon these data. The new will be tested against such predictions as well. The nuclear mission capability of space defense and ballistic missile defense concepts and design are assessed with predictions extrapolated from natural long wavelength infrared (LWIR) data.

H. WORK PERFORMED BY:

1. Principal Department of Defense agencies include Air Force Geophysics Laboratory; Harry Diamond Laboratories, Naval Sea Systems Command; Naval Research Laboratory; and Rome Air Development Command.

2. Contractors include Aerodyne Research, Inc.; General Electric Space Division; HSS, Inc.; Technology International Corp.; Mission Research Corp.; Photometrics; S-Cubed; Science Applications, Inc.; Information Science Inc.; Physical Dynamics Inc.; Sandia Laboratory; and Visidyne, Inc..

3. Educational institutions and nonprofit organizations include University of Alaska; Utah State University; University of California (Los Alamos National Laboratory); and SRI International.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS:

a. Intense stimulated IR emissions were measured by ground based, rocket, and airborne instrumentation. The

Project #: I Title: Effects Simulation Using Natural Disturbances

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data will permit identification and extrapolation to the nuclear case of the chemistry and photo efficiency of the infrared (IR) emissions. Nuclear induced emissions must be understood to determine their impact on the as well as the missions of space defense and ballistic missile defense (BMD) systems under consideration or development. Laboratory measurements were initiated to determine the long wavelength infrared (LWIR) characteristics of uranium oxides in sufficient BMD and space defense systems assessments. Data on scintillation of signals from very high frequency (VHF) throug super high frequency (SHF) were obtained through the DNA Wideband Satellite experiment and more recently in an equatorial cam paign which included rocket, radar and satellite measurements. These latter measurements successfully determined the structu of naturally occurring equatorial striations which form by mechanisms believed to dominate in late time nuclear environments. High altitude barium releases create striations similar to nuclear environments. The Position Location Communications Effects Simulation (PLACES) experiment tested spread spectrum systems used for navigation and antijam communication in the propagation environment of barium releases. This experiment also resolved the last remaining uncertainties in the radio propagation algorithms used in DNA satellite communication systems codes. Environment uncertainties now dominate overall prediction uncertainties in satellite communication. Simulators which scintillate satellite radio signals as they would be in nuclear environments have been developed. The Emergency Rocket Communication System (ERCS), the Integrated Operational Nuclear Detection System (IONDS), and the Defense Satellite Communication System (DSCS) AN/USC-28 receiver have been tested while receiving scintillated signals.

2. FY 1983 PROGRAM:

a. The joint DNA/United States Air Force EarthLimb Auroral Structures (ELIAS) experiment will be launched in February 1983 to gather data on the spatial variability of aurora infrared (IR) emissions

Incorporation of this information into nuclear IR models will greatly enhance the capability to assess the effectiveness A rocketborne experiment will measure the detailed spectra of the auroral emissions in the This experiment will permit identification of the radiating species and modeling of the temporal and spectral characteristics of nuclear emissions.

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b. There are no nuclear test data on radiation from weapons debris metal oxides. Laboratory efforts to measure the brightness and engineering development of a near space release technique for a measurement program will mature.

c. Design/fabrication will be completed for the DNA HILAT satellite borne experiment package in preparation for a June 83 launch. This experiment will investigate high latitude plasma structuring processes and complete the DNA natural disturbed ionospheric data base. A laboratory experiment will continue using laser pellet facilities to investigate the plasma structuring and debris transport processes that operate in the first second following a high altitude nuclear explosion. This experiment supports both scintillation and long wavelength (IR) radiation (LWIR) problems.

d. Experimental efforts in polar regions disturbed by solar proton events will provide much needed transverse electric (TE) mode very low frequency (VLF) transmission data and extremely low frequency (ELF) data. An aircraft will be instrumented to measure high frequency (HF) absorption

e. Laboratory measurements of metal oxide emission processes in the LWIR will continue, focusing on the potential of solar pumping to sustain LWIR emissions for extended periods after high altitude detonations.

3. FY 1984 PLANNED PROGRAM:

a.

The initial auroral experiment in the DNA program to satisfy these requirements will be SPIRIT, an earthlimb viewing auroral LWIR measurement rocketborne experiment.

b. The high latitude structure/scintillation satellite (HILAT) experiment will begin providing data. An experimental campaign will be conducted using radars and possibly rocket probes to complement HILAT. The data will be used to confirm and improve theoretical models of high latitude plasma structure processes. A laboratory early time nuclear plasma structuring and debris transport experiment will be continued; this experiment will gather data which will be used to improve nuclear predictive capabilities for communications and surveillance systems. Transverse electric (TE) very low frequency (VLF)

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and extremely low frequency (ELF) experiments in the polar regions disturbed by solar proton events will continue to provide transmission data. Analysis of data from the high frequency (HF) absorption experiment will be performed; information will be evaluated for adequacy or possible experiment improvements. Engineering tests of metal oxide release methods will be conducted and initial measurements of the resultant long wavelength infrared (LWIR) emissions will be acquired. The Rocketborne Electron Accelerator (EXCEDE) will be augmented to measure the infrared signatures of slow chemistry. Data gathering and experiments will continue using the HILAT satellite and ground diagnostics. The data will be used to upgrade both ambient and nuclear signal scintillation prediction models.

4. FY 1985 PLANNED PROGRAM: Ojective and thrust of FY 1984 will continue. The joint United States Air Force/Defense Nuclear Agency space shuttle experiment, Crygenic Infrared Radiance Instrumentation for Shuttle, (CIRRIS), will make synoptic measurements of the infrared (IR) signatures of the earth limb. This large data base which will include auroral measurement, will provide information on natural variability and will test our capability to model the ambient IR chemistry. This data base is necessary to extrapolate to nuclear enhanced chemistry.

5. PROGRAM TO COMPLETION: Continuing program.

6. MILESTONES:

FY 1983 Initiate link testing of the Gather initial data from HILAT satellite to support the development of a high latitude nuclear effects prediction capability which includes satellite beacon and magnetic measurements, aircraft, radar and possibly rocket probes of the disturbed ionosphere. Execute a second series of experiments using Inertial Confinement Fusion (ICF) facilities to investigate early time high altitude nuclear weapons effects. Complete initial uranium oxide laboratory of LWIR emissions. Conduct Very Low Frequency (VLF) propagation experiments. Conduct the Earth Limb Infrared Auroral Structure (ELIAS) experiment. Complete assembly and test of equipment for HF absorption experiment.

FY 1984 Complete payload definition for a Rocketborne Electron Accelerator (EXCEDE) experiment. Acquire the

Project #: I Title: Effects Simulation Using Natural Disturbances

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first measurements of long wavelength infrared (LWIR) emissions from aurorally disturbed atmosphere for application to nuclear effects codes. Complete the link testing of the Mobile Ground Terminals using the link simulator. Perform early time nuclear weapons effects experiments. Continue collection of HILAT satellite data.

FY 1985 Conduct the joint DNA/United States Air Force space shuttle experiment to measure spatial structure in excited atmosphere infrared (IR) emissions. Conduct Weapons Metal Oxide Release experiment to obtain infrared emission characteristics. Execute the high latitude structure experiment.

7. RESOURCES: Effects Simulation Using Natural Disturbances	($ in Thousands) FY 1982	FY 1983	FY 1984	FY 1985	COST COMPLETION
	11010	12426	13300	15200	Continuing

a. BASIS FOR FY 1984 REQUEST: The bases for the request are requirements to extend the satellite communications investigations to higher frequencies to further investigate nuclear effects on radio propagation, radar and laser systems and on space based infrared (IR) sensors. These investigations provide critical data for survivable design and evaluation of communications and surveillance systems that perform command, control, communications, and intelligence (C^3I) activities in support of the National Command Authority and strategic and theater nuclear force commanders. Effective C^3I activities in nuclear environments are central to force multiplier concepts.

b. BASIS FOR CHANGE IN FY 1984 FROM 1983: Additional emphasis will be placed on enhancing the technology base for predicting nuclear IR effects on LWIR systems and for predicting high latitude nuclear effects on communications/surveillance systems. This increase in emphasis is required to support the expanding mission and rapidly evolving technology for TRACE, weapons, and C^3I systems. These predictions will be used in the design and mission capability assessment of developing space and missile defense systems which use the LWIR for detection, and for developing communications/attack assessment systems. Critical high latitude communications links will be assessed and nuclear effects mitigation techniques developed. System test techniques/hardware are needed to validate survivability in nuclear environments.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: J Title: Underground Nuclear Tests

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: Underground nuclear weapons effects tests (NWET) are conducted by DNA in response to defense requirements for nuclear weapons effects information. The requirements are submitted annually by the Services and the Department of Energy (DOE) laboratories. The underground NWET program consists of a comprehensive series of test events specifically designed to obtain vital experimental information required for weapon system managers to develop nuclear systems with hardness and vulnerability characteristics necessary to achieve a viable defense system, and to validate the systems after they have been developed. Participation in each event in the NWET series is limited to the minimum essential to support relevant Department of Defense (DoD) missions. Thorough technical scrutiny of each requirement limits the NWET events to those experiments which cannot be satisfied by simulation techniques or calculational methods. Event testbed preparation and experimental techniques are closely monitored to identify possible methods of cost reduction. Underground test program emphasis has been on vulnerability and hardness

Testing of the their components and subsystems, to meet project milestones will continue to be of special emphasis in the future events.

G. RELATED ACTIVITIES: The underground NWET program also provides important source data for research on energy coupling, containment mechanisms, ground shock propagation, and amplitude yield scaling related to monitoring the extent of compliance with the Threshold Test Ban Treaty (TTBT).

H. WORK PERFORMED BY:

1. Principal Department of Defense (DoD) agencies include Air Force Ballistic Missile Office; Air Force Space Diviison; Air Force Weapons Laboratory; Harry Diamond Laboratories; Ballistic Missile Division; Naval Surface Weapons Center; and Defense Advanced Research Project Agency.

2. Contractors include Boeing Co.; Lockheed Missiles and Space Co.; Pacific Technology, Physics International Co.; Science Application, Inc.; S-Cubed, Inc.; Kaman Sciences Corp.; EG&G; JAYCOR; Bendix Field Engineering, Inc.; Pan Am; Reynolds Engineering Co.; General Electric Corp.; and Sandia Laboratories.

Project #: J Title: Underground Nuclear Tests

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

3. Educational institutions and non-profit organizations include Lawrence Livermore National Laboratory; Los Alamos National Laboratory; SRI International; and Aerospace Corp.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS: DNA has conducted eleven underground nuclear weapons effects tests in the HUSSAR SWORD series which began with HUSKY ACE in 1973. HURON KING, executed 24 June 1980, was the first DNA vertical line-of-sight (VLOS) since 1971. It provided a weapons effects test to determine the systems generated electromagnetic pulse reponse of the analysis and research satellite (STARSAT), a satellite similar to the Defense Satellite Communications System III (DSCS III). The MINERS IRON event, conducted 31 October 1980,

The latest in this series, HURON LANDING, conducted 23 September 1982, supported the final stages of development of the The emphasis was on the thermostructural response of booster components The first event of the DISTANT ARBOR series, DIAMOND ACE, was detonated concurrently with HURON LANDING. The thrust of DIAMOND ACE was to develop a potential source (device) for a low yield testbed. Test program planning emphasized the next two programmed events: (1) MINI JADE, a cavity event scheduled for April 1983, and (2) MIDAS MYTH, an test of the MK 21 reentry vehicle, scheduled for August 1983.

2. FY 1983 PROGRAM:

a. MINI JADE - Readiness Date: May 1983. This event is a cavity event to investigate energy coupling, ground motion, and cratering phenomenology.

b. MIDAS MYTH - Readiness Date: August 1983. This will be a HLOS test mainly to support the MK 21 (formerly called the Advanced Ballistic Reentry Vehicle) and Department of Energy Component Development.

c. MIDNIGHT ZEPHYR - Complete the testbed construction and conduct the event. (Readiness Date: August 1983). MIDNIGHT ZEPHYR is designed to continue the development of a low yield test capability. The success of this program will allow the fielding of smaller, less expensive UGT's on a more frequent and responsive basis.

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d. MISTY RAIN - Readiness Date: June 1984. Initial planning and construction for this event will start. This event will be a horizontal-line-of-sight (HLOS) test in continuing support of development, with some technology experiments also fielded.

e. MIGHTY OAK - Initial planning and test design for event MIGHTY OAK (Readiness Date: May 1985) will commence. This will be a HLOS test to complete the final verification of the and support development of the missile.

3. FY 1984 PLANNED PROGRAM:

a. MISTY RAIN - Complete the testbed and execute the event.

b. DIAMOND BEECH - Initial planning, design and testbed construction will begin for this event (Readiness Date: March 1985). DIAMOND BEECH will be primarily devoted to developing low yield tests. This is a follow-on to MIDNIGHT ZEPHYR.

c. MIGHTY OAK - Continue planning, experiment definition, test design, mining and initiate HLOS pipe and test chamber construction in preparation for a July 1985 readiness date.

d. MIDDLE NOTE - Initiate planning and testbed design for event MIDDLE NOTE (Readiness Date: July 1986) - This event is planned as a horizontal line-of-sight (HLOS) test to provide a validation test of the missile to SGEMP. As such, the test missile will be located in a large chamber adjacent to the HLOS; the will be provided by a scatterer placed internal to the evacuated line-of-sight pipe.

4. FY 1985 PLANNED PROGRAM:

a. DIAMOND BEECH - Testbed will be completed and the event conducted.

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Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

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b. MIGHTY OAK - Complete the testbed and execute the event.

c. MIDDLE NOTE - Continue planning, testbed design and mining, as well as initiate HLOS and test chamber construction.

d. MISSION CYBER - Definition and construct testbed (Readiness Date: September 1987). It will support development and DoE experiments.

e. MINERAL QUARRY - Efforts for this event (Readiness Date: September 1987) will consist of preliminary planning and test design for a HLOS test dedicated to advanced missile development, development, and DoE experimentation.

5. PROGRAM TO COMPLETION: Continuing program of investigating the effects of nuclear explosions. As different effects become significant or new weapons systems are developed underground nuclear tests are conducted to assess system survivability/vulnerability and validation. Non-nuclear simulation techniques will be used to the maximum extent feasible, but the limitations of current technology are such that it will not be possible to simulate all of the effects adequately in the foreseeable future.

6. MILESTONES: The milestones planned for FY 1983 and FY 1984 in this submission do differ significantly from those planned for the same years in the January 1981 submission.

FY 1983: a. MINI JADE: Testbed construction will start in October 1982. Construction and experiment emplacement will be finished by March 1983 to meet an May readiness date.

b. MISTY RAIN: Initial design efforts will start in January 1983, testbed construction commences in June 1983, and the HLOS pipe fabrication will begin in September 1983.

c. MIDAS MYTH: HLOS pipe construction will be started in January 1983. All testbed construction and experiment emplacement will be complete in July to support a test execution readiness in August 1983.

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d. MIDNIGHT ZEPHYR: Testbed construction will start in January 1983. All testbed construction will be completed by July to support a readiness date in August 1983.

e. MIDDLE NOTE: Initial design efforts will start in August 1983.

FY 1984: a. MISTY RAIN: Horizontal line-of-sight (HLOS) pipe construction will be started just prior to the beginning of this fiscal year. All testbed fabrication will be completed in August 1984 to support a readiness date in September 1984.

b. DIAMOND BEECH: Initial planning and design efforts will begin in April 1984 and the testbed construction will start in July 1984.

c. MIDDLE NOTE: Design and fielding activities will start in July 1984.

	($ in Thousands)				
	FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7. RESOURCES: Underground Nuclear Tests	66756	94265	99500	122300	Continuing

a. BASIS FOR FY 1984 REQUEST: Mining for the MISTY RAIN, DIAMOND BEECH events will be completed and HLOS construction finished. MISTY RAIN will be executed. Initial planning, testbed design and mining will be initiated for MIDDLE NOTE. Construction of the HLOS pipe will begin on MIGHTY OAK.

b. BASIS FOR CHANGE IN FY 1984 FROM 1983: The higher funding is due to an increase in the number of underground nuclear weapons effects tests as well as an increase in the complexity of planned events. The added test events are to support identified critical experiments in the areas of (1) systems development, such as responses of advanced missile materials and understanding and controlling system generated electromagnetic pulse (SGEMP), and (2) the investigation of nuclear weapons phenomenology, e.g., a cratering physics test. The increase in underground experimentation is multi-year funded beginning in FY 1983.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: L

Title: Laboratory Radiation Simulator Development

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: Objective is to develop above-ground nuclear weapon radiation effects testing capabilities using laboratory radiation sources. These simulators are used in support of the design, development and hardness testing of strategic weapons systems such as missiles, reentry vehicles, satellites and ground-based communications systems. The production of energetic X-rays in a laboratory environment requires the use of high-power (million volt, million amperes) pulsed electrical generators as energy sources driving radiation producing loads. Development of both advanced generators and more efficient radiation conversion techniques (source development) is conducted.

G. RELATED ACTIVITIES: Radiation testing of components and systems is also performed using underground nuclear tests (UGTs). Both types of testing are employed to validate military systems nuclear design hardness. Design of DNA radiation simulators is developed for facilitization in Project G, Effects Simulation Using Simulators.

H. WORK PERFORMED BY:

1. Principal Department of Defense agencies include the Air Force Weapons Laboratory; United States Army Harry Diamond Laboratories; and the Naval Research Laboratory.

2. Contractors include Advanced Research and Applications Corp.; IRT Corp.; JAYCOR, Inc.; Lockheed Palo Alto Research Laboratory; Maxwell Laboratories, Inc.; Physical Dynamics, Inc.; Physics International Co.; Pulsed Sciences, Inc.; R&D Associates; and S-Cubed.

Project #: L

Title: Laboratory Radiation Simulator Development

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

3. Educational institutions include the University of California (Lawrence Livermore National Laboratory and Irvine).

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS: In the past ten years, the quality and quantity of radiation output from laboratory radiation simulators have been increased dramatically. This can be attributed to the successful development of versatile high-power pulsed generators and enhanced knowledge of energy conversion kinetics. Energy output of pulsed generators have been increased an order of magnitude from the 1×10^{12} watts (one terawatt) range to 10×10^{12} watts (10 terawatts). This, coupled with improved conversion techniques, has provided the capability to produce large amounts of 100-kilovolt bremsstrahlung radiation and several kilovolt soft X-rays from cold plasma heating. Research and development continues to pursue technology to obtain higher power radiation yields through more energetic pulsed power sources. These advanced concepts include inductive storage devices (e.g., homopolar generators) and high-speed switching techniques (both opening and closing switches). In FY 1982, a large-area electron beam source was developed for thermal/structural response testing of large structures and work on a high-dose, large-area bremsstrahlung source was initiated. Both of these new sources offer an enhanced capability for nuclear weapons effects testing for DoD system development. Also in FY 1982, two transportable pulsed generators were built to support M-X ground basing experiments.

2. FY 1983 PROGRAM: An extensive program of X-ray testing of TRIDENT and M-X missile subsystems, as well as MILSTAR satellite electronics, will be conducted using both bremsstrahlung and soft X-ray sources. Attempts will be made to increase radiation yields by increasing the power delivered to radiative loads by more efficient switching. A high-energy density capacitor will be developed and subsequently used in an experimental capacitor bank to investigate advanced methods of high-energy switching. A two-module pulse generator test bed for high power requirements will be constructed for both technology and source development. The design of a fully convoluted coaxial pulser will commence in FY 1983. Development of inductive storage systems will continue. The homopolar generator will be modified to permit additional testing of electrical surge arrestors and other components. Additional research and development on the high-dose/large-area bremsstrahlung source will be carried out to optimize radiation output.

Project #: L

Title: Laboratory Radiation Simulator Development

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

3. FY 1984 PROGRAM: X-ray testing of TRIDENT, MILSTAR and M-X components and subsystems will continue using laboratory simulators. The modular pulsed generator test bed will be characterized with a plasma radiation source for soft X-ray production. The high-density capacitor bank will be used for fast switching development. Hardware procurement to implement the convoluted coaxial pulse line concept will be initiated. Design of a 10-megajoule homopolar generator will be initiated based on previous experimental work. Experimental efforts to enhance radiative outputs will continue with concentration on plasma radiation sources.

4. FY 1985 PLANNED PROGRAM: The modular pulsed generator test bed will be fully operational as a radiation simulator. A bremsstrahlung capability will be developed for fielding on this pulser in FY 1986. A radiation load will be fielded on the high-density capacitor bank using test switching techniques to perform pulse conditioning and pulse compression. Construction of the convoluted coaxial pulse line will commence in FY 1985 with a design goal of 20 terawatts (20×10^{12} watt). Construction of a 10-megajoule homopolar generator will commence. Source development efforts at elevated power levels to obtain more intense X-rays at low energies (1-10 keV) and larger dose area products at higher energies (100 kilovolts) will continue.

5. PROGRAM TO COMPLETION: Continuing program.

6. MILESTONES: Changes in milestones from the January 1982 submission are attributable to the tremendous increase in user testing support together with the concomitant decision not to pursue the development of a 30-terawatt (30×10^{12} watt), lower-risk, higher-power machine at this time.

FY 1983 Support user nuclear hardness and survivability radiation testing. Determine margins of safety in hardness for Defense Satellite Communications System (DSCS) III subsystems and electronic boxes. Test M-X guidance boxes to validate hardness. Test satellite optical sensors and components. Complete the development of a two-module pulsed generator system. Complete the optimization of a high-dose/large-area X-ray source. Complete the development of a high-intensity, large-area electron beam source for combined thermal/structural testing of reentry vehicles and missile systems.

FY 1984 Continue X-ray validation testing in support of TRIDENT II, DSCS III, MILSTAR and M-X. Continue X-ray validation

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testing of satellite optical sensors and components. Characterize the two-module pulsed generator system with a plasma radiator (soft X-ray) source. Begin the design and fabrication of a completely convoluted, high-power pulse generator. Begin experiments to demonstrate new methods of high-energy switching to provide pulse compression into radiative loads.

FY 1985 Continue X-ray validation testing in support of major system users, particularly MILSTAR and TRIDENT II. Complete the fabrication of a completely convoluted coaxial high-power pulsed generator. Begin the fabrication of a 10-megajoule inertial/inductive homopolar generator energy system. Begin experiments to increase the X-ray source capability utilizing newly developed high-energy switching advances.

	($ in Thousands)				
	FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7. RESOURCES: Laboratory Radiation Simulator Development	12534	19012	17400	20300	Continuing

a. BASIS FOR FY 1984 REQUEST: The FY 1984 request will predominantly (80%) support major system user nuclear hardness and survivability verification testing. The remaining 20 percent will be split between advanced technology development and X-ray source optimization.

b. BASIS FOR CHANGE IN FY 1984 FROM 1983: The decrease in FY 1984 is due to the fact that a major capital investment was made in FY 1983 to procure a two-module, high-power, pulsed generator system. No comparable hardware procurement is planned for FY 1984.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTION SUMMARY

Project #: M

Title: Biomedical Effects Research

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 Defense Nuclear Agency

Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION:

1. Provides data on the biological effects of nuclear weapons on the operational and medical aspects of military personnel. Responses of personnel to radiation and blast are determined, the basis for responses are investigated, and methods for modifying the responses are developed. Information obtained enables prediction of personnel combat task performance decrements and estimation of casualty and risk criteria related to weapon employment, provides means to prevent, delay or treat the medical effects of nuclear weapons, and defines the extent of long-term health effects related to low-level radiation exposures.

2. It is accomplished through experimental research programs, development of models for extrapolating laboratory results to expected operational impacts, and evaluation and analysis of limited human information on nuclear weapons effects. Experimental data are obtained using laboratory animal models ranging from cells through intact species subjected to simulated nuclear environments; these data form the basis for algorithms and mathematical models to predict the response of man as a function of task requirements and exposure conditions. Former Department of Defense participants in the 1945-1962 atmospheric nuclear tests are identified, their radiation doses determined, and the subsequent health experience of a significant number evaluated.

G. RELATED ACTIVITIES: Supports Service needs for information on the biological effects of nuclear weapon environments from the stockpile through employment sequence. Planning for military operations requires information on individual and unit performance degradation as a function of radiation dose, dose rate and quality, time after exposure, and task complexity. Medical support for exposed persons requires a means of determining the exposure type, other injuries and best therapeutic measures. Provides biological data and technology for operational and medical planning.

Project #: M

Title: Biomedical Effects Research

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 Defense Nuclear Agency

Budget Activity: #1 - Technology Base

H. WORK PERFORMED BY:

1. Principal DoD Laboratory is the Armed Forces Radiobiology Research Institute (AFRRI).

2. Contractors include Kaman-TEMPO, Science Applications, Inc., JRB Associates, JAYCOR, Reynolds Electrical and Engineering Co., Inc., and Advanced Research and Applications Corp., R&D Associates; Plessey Periphal Systems.

3. Educational institutions and nonprofit organizations include the Air Force School of Aerospace Medicine; the Nation[redacted] Academy of Sciences; National Research Council; the University of Utah; Dartmouth College; the University of Washington and the United States Air Force Academy; Oak Ridge National Laboratory and Brookhaven National Laboratory; Lovelace Biomedical and Environmental Research Institute, Inc.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS: Research was centered on defining radiation effects on individual performance capabilities, defining the basis of performance decrement, developing treatment regimens, and documenting involvement of DoD personnel in nuclear weapons testing. Simulated weapons radiation spectra was used to study the qualitative and quantitative response of animal models to acute radiation exposure. These results were combined with data from accidental human radiation exposures; and predictions of human incapacitation following acute radiation exposure were made. These predictions serve as the basis for current casualty and troop safety criteria on a nuclear battlefield. A study of radiation sickness symptoms that occur over time and at various dose levels was conducted. Investigations of neurochemical changes after radiation exposure identified several compounds that may be causative. Emphasis was placed on effects of radiation in combination with other battlefield stresses, particularly trauma and infections. Major research programs combining radiation exposure with infections and development of surgical procedures for irradiated casualties were begun. Medical care of irradiated casualties require early and accurate estimates of radiation exposure and biologic damage caused by the exposure. Development of battlefield deployable procedures for estimating hematopoietic (blood), gastrointestinal, and central nervous system damage were continued. Significant progress was made in understanding the blood forming process and bone marrow recovery. The estimated 220,000 DoD personnel that were involved in the 1945-1962 atmospheric testing of nuclear weapons are a continuing concern of the DoD and the Military Services. The participants have been identified and dose reconstructions have been made.

Project #: M Title: Biomedical Effects Research

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 Defense Nuclear Agency Budget Activity: #1 - Technology Base

Personnel identified as having received significant exposures have received medical examinations. Progress was made toward updating radiation doses of Japanese survivors at Hiroshima and Nagasaki. Research was continued into fallout phenomenology and application for both strategic and tactical scenarios. Research was continued into the basic physics of radiation transport. An educational program on the Medical Effects of Nuclear Weapons was expanded to include presentations to medical commands in Europe and the Pacific. Within the last two years the audience within the medical departments of the Military Services increased four-fold to 1200 medical personnel per year.

2. FY 1983 PROGRAM: The Military Services have identified requirements for information on the performance degrading effects of radiation exposure on individual and combat unit effectiveness. Appropriate animal models will be used to study physical and cognitive performance capabilities following acute radiation exposure. Emphasis will be placed on different quality radiations and lower doses than previously investigated. These data will be correlated with previously collated human experience data and formatted for insertion into available combat casualty prediction models. Survey data will be obtained from operational commanders concerning estimates of crew effectiveness when individuals of that crew are experiencing symptoms of acute radiation sickness. These estimates will be compared to previous data obtained on crews experiencing non-radiation-induced signs and symptoms. Research to update radiation dose estimation to survivors of Hiroshima and Nagasaki will address building transmission factors and fission product gammas by dose models. A capability for basic physics radiation transport will be developed. Engineering approaches to passive fallout defense for strategic military forces will be addressed in massive and lesser attack scenarios. The Services have defined requirements for studies of biologic effects encountered on the integrated battlefield. A formal program investigating the combination of chemical warfare agents and radiation exposure will be initiated. Estimates of the radioprotective capability of certain garments will be made. There is continuing requirement by the Military Services for accurate and rapid determination of the level of radiation exposure and the degree of biologic damage. Development of militarily relevant biologic radiation dosimetric techniques will continue. with the emphasis to be placed on field deployable systems and procedures. An appraisal of current doctrinal information on weapon effects available to the operational and medical commander will continue. Mechanisms of radiation-induced biologic damage to the hematopoietic, gastrointestinal, cardiovascular, and central nervous system will continue; as the understanding of these mechanisms provide the basis for accurate diagnosis, prompt treatment, and possible radioprotection. Major efforts will continue on the isolation of an immunologically competent hematopoietic precursor cell, which will greatly enhance the survivability of lower level radiation casualties exposed to lower levels of radiation. Radiation exposure leads to a compromise of the immune system leading to the extreme possibility of secondary and lethal infections. An expanded program investigating the role of infections in the irradiated casualty will be continued. The continued development of radioprotective drugs will lead to an investigation of the side effects of agents that have already been identified as radioprotectants. The incidence of leukemia and thyroid cancers among personnel exposed to fallout from nuclear weapon testing in Utah is being determined by epidemiological methods as well as from radionuclide deposition patterns in tissues.

Project #: M Title: Biomedical Effects Research

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 Defense Nuclear Agency Budget Activity: #1 - Technology Base

Various techniques are being evaluated to predict the intrinsic radiation (INRAD) levels associated with nuclear weapons. These determinations will enhance the radiation health programs in the use and storage of nuclear weapons. Medical follow-up will continue on the selected sample of DoD personnel involved in atmospheric nuclear testing to determine any long-term effects. Dose reconstructions will be collated with the history of personnel exposure in the nuclear weapons testing program. The educational program on the Medical Effects of Nuclear Weapons will continue to be offered to provide the operational commander and the medical departments of the Military Services with the latest information on the biomedical effects of nuclear weapons.

3. FY 1984 PLANNED PROGRAM: Research will emphasize evaluation of unit performance degradation, acute radiation sickness and the development of radioprotective agents that will mitigate the various radiation-induced deleterious effects. The exposure level will be lower than those previously studied, as the threshold for radiation-induced performance decrement is approached. Work on the determination of a reliable biological dosimeter and combined injuries will continue to be expanded. Doctrinal information regarding radiation effects and combined injuries will be made available to operational and medical commanders. Personnel exposed to fallout from nuclear weapon testing in Utah will be identified and preliminary data obtained to determine if there is a significant increase in leukemia or thyroid cancers. If there is an increase, correlation with radiation dose will be attempted. INRAD techniques will be completed and recommendations will be made to Services on how to best calculate INRAD doses for improved radiation safety in weapons handling and storage. Research will evaluate passive protection mechanisms for strategic military application. Radiation transport physics capabilities will be maintained. The histories of Department of Defense activities in the atmospheric nuclear tests will be completed, the reports will be published, and identification of participants and their doses will be near completion. The health experience survey of the sample will also be near completion.

4. FY 1985 PLANNED PROGRAM: The relation between chemical stresses and physical stress as they impact on military relevant situations will be investigated following irradiation. Efforts to enhance the immune system to counteract the infections following irradiation will be continued. These efforts will be combined with the continuing effort to provide effective radioprotectants to combat personnel. The medical follow-up on DoD personnel involved in atmospheric nuclear testing will continue. The modeling of individual and combat unit performance following irradiation will enter the validation phase as sensitivity analyses will be conducted using realistic scenarios.

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Title: Biomedical Effects Research

Program Element #: 6.2715.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 Defense Nuclear Agency

Budget Activity: #1 - Technology Base

Assessments on the role of fallout weapon tests in Utah on the incidence of leukemia and thyroid cancers will center on further delineating dose relationships and identifying the total population involved.

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

6. MILESTONES:

FY 1983

a. To quantify radiation-induced performance decrement at lower doses and different quality radiations.

b. Program on combat unit effectiveness using operationally significant situations.

c. Development phase of biological dosimetry using biochemical, biophysical and cytogenetic techniques.

d. The medical follow-up of DoD personnel involved in atmospheric nuclear testing.

e. Refine techniques for blood component preservation, precursor cell isolation, and bone marrow transplanation.

f. Implement program on radiation and chemical warfare agent interaction.

g. Initiate epidemiological studies on fallout on Utah and incidence of leukemia and thyroid cancer.

h. Initiate studies to evaluate INRAD techniques.

i. Expand the audience for the educational program on medical aspects of nuclear weapons.

Project #: M

Title: Biomedical Effects Research

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USDR&E Mission Area: #540 Defense Nuclear Agency

Budget Activity: #1 - Technology Base

j. Maintain radiation transport capabilities.

k. Radiation dose estimates for surviviors of Hiroshima and Nagasaki will be updated.

l. Address passive fallout defense in strategic military scenarios.

FY 1984

a. The long-range research program in radiobiology and continue to apply the newly acquired data to the problem of individual and unit combat effectiveness.

b. Develop appropriate animal models for the investigation of radiation and infectious disease process.

c. The program on combined injury due to chemical warfare agents and radiation.

d. Development of battlefield deployable physical and biologic dosimeters.

e. Investigate the role of radiation quality with respect to long-term biologic effects of current nuclear weapon operations.

f. The medical follow-up of DoD personnel involved in atmospheric nuclear weapons testing.

g. Screening alternative radioprotectants for effectiveness and toxicity.

h. Epidemiological study of Utah fallout and cancer induction.

i. Complete INRAD studies.

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Project #: M Title: Biomedical Effects Research

Program Element #: 6.2715.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 Defense Nuclear Agency Budget Activity: #1 - Technology Base

j. The educational program on medical aspects of nuclear weapon effects.

k. Maintain radiation transport capabilities.

FY 1985

a. Perform sensitivity analyses on unit and individual combat effectiveness models.

b. To provide technology base for accurate estimation of radiobiologic effects of nuclear weapons.

c. Toxicity and effectiveness studies of radioprotectants.

d. Complete health experience survey of DoD personnel involved in nuclear weapons testing.

e. Epidemiological studies on Utah fallout and cancer induction. Define population involved and dose relationships if appropriate.

f. Provide input on performance degradation due to combined injury into combat performance models.

g. Maintain radiation transportation capabilities.

h. Addressing passive fallout defense issues.

i. Complete updated radiation dose estimate program for Hiroshima and Nagasaki.

	($ in Thousands)				
	FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7. RESOURCES: Biomedical Effects Research	14423	15938	16700	17500	Continuing

Project #: M

Title: Biomedical Effects Research

Program Element #: 6.2715.H

Budget Activity: #1 - Technology Base

USDR&E Mission Area: #540 Defense Nuclear Agency

Budget Activity: #1 - Technology Base

a. BASIS FOR FY 1984 REQUEST: To support: (1) expansion of technology base for quantifying the effects of radiation, blast and thermal pulse on individual and unit combat effectiveness; (2) evaluation of techniques for diagnosis and treatment of injuries due to nuclear weapon related incidents; (3) development of procedures and equipment for accurate biologic and physical dosimetry and the continued development of possible radioprotectants; (4) medical evaluation of DoD personnel involved in atmospheric nuclear testing and provide radiobiologic data on long-term effects due to past and current nuclear weapons operations; (5) expand the educational program on the medical aspects of nuclear weapons; (6) upgrade of in-house DoD capability to provide radiobiologic research support to DoD and Military Services.

b. BASIS FOR CHANGE IN FY 1984 FORM FY 1983: This project remains essentially a level funded effort. However, a drawdown in radiobiology research support from agencies other than DoD has occured in the past several years. In light of a continuing requirement by the DoD and the Military Services for information on the biomedical effects of nuclear weapons phenomonom, there is an increased emphasis on in-house DoD research efforts as well as DoD supported contracting efforts.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: N

Program Element #: 6.27.15.H

OSDR&E Mission Area: #540 - Defense Nuclear Agency

Title: Tactical Systems Vulnerability and Hardening

Title: Defense Nuclear Agency (DNA)

Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: Objective is to enhance the capabilities of U.S. and Allied commanders to operate on the Integrated Battlefield. This goal will be satisfied by increasing the U.S. and Allied ability to plan the employment of nuclear forces and by identifying those improvements to the nuclear forces that will place enemy forces at increased risk. Provides an understanding of the capabilities of enemy conventional and nuclear forces which threaten Europe and Asia and to identify specific opportunities for countering these forces with conventional and nuclear firepower. By improving our understanding of nuclear weapon effects and integrating this data into improved nuclear planning techniques, the near real-time optimized attack of high leverage enemy targets can be accomplished while minimizing collateral damage. Alternative nuclear weapon systems are evaluated for their cost vis-a-vis effectiveness. Specific improvements to enhance effectiveness, responsiveness and survivability of the Allied and U.S. command, control, communications, and intelligence (C^3I) infrastructure supporting theater nuclear forces will be identified. Force modernization requirements and alternatives are assessed relative to the arms control implications of various negotiation options. In addition, direct analytical/research support on Strategic Arms Reduction Talks (START) and Intermediate-Range Nuclear Forces (INF) issues is provided to negotiating teams.

G. RELATED ACTIVITIES: Emphasizes research programs designed to directly support the requirements of U.S. and Allied theater commanders and numerous Department of Defense (DoD) activities; Office of the Assistant to the Secretary of Defense (Atomic Energy); Office of the Director, Net Assessment; Office of the Under Secretary of Defense for Research and Engineering; Special Assistant to the Secretary for North Atlantic Treaty Organization (NATO) Affairs; Joint Chiefs of Staff (JCS); the Defense Agencies; Departments of the Army, Navy, and Air Forces; Supreme Headquarters, Allied Powers Europe and all subordinate commands;

Project #: H

Program Element #: 6.27.15.H

USDR&E Mission Area: #540 - Defense Nuclear Agency

Title: Tactical Systems Vulnerability and Hardening

Title: Defense Nuclear Agency (DNA)

Budget Activity: #1 - Technology Base

U.S. European Command and all subordinate commands; U.S. Pacific Command; North Atlantic Treaty Organization (NATO) Nuclear Planning Group; and the Department of Energy. In addition to Department of Defense (DoD) and NATO activities, also supports the Federal Emergency Management Agency, Arms Control and Disarmament Agency, and the National Security Council. Utilizes nuclear weapon effects vulnerability and hardening data from other DNA research as it pertains to aircraft, missile systems, communications, command posts, battlefield equipment, ships, submarines and support bases.

H. WORK PERFORMED BY:

1. Principal DoD agencies include U.S. Army Ballistic Research Laboratory and Naval Surface Weapon Center.

2. Contractors include Cortana Corp.; The BDM Corp.; PALOMAR Corp.; Analytical Assessments Corp.; JAYCOR; Pacific-Sierra Research Corp.; R & D Associates; Science Applications, Inc.; S-Cubed; Arvin-Calspan; Sy Corp; Leon Sloss Associates, Inc.; TRW, Inc.; Systems Planning Corp.; Horizons Technology Inc.; ORI; Decision-Science Applications, Inc.; Titan Systems, Inc.; Harold Rosenbaum Associates; and Decisions and Designs, Inc.

3. Educational institutions and nonprofit organizations include University of California (Los Alamos National Laboratory/ Lawrence Livermore National Laboratory), Naval Post Graduate School, SRI International, and the Institute for Defense Analyses.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS: Prior research activity has been directed at an evaluation of alternative nuclear weapon systems, force mixes, nuclear weapon doctrines, arms control options and the development of planning aids for the employment of nuclear weapons. Comparisons of alternate missile and aircraft theater nuclear force postures has been provided. An analytical technique has been developed which will quantitatively assess the effectiveness of alternate nuclear weapon geographical distributions. Investigated the capabilities of U.S. theater forces to fight on the integrated battlefield. This research

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has quantitatively demonstrated the value of enhanced air-to-ground coordination and timely command/control in nuclear weapons employment. Addressed current fleet capabilities and the potential of advanced technology for fighting and enduring in maritime theater nuclear environment. Basic nuclear weapons effects related to the entire theater battlefield have received attention because of their importance to the planning or possible use and control of the theater nuclear weapons. Automated techniques have been developed to enable targeteers to plan in near real-time the employment of weapons against fixed installations and mobile forces. Research on force modernization and related arms control issues has taken on a major role in this project. Emphasis has been placed on those arms control/force modernization programs which impact significantly on nuclear weapon improvements for North Atlantic Treaty Organization (NATO), strategic force alternatives, and the conduct of current Strategic Arms Reduction Talks (START) and Intermediate-Range Nuclear Forces (INF) treaty negotiations.

2. FY 1983 PROGRAM: Will place emphasis on satisfying requirements of operational commanders and staff planners. Included will be the refinement of automated planning aids to assist in evaluating alternate force assessments and optimize the nuclear weapon environment. Soviet strategy, doctrine and future technological developments will be of concern as they impact U.S. and Allied doctrine, weapons allocations, force modernization requirements for nuclear weapons effects information.

Improved deployment of weapons, target acquisition requirements, preplanning and real-time nuclear weapon employment against high leverage mobile and fixed targets will be developed. The keystone of this effort is improving automated targeting tools for nuclear weapon planners. Incorporation of near real-time target location information will allow weapon employment against the optimum target. Particular attention will be directed to evaluating the capability of U.S. theater nuclear forces vis-a-vis the Soviet Union. This research will allow the identification of near-term and long-range improvements which should be made to land-based, maritime and airborne nuclear forces.

In addition, will investigate arms control issues with particular concern for force modernization activities that would allow for alternate force limitation approaches, and required direct support to ongoing negotiations. An important objective is to provide a more credible set of weapon effects information, particularly with regard to the vulnerability of enemy tactical systems, together with the appropriate methodologies for use in

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Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

targeting calculations. Will provide substantial support to Allied and U.S. commands to improve coordination of theater integrated operations for air, ground, and naval nuclear forces. Of equal importance is research aimed at improving integrated operations in nuclear, chemcial and conventional weapon environments.

Will also direct attention to enhancing the survivability and effectiveness of U.S. naval forces fighting in a nuclear environment.

3. FY 1984 PLANNING PROGRAM: Will pursue research that supports nuclear force modernization and enhancement of military effectiveness and force survivability in a combined conventional and nuclear warfare environment. This goal will continue to be supported by programs in the following areas:

a. The effects of nuclear weapon employment on enemy capabilities to improve our confidence in assigning vulnerability criteria to these forces.

b. The assessment of alternate weapon systems.

c. An identification of the technological and operational improvements required to support selected theater nuclear options.

d. The refinement of automated targeting techniques that will allow near real-time employment of nuclear weapons on the Integrated Battlefield.

e. The synthesis of nuclear weapons effects data in a form suitable for use by operational planners and training commands. Particular emphasis will be placed on integrating secondary effects.

f. The assessment of force modernization alternatives based on the impact of arms control initiatives with emphasis on direct support to Strategic Arms Reduction Talks (START) and Intermediate-Range Nuclear Forces (INF) negotiations.

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USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

4. FY 1985 PLANNED PROGRAM: Assist commanders and planners in determining how to use nuclear, chemical, and conventional weapon systems in concert to achieve the best military effects in an integrated battlefield/maritime engagement. Continue the identification and investigation of exploitable enemy vulnerabilities to nuclear weapons. Continue to conduct the research required in weapon effects that will enable planners to more effectively employ nuclear weapons to achieve their military objectives. Identify, develop, and assess technological advancements for the computer software necessary to optimize the near real-time employment of nuclear weapons in the prosecution of a war. In addition, identify and field test computer hardware and software that will enable planners to rapidly develop war plans or small unique options. Continue to assess the impact of arms control options on force modernization alternatives to ensure nuclear weapon improvements which support national security objectives.

5. PROGRAM TO COMPLETION: This program will be responsive to the requests and needs of the Commanders in Chief, Agencies, and U.S./North Atlantic Treaty Organization (NATO) elements discussed earlier in related activities.

6. MILESTONES:

FY 1983 a. Refinements to the automation of nuclear weapon employment planning process to allow near real-time targeting.

b. Recommendations for enhancing the effectiveness of U.S. naval forces fighting in a nuclear environment.

c. Definition of alternative methods of enhancing air-to-ground coordination of nuclear weapon usage on the battlefield.

d.

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Title: Defense Nuclear Agency

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Budget Activity: #1 - Technology Base

e. Development of optimum short- and mid-range Intermediate-Range Nuclear Forces (INF) system modernization requirements and resulting force mixes.

f. Assessment of U.S. nuclear forces vis-a-vis the Soviet Union considering force modernization/arms control initiatives of each side.

g. Provide weapon effects information as it relates to enemy tactical systems vulnerabilities.

h. Improvement of U.S. and Allied operations on the Integrated Battlefield.

FY 1984 a. Definition of alternate theater nuclear operational concepts.

b. Upgrade nuclear weapons effects data into employment planning tools.

c. Assessment of requirement for a nuclear Corps Support Weapon System (CSWS).

d. Recommendations for improving Pacific area nuclear weapon C^3 and targeting.

e. Synthesize secondary nuclear effects data for operational and training use.

f. Direct support to arms negotiations.

FY 1985 a. Support theater commanders in assessing capabilities/vulnerabilities and targeting of fixed and mobile targets.

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Title: Defense Nuclear Agency

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

b. Assessments of Soviet military forces, doctrine, and training.

c. Support to Services concerning tactical nuclear doctrine and force structure issues.

d. Assessments of force modernization/arms control issues and provide research and analysis support to negotiations as required.

	($ in Thousands)				COST TO
	FY 1982	FY 1983	FY 1984	FY 1985	COMPLETION
7. RESOURCES: Tactical Systems Vulnerability and Hardening	22709	24548	21900	21000	Continuing

a. BASIS FOR FY 1984 REQUEST: Major efforts include identification of means to enhance the capabilities of Allied military commanders to deter aggression and control escalation. This will be accomplished by assisting in the development of technological improvements and credible flexible response options to counter enemy threats and blunt attacks. Research and analysis in the area of automated targeting techniques, force modernization requirements, nuclear weapon effects, and arms control will contribute significantly to the achievement of U.S. national security objectives.

b. BASIS FOR CHANGE IN FY 1984 FROM FY 1985: The program will contain decreased effort directed to the development of real-time nuclear planning tools inasmuch as these automated techniques should be largely inhand by this date. On the other hand, increased emphasis will be directed to developing enduring command and control capabilities that are survivable in a nuclear environment. As a result, there is little change in the funding level of this program.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: 0 Title: Strategic Nuclear Implications and Assessments

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION:

1. Goals are to recommend alternative U.S. strategic weapon employment objectives; to provide increased understanding of the relationship between nuclear weapon effects and strategic nuclear employment objectives; and to develop techniques for planning the applications of nuclear weapons necessary to carry out national strategic objectives. These programs are specifically designed to allow for optimally implementing guidance cited in the Policy Guidance for Employment of Nuclear Weapons and the Joint Strategic Capabilities Plan Annex C-Nuclear. This research is responsive to increasing requests for technical data and information from the Office of the Secretary of Defense, Joint Chiefs of Staff (JCS), and the military services.

2. Specific issues identified for investigation include determining the effectiveness of nuclear weapon applications. Also, alternative strategic nuclear weapon employment policies and procedures will be evaluated vis-a-vis varying conflict durations as well as generated or degraded force postures. This research will examine an enhanced flexible planning capability that will provide the JCS and the nuclear Commanders in Chief with more flexible weapon employment options. Additional research efforts will examine the alternative uses of strategic nuclear forces against all aspects of the Soviet military force structure, political, governmental, and economic installations and activities in order to apply nuclear weapons most effectively. Finally, research efforts will also define target damage objectives and damage criteria in order to correctly apply nuclear weapons. The number of installations and activities which must be targeted by strategic nuclear forces demands computerized tools. These automated techniques must account for target priority, size, vulnerability, and adjacent installations as well as U.S. nuclear weapon systems characteristics.

Project #: 0 Title: Strategic Nuclear Implications and Assessments

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

G. RELATED ACTIVITIES: Directly related to Department of Defense (DoD) supported activities involving strategic nuclear weapon employment planning.

H. WORK PERFORMED BY:

1. Contractors include Science Applications, Inc.; TRW-Defense and Space Systems Group; LOGICON Inc.; IRT Corp.; BOEING Aerospace Co.; SRI Inc.; Systems Planning Corp.; and Leon Sloss Associates.

2. The nonprofit organization utilized is RAND Corp.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS: Results have provided strategic nuclear force planners with detailed assessments of U.S. and Soviet vulnerabilities resulting from extended nuclear conflict. These assessments have resulted in alternative employment options designed to increase flexibility in nuclear weapon employment planning. Essential force status information, minimum essential planning functions, and critical command and control elements necessary for near real-time retargeting of strategic nuclear forces were identified. A concept for a deployable, survivable nuclear targeting facility was developed. Alternative sensor systems for target acquisition and classification were developed. Computerized methods for the optimum application of nuclear weapons based on varying criteria, to various target data bases were provided to nuclear planners. An integrated nuclear exchange model was developed for use by the Joint Chiefs of Staff (JCS).

2. FY 1983 PROGRAM: Investigate alternative nuclear weapon employment policies, concommitant employment options, and synthesized consequences of the alternative employments. In addition, automated techniques for optimized weapon employment will be refined to incorporate new national guidance; and capabilities necessary for nuclear weapon employment in extended conflicts will be developed. The research will:

Project #: 0 Title: Strategic Nuclear Implications and Assessments

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

a. Examine the implications of protracted nuclear conflict on strategic nuclear force development, planning, and operations.

b. Determine enduring nuclear force requirements.

c. Complete concept development for a mobile, enduring targeting facility.

d. Refine analytical techniques for implementing flexible employment planning.

e. Develop analytical techniques describing the relationship between military targets and nuclear weapons effects.

f. Improve targeting and nuclear weapons allocation models to allow rapid development and evaluation of alternative weapons employments.

g. Postulate alternative attack scenarios to assess their impact upon U.S. strategic employment options and weapons requirements.

h. Examine the use of third world assets in an extended conflict.

i. Examine U.S. capability to target Soviet movable forces which have strategic implications.

j. Assist policymakers in the identification of strategic issues which impact the Nuclear Weapons Employment and Acquisition Master Plan (NWEAMP).

k. Identify potential strategic capabilities of third party countries and their potential impact on U.S. strategic planning.

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Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Area

3. FY 1984 PLANNED PROGRAM: Support is planned for Department of Defense (DoD) planners and decisionmakers on technical issues in nuclear weapon effects and alternative nuclear employment options. Specifically, research results will be directed to allow for optimally implementing guidance cited in the Policy Guidance for Employment of Nuclear Weapons and Joint Strategic Capabilities Plan Annex C - Nuclear. Specific examination of nuclear weapon effects technology for enduring strategic force requirements and nuclear weapons effects environments during protracted nuclear conflict will provide essential information. The long range theater nuclear forces on strategic planning will be specifically examined and provided as input for the 1984 Joint Strategic Capabilities Plan (JSCP) and Nuclear Weapons Employment and Acquisition Master Plan (NWEAMP).

4. FY 1985 PLANNED PROGRAM: To assist the Office of the Secretary of Defense/Net Assessment (OSD/NA) and Deputy Under Secretary of Defense for Policy Planning (DUSD/PP) in the identification, development, examination, and assessment of alternative nuclear weapon employment options and strategic nuclear force capabilities in support of national strategic employment planning requirements. Using increased technical knowledge from nuclear weapons research and nuclear weapons effects testing, the program will assess the impact on alternative options. Technological improvements in advanced automated planning support systems will provide national strategic policy decisionmakers with those critical factors which contribute to the deterrent posture and increased operational readiness, capabilities, and effectiveness of U.S. strategic nuclear forces.

5. PROGRAM TO COMPLETION: Will conduct the research needed to integrate nuclear weapons effects information into techniques for optimizing the application of strategic nuclear weapons. The project will continue until these methods are developed and appropriate results disseminated to nuclear weapons employment planners.

6. MILESTONES:

FY 1983 a. Assessment of factors designed to enhance strategic force endurance.

b. The evaluation to determine U.S. limited responses in limited conflict scenarios.

Project #: 0 Title: Strategic Nuclear Implications and Assessments

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

c. Complete preliminary design of a mobile survivable nuclear targeting facility to provide a prolonged nuclear weapon employment planning capability.

d. Development of a family of automated nuclear planning aids.

e. Examination of alternative concepts for use of national technical means to target systems.

FY 1984 a. Complete examination of extended warfare on strategic force development, operations, and employment planning.

b. Complete examination of use of national technical means in targeting systems.

c. Continue identification of requirements and capabilities required for survivable and enduring battle management and control systems.

d. Initiate a program to exploit newer automated techniques for optimization of Air Launched Cruise Missiles (ALCM)/TOMAHAWK Land Attack Missile (Nuclear)(TLAM(N))/Ground Launched Cruise Missile (GLCM) penetration when delivering nuclear weapons.

e. Initiate a program to explore newer automated techniques and man-machine interfaces necessary to enhance force effectiveness.

f. Identify the role of reserve forces in a post-nuclear exchange environment.

g. Develop alternative employment options for the Navy's TLAM(N) missile.

Project #: 0 Title: Strategic Nuclear Implications and Assessments

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

h. Evaluate the effectiveness of the strategic and nuclear reserve forces to meet prescribed and potential national objectives.

	($ in Thousands)				
	FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7. RESOURCES: Strategic Nuclear Implications and Assessments	4842	3588	3500	3600	Continuing

a. BASIS FOR FY 1984 RQUEST: Requirements from the Office of the Secretary of Defense (OSD) and Joint Chiefs of Staff (JCS). Particular emphasis is directed to investigating the impact of alternative forces mixes and strategies on achievement of national goals. In addition, support to the Strategic Air Command (SAC) and the Joint Strategic Target Planning Staff (JSTPS) in providing tools for their optimizing nuclear weapon employment is essential.

b. BASIS FOR CHANGE IN FY 1984 FROM 1983: The Policy Guidance for Employment of Nuclear Weapons has placed emphasis on requirement for enduring, survivable, and flexible strategic nuclear forces and supporting planning systems. The FY 1984 research program will significantly increase research associated with changes in national strategic policy and employment guidance. Decreased emphasis will be placed on developing vulnerability criteria for urban-industrial installations. Overall the program decreases slightly.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: P Title: Physical Security

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: Physical security of nuclear weapons is a critical element which is vital to United States national security interests. The DNA is designated by Department of Defense (DoD) Directive 3224.3, "Physical Security Equipment: Assignment of Responsibility for Research, Engineering, Procurement, Installation, and Maintenance," as the single authorized source within the DoD to initiate and fund exploratory research in support of Service requirements to safeguard these national resources. Traditional security philosophy and procedures historically focused on a covert threat posed by the terrorist, saboteur and espionage agent. Recent tests suggest

The above modus operandi could place Global acts of terrorism mandate an immediate and concentrated effort to upgrade nuclear weapons security. Constraints on manpower and dollars dictate the most efficient and prudent use of these resources to insure adequate security. Program direction continues to focus towards research efforts that provide scientific validation of standards and procedures which insure effective security. This optimum level of achievable security is pursued through test, evaluation and validation of concepts and begins with proper planning and interface design, the development of security hardware and materials, and must also include human behavioral factors. The performance of concepts and the redesigned system is validated through testing, which is the final task element. A successful research and development program enhances our nuclear security posture and can resist an expanded threat spectrum launched by a determined terrorist adversary.

G. RELATED ACTIVITIES: Supports all DoD and State activities concerned with the physical security of nuclear weapons, materials, chemical agents and public facilities. Joint research efforts of common interest to the Federal community in nuclear security are ongoing.

H. WORK PERFORMED BY:

1. DoD laboratories include Army Mobility Equipment Research and Development Command; Army Construction Engineering Research Laboratory; Army Electronics Research and Development Command; Army Corps of Engineers; Army Military Police School;

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Army Engineer Division, Europe; Army Engineering Waterways Experiment Station; Naval Surface Weapons Center, White Oak; Naval Ordnance Station, Indian Head; Naval Personnel Research and Development Center, San Diego; Air Force Office of Security Police; Air Force Systems Command, Rome Air Development Center; and the Air Force Electronics System Division.

2. Other Government agencies include: Department of State; Department of Commerce, National Bureau of Standards; Defense Supply Service; and the Central Intelligence Agency.

3. Civilian contractors include: GTE Sylvania; Technical Security Associates; Abbott Associates, Inc.; Household Data Systems, Inc.; Human Factors Research; Effects Technology, Inc.; and Sandia National Laboratory.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS: As the single manager for the Department of Defense (DoD) exploratory development program of physical security techniques and technology for the security of nuclear weapons, Service laboratories, academia, other Government agencies, and various commercial enterprises were funded within areas of human factors, security concepts and new technologies for improving the security of nuclear weapons. Some of the major efforts include:

a. Development of new operational concepts which could be used against a terrorist attack.

b. Investigation into the human factors areas of nuclear security personnel, such as vigilance, selection, training and motivation.

c. Design of several new storage facilities which use current day/future construction techniques and optimize/consider explosive safety, nuclear safety, security, operational considerations and defensive needs.

d. An automated site security monitor and response system was conceptually developed utilizing new technologies and data transmission capabilities.

e. Development of a Weapons Access Delay System (WADS), which consisted of current technology delay devices which could be installed in weapon storage areas.

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f. Fort McClellan, Alabama was selected for a Department of Defense (DoD) Security Operational Test Site and final design plans were prepared.

2. FY 1983 PROGRAM:

a. Investigation of the behavioral assessment of nuclear security personnel.

b. The furtherance of anticompromise emergency destruct technologies, and improvement in sensor signature data acquisition and evaluation methodologies which will enhance the detecting/deterring/defeating of intruders.

c. Construct and begin the operation of the Security Operational Test Site which will support the testing of nuclear security equipment and concepts.

d. Research into the feasibility of using fiber optics technology as a basis for a new low cost sensor for intrusion detection.

e. Investigation into composite barrier materials (steel, plexiglass, lexan, titanium, etc.) to determine the type of barrier materials which would constitute an appropriate deterrent against cutting by drill, power saw, torch, shape charge, gunfire and standoff weapons.

f. Develop advanced storage structures and perform testing to insure that the design will function as anticipated.

g. Develop an optimally configured hybrid entry control system.

h. Develop a computer site security monitoring and response system through the use of state-of-the-art computer based systems to enhance overall security of nuclear weapons.

Project #: P

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Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

3. FY 1984 PLANNED PROGRAM:

a. Assessing physiological and psychological effects on security forces.

b. Test newly developed security systems using fiber optics as a sensing device.

c. Record and analyze information passing through sensor communication networks of operational nuclear sites. Measure operational performance in existing systems in order that man related strengths and weaknesses of the system can be identified.

d. Develop a prototype hardware/software sensor system utilizing distributed microprocessor data processing, adaptive learning networks and fiber optic data links.

e. Provide testing equipment and continue development of the Security Operational Test Site at Fort McClellan, Alabama.

f. Develop technologies for intruder tagging and tracing.

g. Evaluate and test barrier composite materials against a standoff attack using Rocket Propelled Grenades (RPG's) or weapons with this type capability.

4. FY 1985 PLANNED PROGRAM: The effort for this fiscal year will be a continuation of the research, development, test and evaluation efforts planned for FY 1984. This effort will continue to have the goal of seeking ways to provide significantly better security for nuclear weapons while reducing the manpower, operational and maintenance costs required to secure them.

5. PROGRAM TO COMPLETION: Continuing program that works toward optimum security policies, procedures and criteria for the Department of Defense nuclear weapons arsenal and attempts to preclude the necessity for hastily organized programs. The ongoing program not only satisfies the requirement for near term modernization and security upgrade, but also provides a viable approach for performing the security function in the 1990's and beyond.

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Budget Activity: #1 - Technology Base

6. MILESTONES:

FY 1983 a. Complete the advanced storage structure design explosive tests; transfer the Anti-Compromise Emergency Destruction project to Advanced Engineering Development; and complete the exploratory development of a usable entry control system.

b. Complete the design and test the portable electret tape sensor.

c. Construct the Department of Defense (DoD) Security Operational Test Site and procure initial test equipment.

d. Complete the survey of Navy physical security occupation position requirements.

FY 1984 a. Develop the DoD Security Operational Test Site and procure test equipment.

b. Complete design and develop a simple-to-operate prototype Security System Operational Recording and Analysis (SSORA-3) system which can be employed by security personnel to objectively assess the state of equipment, personnel, environment and procedural factors that influence performance effectiveness. This system can also be used to track changes in the state of system effectiveness over time.

c. Field validate the design of an advanced electonic security system which utilizes three emerging technolgies -- artificial intelligence, distributed microprocessing and fiber optics data links.

d. Design new storage structures and automated material handling equipment. Build a prototype site using these new techniques.

e. Develop an ultrasonic sensor and a laser enhanced ionization detection device.

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Title: Defense Nuclear Agency (DNA)

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Budget Activity: #1 - Technology Base

FY 1985 a. Complete research in the development of a computerized site security monitoring and response system.

b. Plan for future operational testing of security equipment and concepts at the DoD Operational Test Site.

c. Procure equipment for a prototype GRIDNET system, a highly survivable, state-of-the-art, security systems communication net.

		($ in Thousands)				
		FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7.	RESOURCES: Physical Security	7838	8600	9200	9700	Continuing

a. BASIS FOR FY 1984 REQUEST: The FY 1984 request will support the sixth year of a comprehensive Department of Defense (DoD) research, development, test and evaluation (RDT&E) effort in nuclear security detection and deterrent systems; concept development; field experimentation and validation of the deterrent/detection systems; and continue research in increasing our technological development in such areas as materials, structures, barriers, and human behavioral factors.

b. BASIS FOR CHANGE IN FY 1984 FROM FY 1983: The FY-84 program represents no real growth over FY-83. Adequate resources are not being applied to the new storage structure technology techniques. Essentially, FY 1983 funded research projects will continue in FY-84 at near the same levels as approved by the Services in the Physical Security Equipment Action Group (PSEAG), with several new projects, to permit sufficient resources to be applied to the DoD Security Operational Test Site.

DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: S

Title: Strategic Structures Vulnerability and Hardening

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION:

1. Objective to explore vulnerability and hardening issues related to land and sea based strategic systems such as ICBM basing, secure reserve basing, advanced submarines and ships, and basing for cruise missiles and ballistic missile defense systems require an enhanced understanding of cratering, ejecta, airblast, ground shock, and at-sea environments resulting from nuclear detonations.

2. In the absence of atmospheric nuclear tests, information on nuclear weapons effects and their interaction with hardened structures will continue to be derived from theory, calculations, scaled laboratory experiments, high explosive tests, underground nuclear weapons effects tests and assessments of data gathered on previous atmospheric nuclear detonations. Improved understanding of nuclear cratering and blast pressure become more important because of continually improving accuracies in weapon delivery systems, increasing numbers of weapons with widely varying yields, and the growing diversity in targets of interest. Specific subjects being pursued include: resolution of the prediction of crater size; dynamic airblast; ejecta size and distribution; shock propagation through the ocean; the interaction of these effects with hardened structures; and the resulting structural behavior and internal equipment response.

G. RELATED ACTIVITIES: Service and other agency research and development for nuclear weapons effects information and support systems such as: New Land Based ICBM, upgrading for MINUTEMAN; naval vessels; ballistic missile defense and tactical nuclear weapons systems; and the similar foreign systems.

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Project #: S

Title: Strategic Structures Vulnerability and Hardening

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

H. WORK PERFORMED BY:

1. Principal Department of Defense Agencies include: Army Ballistic Research Laboratory; Army Engineer Waterways Experiment Station; Air Force Weapons Laboratory; Naval Research Laboratory; Naval Surface Weapons Center, White Oak; the David W. Taylor Naval Ship R&D Center; and the Naval Civil Engineering Laboratory.

2. Principal contractors include: Science Applications, Inc.; Physics International Co.; TRW Defense and Space Systems Group; Weidlinger Associates; S-Cubed; Terra Tek, Inc.; California Research and Technology; Lockheed Missiles and Space Co.; the Boeing Co.; Merritt CASES, Inc.; Sandia Laboratories; Physics Applications, Inc.; Applied Research Associates, Inc.; Applied Theory, Inc.; Aerospace Corporation; Tetra Corporation; H-Tech Laboratories, Inc.; and Agbabian Associates.

3. Educational institutions and nonprofit organizations include: The California Institute of Technology; the University of Miami; Los Alamos National Laboratory and Lawrence Livermore National Laboratory; SRI International; Southwest Research Institute; Denver Research Institute and the University of Illinois.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS:

a. Major support was provided to the Air Force on nuclear hardness and survivability (NH&S) aspects of the M-X weapon system full scale engineering development. The primary emphasis was on the definition of nuclear weapons effects design environments that form an envelope of plausible single and multiburst attack options; the acquisition of system hardening data for evolving a cost effective design; and the development of simulation and test techniques for system level validation.

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b. A joint program with the Army's Ballistic Missile Defense System Command (BMDSCOM) was continued to support the nuclear weapons effects environment definition for the ballistic missile defense (BMD) system.

c. Efforts were completed to quantify and reduce uncertainties in target specifications and vulnerability assessment methods. Blast tests of models of foreign hard targets, including missile silos and shallow buried structures were completed. Planning for combined airblast and crater related effects tests on hard targets was continued.

d. Work was directed at applying and extending existing water shock, water wave, and submerged structures technologies to both increase the survivability of submarines and to understand their vulnerability to nuclear weapon effects. Shock loading prediction methods developed for submarines were applied to the surface ship response problem in conjunction with the joint DNA-Navy underwater shock test of the USS ARKANSAS (CGN-41). The water shock and wave environments produced by nuclear explosions in shallow water were defined for application to vulnerability estimates of ships and submarines in port.

e. Structure media interaction computer codes were used in concert with test results to increase understanding of structural response, and to improve design procedures for facilities such as missile silos, command and control centers, and submarines. Related computational efforts included improving the understanding of cratering, blast and shock effects from nuclear weapons.

f. A simulation technique was developed for conducting underwater nuclear effects experiments against submarine models. Efforts were conducted to investigate new applications of existing simulation techniques to satisfy requirement of nuclear weapons effects on M-X basing systems.

Project #: S Title: Strategic Structures Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

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g. The "benchmark" cratering calculation was completed and interpretation of the revised empirical data base should result in a better understanding of the uncertainty in cratering predictions. Calculations to increase understanding of height-of-burst and geologic effects on cratering and related ground motions were continued.

h. A joint DNA/Navy/NATO experiment using high explosive charges was conducted to investigate acoustic reverberation in the eastern Atlantic. Planning for a joint DNA/Navy/NATO experiment was initiated to evaluate explosively induced acoustic reverberation in

2. FY 1983 PROGRAM:

a. Provide nuclear weapon effects (NWE) criteria to support the development of advanced silo hardening concepts for the M-X missile as well as the NWE environment and the nuclear hardening and survivability (NH&S) criteria for developing and evaluating the long-term M-X deep underground basing option. The state-of-art of tunneling technology from the underground nuclear test, Huron Landing, is being assessed in evaluating the constructability/survivability/hardenability of the deep basing concepts. Planning is commencing for a post-attack egress demonstration of a deeply buried facility.

b. The most advanced experimental and analytical methods are being used to improve hardness assessment techniques for analyzing This work is expected to reduce uncertainties in target specification and vulnerability assessment techniques.

c. Participation is continuing in the testing program conducted by the British Navy utilizing models of nuclear powered submarines. Greater emphasis is being placed on upgrading and validating existing analytical and in understanding the behavior of structural materials, damage mechanisms in structural assemblies, and the The submarine program is also utilizing the results of the accelerated naval surface ship vulnerability effort.

AD A125 228 JUSTIFICATION OF ESTIMATES FOR FISCAL YEAR 1984 SUBMITTED TO CONGRESS(U) OFFICE OF THE SECRETARY OF DEFENSE WASHINGTON DC JAN 83 5/6

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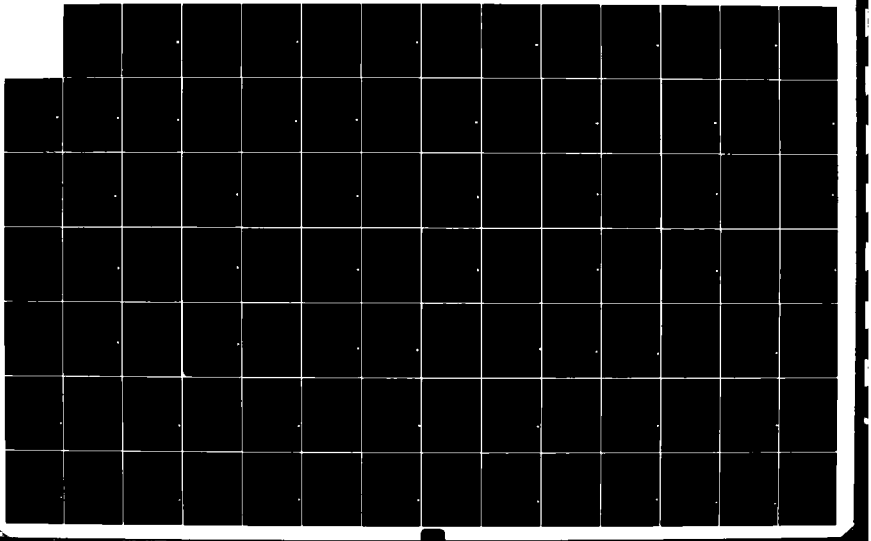

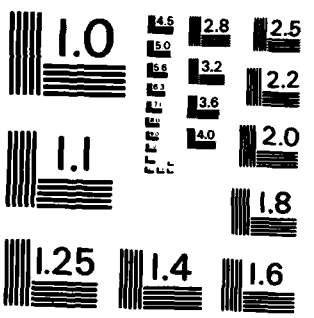

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USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

d. A combined theoretical and experimental program is being conducted to evaluate new prediction techniques for explosively induced ground motions. A large scale high explosive height-of-burst experiment is being conducted to provide data on dust sweep-up and lofting mechanisms for evaluation of
Cratering calculations to refine and verify the improved predictive techniques are continuing with emphasis being placed on obtaining additional experimental data. Planning of experiments for a dedicated underground nuclear test to verify improved calculational techniques will continue.

e. Data from the nuclear weapon effects (NWE) simulation development tests are being evaluated and the most promising techniques are being further developed and evaluated for large-scale structural testing application/validation of candidate M-X basing options. A technique to develop a 40 metric ton payload shock-testing generator is being developed.

f. Support of the nuclear environment definition for ballistic missile defense system structures is planned.

g. A long range acoustic reverberation (BLUEOUT) experiment is being conducted as a joint DNA/Navy/NATO experiment to evaluate the global effects of nuclear weapons on naval strategic systems. A critical evaluation of explosion generated water waves (Van Dorn effect) and the cavitation loading of ships is being conducted.

h. Dynamic measurements in structural backfill of airblast-induced ground shock for close-in structure vulnerability/survivability evaluation is being conducted and is being correlated with static laboratory data. An analytical method for comparing analytical waveforms is being developed along with strain path laboratory testing equipment.

i. Structural loading data is being collected on a variety of targets and applied to vulnerability assessments of hard target structures. A series of tests are being conducted on one-eighth scale missile silos in various geologies. Simulators for upstream airblast and cratering effects are being developed.

Project #: S Title: Stategic Structures Vulnerability and Hardening

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

3. FY 1984 PLANNED PROGRAM

a. In response to specific Secretary of Defense requirements, efforts will support the concept definition/validation program for a deep underground basing system for ICBM'S. Deep underground basing survivability at depth, egress techniques, endurance concepts, communication responsiveness, and site identification will be evaluated. This same information will be applicable to deep underground C^3 systems.

b. Missile silo component tests and complete silo tests will be conducted at about one-eighth scale in dry soil in support of closely spaced basing (CSB) of M-X. The tests will be used to examine the upper limits of hardening for missile silo concepts.

c. A one-fourth scale missile silo vulnerability test will be conducted to evaluate the combined effects of airblast, airblast-induced ground motion and cratering. Test data will be used to validate codes and scaling methods for developing advanced silo hardness concepts.

d. Controlled laboratory strain path tests will be conducted to determine in-situ material properties. Experiments to determine the horizontal stress in structure backfill and the simulation development for an airblast-induced horizontal motion concept will be completed.

e. Data from the underwater reverberation experiment will be used to calibrate and extend both the environmental and system computer models.

f. Airblast prediction procedures for nonideal environment data including thermal precursor and post-shock dust scouring will be developed.

Project #: S

Title: Strategic Structures Vulnerability and Hardening

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

g. Verification of underwater explosion-induced bubble loading, shadow and convergence zones will commence. Results from scale-model double hull submarines will be used to develop a damage rule. ships assessment modeling prediction and testing will continue.

h. Cratering calculations will continue and will provide support for the MISTY JADE test design.

4. FY 1985 PLANNED PROGRAM:

a. The deep underground basing concept definition/validation effort will continue. Parametric efforts to further define deep underground structures system environment, better understand the survivability of tunnels and tunnel liners, and in-situ tests using high explosives and underground nuclear tests will be initiated.

b. Crater and related effects tests in a wet and a dry geology to define free field effects will be performed.

c. The structural response of one-eighth and one-fourth scale missile silos will be tested in two different geologies with differing backfill conditions.

d. A height-of-burst experiment will be conducted to evaluate non-ideal effects on military targets and to resolve urban industrial targeting issues. A very large high explosive surface burst experiment will be conducted to evaluate the target response of aircraft to large yield weapons.

e. Strain path data base will be proved by performing controlled laboratory tests and fielding venting, burst and surface burst experiments.

f. Structural response of missile silos and components will be tested in support of M-X validation. The material properties of structural materials under intense, highly transient dynamic loads will be investigated.

Project #: S Title: Strategic Structures Vulnerability and Hardening

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g. An explosion generated water wave experiment will be conducted to determine the response of ships, submarines and harbor facilities Efforts will continue to evaluate the data from the underwater reverberation experiment and the results will be used to improve systems.

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

6. MILESTONES: There is no significant change in project milestones from January 1982 submission.

FY 1983 a. Evaluation of the M-X missile near surface and deep underground basing options.

b. Participation in British Navy's testing of submarines.

c. Conduct vulnerability tests on one-eighth scale missile basing systems.

d. Revise cratering prediction techniques and planning for underground test (UGT) verification.

e. Conduct acoustic reverberation experiments

f. Conduct height-of-burst (HOB) experiment for the high explosive event DIRECT COURSE.

g. Support environment definition and resulting loads on ballistic missile defense structures.

FY 1984 a. Support and evaluate the design, validation, planning and testing of the deep underground basing concept.

b. Program to verify underwater explosion-induced bubble loading and shadow convergence zones begins.

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USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

c. One-fourth scale basing system vulnerability test will be conducted.

d. Deep underground facility subsystems and system-level testing at prototype-like scale will commence.

e. Continue definition of nuclear environment on ballistic missile defense structures.

FY 1985 a. Large surface burst experiment designed.

b. Support of the deep basing program will continue.

c. Structural response of missile silos and components evaluated.

d. Venting burst and surface burst strain path experiments conducted.

e.

f. Early time cratering and ground shock phenomenololgy experiment conducted.

g.

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		($ in Thousands)				
		FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7.	RESOURCES: Strategic Structures Vulnerability and Hardening	21603	21229	21200	31200	Continuing

a. Basis for FY 1984 Request: The FY 1984 request will evaluate

The final preparation will be completed test. The airblast technology data base will be improved by developing sharp shock code techniques, the continued evaluation of dust phenomenology, and evaluating the airblast load in structures. The geologic material properties data base will be enhanced through material property testing and dynamic in-situ tests in backfill material. The cratering data base will be improved through the acquisition of empirical data in late-time motion experiments and geologic variations. The results of the underwater high explosive generated acoustic reverberation experiment will be used to provide the means to develop techniques to mitigate reverberation effects. Structure medium interaction codes will be refined and validated on surface ship and submarine models. The FY 1984 request will also provide information on energy coupling, attenuation, rubble, fracture zone, fault motion and evaluation of tunnel hardening techniques in support of the deep basing program.

b. Basis for Change in FY 1984 from FY 1983: The decrease in FY 1984 is based in the decision to delay the investigation of double mach flow fields on dusty surfaces and late time dust phenomena until FY 1985.

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DEFENSE NUCLEAR AGENCY

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #: V Title: Nuclear Effects on Electronics

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION:

1. Objective is to quantify nuclear effects on electronics and to provide the technology and other support required to harden and maintain the hardness of electronic systems.

2. Electronic assemblies are susceptible to interrupted operations, degraded performance or catastrophic failure when subjected to nuclear weapon radiation. Rapid evolution of semiconductor technology has generated new types of devices, new processing techniques and increased microminiaturization, all of which introduce new hardening problems.

3. Electromagnetic Pulse (EMP) and source region EMP (SREMP) effects result when large currents are induced on metallic elements of a system in the aftermath of a nuclear event. These currents can upset and/or permanently damage critical circuit elements.

4. The interaction of nuclear X-rays with materials throughout a system's structure produces System Generated EMP (SGEMP) effects. These SGEMP-induced currents and fields couple energy into the system electronics causing upset or burnout of key components.

G. RELATED ACTIVITIES: This program supports vulnerability and hardening programs for M-X, Ballistic Missile Defense Systems, TRIDENT D-5, LANCE and other missile programs, various early warning, communication, meteorological, navigational, and

surveillance satellite programs, several aeronautical systems, fighter/attack aircraft (A7E, F-14, F-16, et al), air and ground-launched cruise missiles, maneuvering reentry vehicles and Army tactical systems to include the Single Channel and Airborne Radio System.

H. WORK PERFORMED BY:

1. Principal DoD agencies include the Army Harry Diamond Laboratories; Air Force Rome Air Development Center; Air Force Weapons Laboratory; Naval Research Laboratory; Naval Surface Weapons Center; and Naval Weapons Support Center; the Air Force Space Division; Air Force Ballistic Missile Office; Naval Electronics Systems Command; Naval Air Test Center; Naval Weapons Evaluation Facility; and the Naval Ocean Systems Center.

2. Other government agencies include the National Bureau of Standards, the National Aeronautics and Space Administration Jet Propulsion Laboratory, and the National Security Agency.

3. Contractors include ARACOR; Beers Associates, Inc.; Boeing Corp.; Electro-Magnetic Applications, Inc.; General Electric Co.; Honeywell, Inc.; Hughes Aircraft Corp.; JAYCOR, Inc.; Kaman Sciences Corp.; Lockheed Missile and Space Corp.; LUTECH, Inc.; McDonnell Douglas Corp.; Maxwell Laboratories, Inc.; Mission Research Corp.; Physics International Co.; Pulse Sciences, Inc.; RCA; Rockwell International; Sandia National Laboratories; Science Applications, Inc.; Texas Instruments, Inc.; TRW Space & Defense Systems Group, Inc.; and Westinghouse Corp.

4. Educational institutions and nonprofit organizations include Auburn University; the University of California (Lawrence Livermore National Laboratory); Clemson University; University of Illinois; University of Indiana; University of Michigan; Mississippi State University; University of New Mexico; Yale University; and Stanford Research Institute International.

Project #: V

Title: Nuclear Effects on Electronics

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

I. PROGRAM ACCOMPLISHENTS AND FUTURE PROGRAMS:

1. FY 1982 AND PRIOR ACCOMPLISHMENTS:

a. Radiation Hardening of Electronics. Major accomplishments in FY 1982 were (1) development of a new radiation hard process in silicon on saphire (SOS) to manufacture 4K-bit random access memories (RAMs) and smaller scale integrated circuits to meet satellite radiation environments; (2) start of the DNA very high speed integrated circuit (VHSIC) program to support the DoD VHSIC Phase I program in meeting radiation requirements; (3) publication of radiation effects standard test methods by the Americ Society for Testing and Materials (ASTM) and Military Standard Procurement System; (4) development of an improved radiation hard process for long wave infrared detectors.

b. Electromagnetic Pulse (EMP). M-X efforts concentrated on planning and readiness for 1983 system design validation tests for both the missile and basing elements. Large-scale experiments were conducted to validate powerline and communication systems concepts utilizing specially developed high-energy source region EMP (SREMP) simulators. Predictions of the nuclear environments and the coupling of SREMP energy to long lines were refined and upgraded. Detailed calculations were provided for the EMP output of specific United States weapons. A program was initiated to develop new and improved high-energy electrical surge arrestors suitable for application in land-based Command, Communications and Control (C^3) systems. Engineering guidelines for the integration of fiber optic links into overall system EMP hardness designs were developed.

c. System Generated Electromagnetic Pulse (SGEMP). Research on SGEMP for missiles, satellites, and tactical systems was conducted. M-X hardware and the effects of high-altitude missile SGEMP were examined by experiments at several simulators. The SGEMP Test, Analysis, and Research Satellite (STARSAT) was tested at the and the AURORA facility. Tactical SGEMP experiments were conducted at the AURORA facility.

d. Source Region EMP (SREMP). In FY 1982, a new task was initiated to develop appropriate simulation facilities and test techniques to validate military systems to SREMP effects. This supported M-X, Ballistic Missile Defense Systems, and Army

Project #: V Title: Nuclear Effects on Electronics

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

Tactical Systems. This task addressed the definition of the SREMP threat environment, the investigation of candidate pulsed power technologies for transportable SREMP simulators, and the development of a test methodology for SREMP hardness validation.

2. FY 1983 PROGRAM:

a. Radiation Hardening of Electronics. Major emphasis is in five major project areas: (1) process development to support a wide variety of electronic memory and microprocessor devices hardened to nuclear radiation environments; (2) research into the physics of the radiation response in electronic devices; (3) investigation of the single event radiation effect phenomena; (4) continuation of the very high speed integrated circuits (VHSIC) program to provide improved radiation hardening; and (5) development of hardness assurance procedures for incorporation into the Military Standard Procurement System.

b. Electromagnetic Pulse (EMP). Validation tests of the M-X missile to both high-altitude EMP and other source region EMP (SREMP) effects will be conducted. Validation of baseline M-X power line and communications antenna designs will be accomplished to support a June 1983 basing System Design Review. A ship EMP response data base will be compiled to assist the Navy in developing protection and validation guidelines. New high-energy electrical surge arrestors will be fabricated and tested. A chapter on SREMP physics, interaction, protection, and hardness validation will be added to the DNA EMP Handbook.

c. System Generated EMP (SGEMP). Research will continue on high-altitude missile SGEMP including scale model missile experiments on the Underground Test (UGT). Tests of the M-X guidance and control electronics to internal SGEMP effects will be conducted. Satellite SGEMP research on precharged satellite response, weapon electron charging, and box effects will be continued. Preparation for a satellite SGEMP experiment including tests of electronic boxes at a laboratory X-ray facility, will be accomplished.

d. Source Region EMP (SREMP). The AURORA generator will provide a mixed scattered electron beam and high dose rate gamma-dot capability for SREMP testing of tactical Army systems. Proof-of-principle demonstrations of candidate pulsed power technologies for transportable SREMP testing applications will be initiated.

Project #: V

Title: Nuclear Effects on Electronics

Program Element #: 6.27.15.H

Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency

Budget Activity: #1 - Technology Base

3. FY 1984 PROGRAM:

a. Radiation Hardening of Electronics. Emphasis will continue in the five major project areas: (1) improved radiation hardening of memory and microprocessor devices; (2) research into the physics of radiation response of electronic devices; (3) developing methods of preventing single event upset; (4) continued support of the very high speed integrated circuits (VHSIC) program and preparation for VHSIC Phase II; (5) development of hardness assurance procedures for incorporation into the Military Standard Procurement System.

b. Electromagnetic Pulse (EMP). Data from the 1983 M-X design validation tests will be reduced and evaluated. Preparation will begin for full-scale validation tests of M-X. Higher energy, threat-level source region EMP (SREMP) simulators will be designed. General guidelines for hardening ground mobile systems and ships will be formulated. Development of improved tools for simulating tactical EMP environments will begin.

c. System Generated EMP (SGEMP). Planning for M-X system-level tests and reentry vehicle tests based on past underground tests (UGTs) and simulator experiments will be performed. The SGEMP Test, Analysis, and Research Satellite (STARSAT) will be tested in the UGT. Precharged satellite response will continue to be analyzed. The writing of a satellite design handbook will commence.

4. FY 1985 PROGRAM:

a. Radiation Hardening of Electronics. Support of the very high speed integrated circuits (VHSIC) program Phase II will begin. Added emphasis will be placed on submicron devices, and single event upset/burnout will be looked at.

b. Electromagnetic Pulse (EMP). Plans for the full-scale validation tests of M-X will be finalized. A prototype tactical EMP environment simulator will be developed. Plans for validating the hardening of ground mobile systems and ships will be initiated.

Project #: V Title: Nuclear Effects on Electronics

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

c. System Generated Electromagnetic Pulse (SGEMP). Missile and reentry vehicle SGEMP experiments and tests of M-X and reentry vehicle hardware will be conducted. Analysis of data from SGEMP experiment will be completed. Precharged satellite SGEMP experiments will be conducted. Planning for satellite center-body experiments at the BLACKJACK 5' facility will be initiated.

d. Source Region EMP (SREMP). The construction of the first module of the SREMP simulator will be completed and fielded to support testing of strategic and tactical subsystems.

5. PROGRAM TO COMPLETION: Continuing program.

6. MILESTONES: Changes in milestones from the last submission are attributable to the following factors: major increase in the Direct Interaction Effects of Electronics in support of the VHSIC initiative; major expansion of SREMP test definition and simulator development to support Army tactical needs; changes in the M-X basing mode and proposed Ballistic Missile Defense Systems.

FY 1983 Continue radiation hardening support of very high speed integrated circuits (VHSIC) program. Conduct SGEMP missile experiment Begin ship simulator development. Complete the source region electromagnetic (SREMP) handbook. Complete the improved high energy electrial surge arrestor development program. Continue development of transportable SREMP simulator and begin development of a test methodology for validation of strategic and tactical systems to SREMP effects. Support M-X design verification testing.

FY 1984 Continue radiation hardening support of VHSIC program. Conduct SGEMP satellite experiment Continue the construction of a transportable SREMP simulator.

FY 1985 Begin radiation hardening support of VHSIC Phase II. Begin drafting of satellite design handbook. Field first gamma-dot module of the SREMP simulator and conduct demonstration tests on military systems.

Project #: V Title: Nuclear Effects on Electronics

Program Element #: 6.27.15.H Title: Defense Nuclear Agency (DNA)

USDR&E Mission Area: #540 - Defense Nuclear Agency Budget Activity: #1 - Technology Base

testing and complete ship EMP hardening guidelines. Begin planning for full-system M-X validation testing.

	($ in Thousands)				
	FY 1982	FY 1983	FY 1984	FY 1985	COST TO COMPLETION
7. RESOURCES: Nuclear Effects on Electronics	19860	28163	30400	36100	Continuing

a. BASIS FOR BY 1984 REQUEST: The FY 1984 request will support hardening of electronic components and systems t[redacted] direct radiation effects, EMP, SGEMP, and SREMP. Approximately one-half of the total funding will support the direct radiation effects program with the remainder equally divided among the three other areas.

b. BASIS FOR CHANGE IN FY 1984 FROM FY 1983: The increase in funding in FY 1984, vice FY 1983, will be utilized to construct the first module of a transportable SREMP simulator and to expose a test satellite in the underground test.

RESEARCH, DEVELOPMENT, TEST AND EVALUATION DEFENSE AGENCIES

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

DEFENSE RECONNAISSANCE SUPPORT PROGRAM

FY 1984

JANUARY 1984

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE RECONNAISSANCE SUPPORT PROGRAM
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE AGENCIES

SUMMARY BY BUDGET ACTIVITY
($ in Thousands)

		FY 1982 ESTIMATE	FY 1983 ESTIMATE	FY 1984 ESTIMATE	FY 1985 ESTIMATE
5.0	Intelligence and Communications	27,463	130,200	477,900	
	Total Program	27,463	130,200	477,900	

SUMMARY BY PROGRAM CATEGORY

3.5	Operational Systems Development	27,463	130,200	477,900	
	Total Program	27,463	130,200	477,900	

DESCRIPTIVE SUMMARIES AND OTHER DETAILS ON DEFENSE RECONNAISSANCE SUPPORT PROGRAMS ARE NOT INCLUDED AS THEY REQUIRE SPECIAL ACCESS.

RESEARCH, DEVELOPMENT, TEST AND EVALUATION DEFENSE AGENCIES

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

DEFENSE COMMUNICATIONS AGENCY

FY 1984

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DEFENSE COMMUNICATIONS AGENCY

PROGRAM ELEMENT DESCRIPTIVE SUMMARIES
INTRODUCTION AND EXPLANATION OF CONTENTS

PROGRAM ELEMENT	REMARKS
BUDGET ACTIVITY 2: ADVANCED TECHNOLOGY DEVELOPMENT	
35103K Command and Control Research	New program element proposed for FY 1984
BUDGET ACTIVITY 3: STRATEGIC PROGRAMS	
32016K National Military Command System-Wide Support 32017K Worldwide Military Command & Control System (WWMCCS) ADP-ITSA 32019K WWMCCS System Engineer 33131K Minimum Essential Emergency Communications Network 53735K Worldwide Military Command & Control System (WWMCCS) Architecture	All Program Elements in Budget Activity 3 are continuing programs and were last funded in FY 1983
BUDGET ACTIVITY 4: TACTICAL PROGRAMS	
21135K CINC Command and Control Initiatives	Existing program element for effort last funded in FY 1983
BUDGET ACTIVITY 5: INTELLIGENCE AND COMMUNICATIONS	
33126K Long-Haul Communications (DCS) 33127K Support of NCS	All Program Elements in Budget Activity 5 are continuing programs and were last funded in FY 1983.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Elements: 35108K
USDR&E Mission Area: Multi-Mission, Technology and Support #360

Title: Command and Control Research
Budget Activity: #2 Advanced Technology

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Total Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	0	2,000	2,500	Continuing	Continuing
3700	Joint Command and Control Research	0	0	2,000	2,500	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element supports basic research into emerging technologies, methodologies, and theories of military command and control (C^2) and the application of research results on the problems of C^2 associated with joint operations. Analysis of the current U.S./Soviet balance in command and control indicates the Soviets are better prepared to exercise effective C^2 over their forces, partly the result of greater Soviet emphasis on research into the theoretical foundations of military command and control. In response to this imbalance, the Deputy Secretary of Defense has approved the initiation of a C^2 research program and center at and in association with the Naval Postgraduate School located in Monterey, California, to develop C^2 as an intellectual discipline and science. Locating the center and research program at the Naval Postgraduate School will allow access to the intellectual resources of a faculty experienced in the application of advanced technology to military problems, participation of the school's graduate student body in research activities, and utilization of the institution's physical resources.

C. BASIS FOR FY 1984 RDT&E REQUEST: A joint command and control research program is required to fulfill a longstanding need for basic and applied research into military command and control. The FY 1984 budget request will support the initial development of basic conceptual frameworks, improved methodologies for the quantitative evaluation and analysis of C^2 wargaming, computer based simulations for hypotheses testing, and methodologies for assessing the C^2 balance of the U.S. against potential adversaries. The main thrust of the program is on the application of research results from many diverse academic areas (e.g. Cybernetics, Control Theory, Artificial Intelligence, Theory of Combat, etc.) to the problems of C^2 from the major operating commands to the operational elements.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: This is a new program with C^2 research efforts beginning in FY 1984.

E. OTHER APPROPRIATION FUNDS: None.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 32016K
DoD Mission Area: Strategic Command and Control #331

Title: NMCS-Wide Support
Budget Activity: Strategic Program #3

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	Total FY 1985 Estimate	Additional To Completion	Estimated Cost
2621	NMCS Systems Engineering	1558	1206	612	996	Continuing	N/A
2622	NMCS Command Center Engineering	1881	2759	2214	2115	Continuing	N/A
2623	NMCS Subsystem Engineering	2638	3666	3250	3221	Continuing	N/A
2624	WWMCCS/NMCS Exercise & Evaluation	407	275	820	788	Continuing	N/A
	TOTAL FOR PROGRAM ELEMENT	6484	7906	6896	7120		

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides system engineering and technical support to the National Military Command System (NMCS), the priority component of the Worldwide Military Command and Control System (WWMCCS), designed to meet the command and control requirements of the National Command Authorities (NCA) and the Joint Chiefs of Staff (JCS). The NMCS provides the NCA with information concerning military posture, readiness, and activities in all environments from normal day-to-day operations to nuclear war and crisis management situations.

C. BASIS FOR FY 1984 RDT&E REQUEST: For FY83 and after, this program element is comprised of four projects. NMCS Systems Engineering provides the basic overall systems engineering support for the development and integration of NMCS system requirements, studies, and analysis and for planning and programming evolutionary improvements for the NMCS. Command Center Engineering supports the system engineering responsibilities of the Defense Communications Agency (DCA), Command and Control Technical Center (CCTC) for the NMCC, ANMCC, and NEACP,to develop concepts and requirements and provide subsystems engineering support. WWMCCS/NMCS Exercise and Evaluation supports OJCS exercises, testing of WWMCCS/NMCS functional processes, command post training exercises, and special studies directed at providing performance and evaluation data about the NMCS and selected portions of the WWMCCS. NMCS Subsystem Engineering provides system engineering, design, and development support necessary to improve the flow of Tactical Warning and Attack Assessment (TW/AA) information to high level decision makers, and provides for the near-term systematic engineering development of data collection and processing equipment for the NMCS.

Program Element: 32016K
DoD Mission Area: Strategic Command and Control #331

Title: NMCS-Wide Support
Budget Activity: Strategic Program #3

D. COMPARISON WITH FY83 DESCRIPTIVE SUMMARY: This PE shows a net decrease of 1010K from FY83 to FY84 due to transfer of funds to other higher priority efforts in strategic connectivity projects.

E. OTHER APPROPRIATION FUNDS: ($ in Thousands)

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
Operation and Maintenance		4343	4559	5060

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FY 1982 RDT&E DESCRIPTIVE SUMMARY

Program Element: 32017K
DoD Mission Area: Strategic Information Systems #334

Title: WWMCCS ADP-JTSA
Budget Activity: Strategic Programs #3

A. RESURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional To Completion	Total Estimated Cost
2777	Systems Research and Engineering	5138	2819	1122	1121	Continuing	N/A
2778	WIS Transition Support	607	11371	0	0	0	
2779	R&D in New WWMCCS ADP Applications	7038	6302	6893	1517	Continuing	N/A
2780	Advanced Concepts	2093	2863	0	0	0	
	TOTAL FOR PROGRAM ELEMENT	14876	23355	8015	2638		

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides technical assistance to the Organization of the Joint Chiefs of Staff, Military Departments, Defense Agencies, NATO, Air Force Major Commands and the Unified and Specified Commanders for Standard ADP Systems supporting the Worldwide Military Command and Control System (WWMCCS). The program element consists of four projects. The first project, Systems Research and Engineering, develops amd improves upon the integrated ADP system which supports the command and control functions of the National Command Authorities and the WWMCCS Commanders. The WIS Transition Support project assists the WIS Program Manager to prepare for and bring about a major system-wide modernization and includes the WIS Command Information Subsystem task which implements Phase II of the WIS Plan by providing a common user interface, local network and message handling capability for transition to the WIS. The third project, R&D in New Applications explores new uses of ADP to support command and control through improved information management and presentation. The fourth project, Advanced Concepts, explores the latest state-of-the-art technology in software/hardware computer security design, performance measurements and modeling, and advanced network-accessed graphics for use in supporting the implementation of the new WWMCCS Information System topology.

C. BASIS FOR FY 1984 RDT&E REQUEST: Funding for the WIS Transition Support and Advanced Concepts projects will be transferred to the Air Force WIS Joint Program Manager (JPM) in FY 1984. Funding will be required for the two remaining active projects. The Systems Research and Engineering project will continue to develop enhancements to the utility and reliability of the WWMCCS Intercomputer Network (WIN). The R&D in New WWMCCS ADP Applications project will identify and demonstrate new ways to improve ADP support in the performance of WWMCCS functions during crisis.

Program Element: 32017K
DoD Mission Area: Strategic Information Systems #334

Title: WWMCCS ADP-JTSA
Budget Activity: Strategic Programs #3

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: The FY 1984 project structure is identical to that carried in the FY 1983 Descriptive Summary. However, as mentioned above, two of the four projects are no longer funded by PE 32017K in FY 1984.

E. OTHER APPROPRIATION FUNDS: ($ in Thousands)

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
Procurement	2938	1040	8045	780
Operation and Maintenance	9629	11580	17154	16615

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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Elements: 32019K
USDR&E Mission Area: Strategic C2 - #331

Title: WWMCCS System Engineering
Budget Activity: #3 Strategic Programs

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Addtional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	48,747	42,759	36,549	31,829	Continuing	Continuing
2910	WWMCCS System Engineering	1,946	2,920	893	930	Continuing	Continuing
2920	Enhanced C^3 Survivability and Endurance	29,142	27,954	20,519	15,525	Continuing	Continuing
3000	MILSATCOM Systems	0	0	2,773	2,730	Continuing	Continuing
3310	C^3 System Engineering	9,443	10,335	10,369	10,609	Continuing	Continuing
3330	NATO C^2 Engineering	0	0	331	345	Continuing	Continuing
3350	Post-Attack Architecture	1,650	1,550	1,664	1,690	Continuing	Continuing
3380	Next Generation WWMCCS ADP	6,566	0	0	0	0	0

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element supports the Worldwide Military Command and Control System (WWMCCS) which provides the President, Secretary of Defense and senior military commanders with essential information pertaining to the need for action by U.S. military forces, and disseminates their decisions and orders to those forces. The program was established by the Deputy Secretary of Defense in 1976 to achieve new Command and Control capabilities and to provide continuing improvements to the WWMCCS. In 1978, the WWMCCS Council initiated efforts in survivability and endurability. To effect improvements, the Defense Communications Agency (DCA) retains the responsibility for ensuring overall program integration through implementation engineering and system planning.

C. BASIS FOR FY 1984 RDT&E REQUEST: DCA technically guides, monitors, assists, and advises the responsible components, OJCS, DUSD (C^3I) and other Defense Agencies on Command, Control and Communications (C^3) related matters. In this capacity, DCA will continue to guide the implementation of near-term WWMCCS improvements and to plan overall C^3 system improvements through engineering and programmatic analysis, promulgation of system planning documents, requirement analysis and definition, system integration and interoperability studies, and development of performance measurement parameters.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: Two new projects are identified as beginning in FY 1984. The NATO C^2 Engineering Project was formerly included within Project 3310, C^3 System Engineering. The NATO work is segregated into

its own project to provide visibility to this effort as emphasis is placed on this critical C^3 work. Also, Project 3000, MILSATCOM Systems is added to Program Element 32019K. This work was formerly identified in Program Element 33126K, Long Haul Communications. It is moved to reflect realignment of functions within DCA, and to move accounting of the functions into a C^3 program element.

E. OTHER APPROPRIATION FUNDS:

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate
Procurement	34	0	0
Operations and Maintenance	3,923	8,135	8,570

Project: 2910
Program Element: 32019K
DoD Mission Area: #331

Title: WWMCCS Engineering
Title: WWMCCS System Engineering
Budget Activity: Strategic Programs #3

F. DETAILED BACKGROUND AND DESCRIPTION: Provides the development of system-level specifications, technical support to WWMCCS field nodes, and special studies of Command, Control and Communications (C^3) problems and issues. These system engineering, planning, and field engineering efforts are required by the Defense Communications Agency (DCA) in order to fulfill its responsibility for technically guiding the implementation of new WWMCCS capabilities and directing the evolution of the WWMCCS. System engineering responsibilities for the WWMCCS are segregated into the areas of near/mid-term improvements and long-range planning. This project guides the implementation of new WWMCCS capabilities and performs the required engineering studies and analyses which are directed toward 1980's near/mid-term WWMCCS improvements. It also provides engineering support to field WWMCCS nodes directed toward early WWMCCS improvements. These efforts permit DCA to formulate rational guidance for improvement of the WWMCCS and to support implementation of increased capabilities.

G. RELATED ACTIVITIES: This project is related to other on-going projects such as the Defense Communication System, WWMCCS Information System (WIS) and the CINC C^3 Initiative Program.

H. WORK PERFOMED BY: TRW, CSC, and ESI.

I. PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: The WWMCCS Current System Description (CSD) first edition was published in FY 80. It described all major nodes except for the Defense Agencies. Additional coverage was incorporated in an FY 1981 update which expanded the CSD to include representative alternates, emergency relocation sites, and the Rapid Deployment Joint Task Force. During FY 81 a method was developed, based upon the WWMCCS CSD, for system integration analyses of WWMCCS improvements. In FY 82 CSD improvement was continued and analysis of WWMCCS requirements for improvements was begun. Also in FY 82, field support was provided for command center improvements at CINCLANT and CINCSOUTH.

2. FY 1983 Program: The impact of several enhancement projects on WWMCCS and the improvements in capabilities and endurance will be defined. Analysis tools for determining WWMCCS capabilities in crisis and war will be developed. Field engineering and technical support will be provided to CINC's to identify deficiencies, define improvement projects and initiate improvements in C^3 systems.

3. FY 1984 Program: The WWMCCS CSD will be refined to include changes in configuration and improved measures of effectiveness. Field engineering and technical support to CINC's will be continued.

Project: 2910
Program Element: 32019
DoD Mission Area: #331

Title: WWMCCS Engineering
Title: WWMCCS System Engineering
Budget Activity: Strategic Programs #3

4. FY 1985 Program: The WWMCCS CSD will be refined to include changes in configuration and improved measures of effectiveness. Field engineering and technical support to CINC's will be continued.

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

6. Milestones: The WWMCCS CSD expansions will be published at the end of each fiscal year and incorporated with each field update, Studies and analysis of various projects/nodes will be performed continually and reported as completed. Field support will be provided on an ad hoc basis.

7. Resources ($ in thousands):

FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88
1946	2920	893	930	1320	1336	1336

Project: 2920
Program Element: 32019K
DoD Mission Area: #331

Title: Enhanced C^3 Survivability and Endurance
Title: WWMCCS System Engineering
Budget Activity: Strategic Programs #3

F. DETAILED BACKGROUND AND DESCRIPTION: In October 1977, the Assistant Secretary of Defense (C^3I) directed a review of the capabilities of the Worldwide Military Command and Control System (WWMCCS) to support general nuclear war. One of the findings of this review was that there are major deficiencies in the of WWMCCS which limit the ability of WWMCCS to support the National Command Authorities (NCA) under certain attack conditions and for There are a number of conceptual alternatives for improving these deficiencies. However, today there is not sufficient technical information available to adequately assess the cost and performance risk associated with these alternatives. This project has been established to conduct research and development aimed at establishing a responsive, reconstitutable and enduring Command, Control and Communications (C^3) system and support the acquisition of more WWMCCS General War capabilities. This program includes analyses to support the modification of existing plans, the development of new procedures to improve the use of current WWMCCS and non-WWMCCS systems and technology activities to enhance the capability, endurance and reconstitution of both the WWMCCS. The focus of the technology activities will be the development of detailed design and cost tradeoffs, testing and prototype development for technical and cost risk reduction, and the formulation of cost and schedule data to support informed decisions.

G. RELATED ACTIVITIES: On 2 October 1981, the Deputy Secretary of Defense directed Army, in coordination with DCA to develop and deploy a On 9 December 1981, the Deputy Under Secretary of Defense (C^3I) directed termination of the Program in favor of other, more enduring capabilities such as Radio and other satellite communications.

H. (U) WORK PERFORMED BY: USAF, MITRE, IBM and TRW.

I. PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: This project (formerly called Enhanced Post-Attack WWMCCS Capabilities) began in FY 1980. Major efforts which were initiated include: an architecture for post-attack C^3; detailed analyses of the design and cost tradeoffs associated with the reconstitution of critical systems; identification of alternatives for and definition of capabilities. A program management plan was produced in FY81 and revised in FY82. In a concept definition for was produced, and concept definition and assessments of a were conducted. The design was completed and fabrication of the equipment was begun. Communications initiatives included designs of

Alternatives were developed.

Project: 2920
Program Element: 32019K
DoD Mission Area: #331

Title: Enhanced C^3 Survivability and Endurance
Title: WWMCCS System Engineering
Budget Activity: Strategic Programs #3

2. FY 1983 Program: Analysis of the

will be conducted. The project plan will be revised.

will be investigated.

Operational equipment will be obtained, tested and installed in
System engineering, technical assistance and management support will be provided to include configuration control, system descriptions, and security, engineering and test and evaluation planning.
Development will continue on a

3. FY 1984 PROGRAM: Update project plan and requirements analysis. Support OJCS/OSD requests for analysis and studies. Demonstrate proof-of-concept for

Define

C^3 architecture. Complete

Demonstrate a

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Project: 2920
Project Element: 32019K
DoD Mission Area: #331

Title: Enhanced C^3 Survivability and Endurance
Title: WWMCCS System Engineering
Budget Activity: Strategic Prgram #3

4. FY 1985 PROGRAM: Program planning activities include analysis of update of the R&D Plan and requirements analysis and studies in support of OSD/OJCS requests. The following will be demonstrated:
Interface definitions will be developed for NMCS System Engineering R&D
Support will continue in the development, enhancement and deployment of the Test and evaluation of will be conducted and the will be continued.

5. (U) Program to Completion: This is a continuing program with an overall objective of providing the

6. Milestones:

- o Demonstrate (FY84).
- o Demonstrate (FY84).
- o Demonstrate (FY84).
- o Demonstrate (FY84).
- o Test and evaluate (FY85).

7. (U) Resources ($ in Thousands)

FY82	FY83	FY84	FY85	FY86	FY87	FY88
29142	27954	20519	15525	13036	10112	8541

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: 3000 — Title: Military Satellite Comm (MILSATCOM) Systems
Project Element: #32019K — Title: WWMCCS System Engineering
USDR&E Mission Area: Strategic C2 - #331 — Budget Activity: #3 Strategic Programs

F. DETAILED BACKGROUND AND DESCRIPTION: This project supports the Military Satellite Communications (MILSATCOM) Systems Office (MSO) in its efforts to provide an overall DoD satellite communications systems architecture. The objective of this effort is to establish a single coordinated approach to the planning, development, acquisition, and operational deployment of secure, reliable, enduring and cost-effective DoD satellite communications. This coordinated approach serves to ensure maximum interoperability among different DoD satellite systems and with other military and commercial communications systems.

G. RELATED ACTIVITIES: The Defense Satellite Communications System (33126K, 33142A, 33109N, 33110F), Advanced Space Communications (63431F), and MILSTAR (33603F) are related MILSATCOM System activities.

H. WORK PERFORMED BY: Rockwell International, MIPR U.S. Air Force, and competitive contracts.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1 FY 1982 and Prior Accomplishments: The first MILSATCOM Systems Architecture was published in 1976. It was revised in 1979 to reflect a three segment architecture (wideband, tactical, and nuclear capable force systems). The documentation associated with this architecture provided a comprehensive user requirements data base, identified candidate options for future systems and technology development needs. A new MILSATCOM architecture was begun to include the totality of DoD, the satellite communications requirements over the next twenty years. The extent of the new architecture formulated to date identifies the enhancement of the AFSAT/FLTSAT, DSCS III and the Satellite Data System (SDS) systems, including the new MILSTAR satellite system, for the accommodation of the strategic and tactical forces needs in the late 1980s.

2. FY 1983 Program: The MILSATCOM Systems Architecture, developed in FY 1981 and expanded in FY 1982, is being updated to correspond with the results of studies undertaken in FY 1982 as well as to reflect current funding authorizations. The FY 1982 enhancement of the User Requirements Data Base (URDB) as an architectural tool and the formulation of a resources data base is being used to support the architectural updating effort. A Five-Year MILSATCOM Summary and the Twenty-Year MILSATCOM Architecture Plan are being completed. Increased emphasis is being placed on developing transition plans from the current systems to the future systems of MILSTAR, DSCS III, etc.

3. FY 1984 Planned Program: The MILSATCOM Architecture will be reviewed and revised as required. The URDB will be updated and the Five-Year Summary and Twenty-year Architectural Plan will be reviewed and revised. Transition planning will continue. Advanced studies for concepts beyond MILSTAR will begin, and emphasis on survivability and endurance issues will be maintained.

4. Program to Completion: The MILSATCOM Systems Architecture will be continually updated to meet the dynamic needs of MILSATCOM users in an evolutionary manner consistent with technology, cost and risks. Continuing efforts will be pursued in the areas of system and technology developments that influence space and earth segment configuration design to provide an optimum cost effective mix to meet user requirements and improve mission success.

5. Milestones: Not Applicable.

6. Explanation of Milestone Change: Not Applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: 3310 — Title: C3 System Engineering
Project Element: #32019K — Title: WWMCCS System Engineering
USDR&E Mission Area: Strategic C2 - #331 — Budget Activity: #3 Strategic Programs

F. DETAILED BACKGROUND AND DESCRIPTION: This Project provides the development of planning guidance for Command, Control and Communications (C^3) systems, technical plans and analyses, C^3 systems architectures and special studies of C^3 systems and issues. These system engineering and planning activities are required by the Defense Communications Agency in order to fulfill its responsibility for technically guiding the growth and modification of the Worldwide Military Command and Control System (WWMCCS) and insuring the overall reliability and integration of C^3 systems through current and future C^3 planning.

This project consists of seven major task areas: (1) Strategic C^3 - provides for the examination of strategic C^3 architectures and development of plans for the modification of C^3 systems and future upgrades to U.S. strategic C^3 capabilities; (2) Nonstrategic Nuclear Forces Architecture and Plans - provides for the development and preparation of system improvement planning documents for C^3 systems supporting the theater nuclear forces in Europe, the Pacific and other theaters; (3) HF Architecture - allows the development of alternative HF architectures and associated improvement plans to support the coordination and orderly evolution of DoD HF programs; (4) Worldwide Digital Systems Architecture (WWDSA) - permits the modification and updating of the WWDSA goal architecture and transition plan to reflect changes in DoD communications requirements and technology as a means of insuring the survivability/endurability and interoperability of DoD telecommunications; (5) Joint Multichannel Trunking and Switching System (JMTSS) Architecture - provides for the development of JMTSS architectures and system designs to satisfy the crisis and/or wartime communications needs of theater commanders; (6) Data Communications Protocol Development - supports the assessment of communications standards activities and develops new protocol standards to ensure the reliable and efficient transfer of critical DoD information; and, (7) Theater/Tactical C^3 Architecture and Plans - provides the development of long-range system planning and architectural documents to remedy deficiencies in theater/tactical C^3 systems.

G. RELATED ACTIVITIES: This project relates to other ongoing programs such as the Nuclear Weapons Employment Acquisition Master Planning activities, Post-Attack Architecture, Defense Communications System, WIS Modernization, etc.

H. WORK PERFORMED BY: C^3 System Engineering work is accomplished by MITRE Corporation, IBM, Institute for Defense Analysis, TRW Inc., and BDM Inc.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: FY 1977 and FY 1978 efforts concentrated on developing, coordinating and issuing technical and programmatic guidance for the implementation of the WWMCCS Selected Architecture as well as developing a more comprehensive system engineering program aimed at the total WWMCCS rather than just the future WWMCCS capabilities. Selected communications integration and mobile command center problems have been reviewed and analyzed for the development of

alternatives to resolve future WWMCCS interoperability and standarization problems. Technical support was provided during FY 1981 for the finalization of architectural and communications technology for use in a NATO environment. A European Theater Nuclear Weapons C^3 System Improvement Plan defining an orderly evolution from the existing and near-term planned system to a system which satisfies future theater requirements was published in FY 1981. The final WWMCCS Five Year Plan was published and, in its place, more comprehensive strategic C^2 planning guidance was developed during FY 1982.

2. FY 1983 Program: A DoD HF Improvement plan is being developed to resolve existing technical issues in DoD HF programs. Strategic C^3 capabilities are being assessed to improve the effectiveness of C^3 support to strategic nuclear weapons systems and forces. As follow-ons to the published European Theater Nuclear Weapons C^3 Systems Improvement Plan (SIP) and PACOM Theater Nuclear Weapons C^3 Plan, architectures are being developed and efforts leading to program plans initiated. The contributions of existing and proposed C^3 system configurations will be analyzed in order to develop alternative investment strategies for the C^3 systems supporting theater and tactical military missions. On-going support to the Deputy Under Secretary of Defense for Communications, Command, Control and Intelligence (C^3I) will continue for the Nuclear Weapons Employment Acquisition Master Planning activities.

3. FY 1984 Planned Program: C^3 planning, system engineering, and theater C^3 improvement efforts will continue to provide the long range planning, architectural developments and technical assistance necessary for integrated and effective C^3 systems. As Protocol Standardization Executive Agent for DoD, new protocol standards for data communications will be developed and tested for operational viability. The Worldwide Digital Systems Architecture (WWDSA) Baseline Documents will be updated and theater Joint Multi-Channel Trunking and Switching System (JMTSS) Architectural development efforts will continue to support the evolutionary improvement of DoD telecommunications Systems.

4. Program to Completion: This is a continuing program. System engineering for both strategic and theater/tactical C^3 systems will continue to provide the development of system architectures and plans necessary for the overall integration of C^3 systems. Additionally, work will continue for the development of architectures, communications standards, and plans needed for achieving interoperable and operationally responsive DoD telecommunications systems.

5. Milestones: Initiate the development of protocol standards during FY83.
Provide continuing support to the DUSD (C^3I) for the Nuclear Weapons Employment Acquisition Master Planning activities during FY83-84.
Develop revised United States European Command (USEUCOM) and Pacific Command (PACOM) improvement plans in FY83-84.
Complete development of a European C^3 Program Plan for Theater C^3 in central European during FY84.
Revise and publish an HF improvement plan during FY84.
Develop a PACOM Joint Multichannel Trunking and Switching System (JMTSS) Architecture - FY84.
Develop a EUCOM Joint Multichannel Trunking and Switching System (JMTSS) Architecture - FY84.

6. Explanation of Milestone Changes: Not applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: 3330 Title: NATO C2 Engineering
Project Element: #32019K Title: WWMCCS System Engineering
USDR&E Mission Area: Strategic C2 - #331 Budget Activity: #3 Strategic Programs

F. DETAILED BACKGROUND AND DESCRIPTION: The North Atlantic Treaty Organization (NATO) is planning and implementing advanced, integrated command and control systems. As a result, it must be assured that these new systems are engineered for effectiveness, in view of their high cost impact on the U.S. It must also be assured that NATO systems and related U.S. systems are compatible. Although NATO and the Department of Defense have structures for reviewing and monitoring the new NATO C^2 systems, both lacked organized system engineering support. In order to provide the system engineering support necessary to ensure the maximum effectiveness of NATO C^2 system, the Assistant Secretary of Defense for Communications, Command, Control and Intelligence (C^3I), in a memorandum dated 27 February 1981, directed the Defense Communications Agency (DCA) to establish a NATO system engineering capability.

This project provides system engineering support for U.S. participation in various NATO command and control activities to include: assistance in identifying technical issues; developing U.S. positions on issues; analyzing the effects of NATO systems and actions on U.S. systems; and harmonizing the technical aspects of these systems.

G. RELATED ACTIVITIES: The NATO work is closely tied to the NSNFC^3 Architectural development under project 3310, Program Element 32019K.

H. WORKED PERFORMED BY: The MITRE Corporation

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: Prior to FY 1984, NATO C^2 system engineering efforts were performed under project 3310 WWMCCS System Engineering (P.E. 32019K) and project 3000 Military Satellite Communications (P.E. 33126K). With the establishment of a NATO System Engineering Office in FY 1981, technical support was provided for the preparation and refinement of the Multi-information Distribution System (MIDS) architecture. On-site NATO C^3 engineering and planning support was provided to Supreme Headquarters Allied Powers Europe (SHAPE) in both FY 1981 and FY 1982.

2. FY 1983 Program: The FY 1983 efforts focus on the development of architectural solutions for providing survivability and endurance to essential Allied Command Europe (ACE) Air Command and Control System (ACCS) functions.

3. FY1984 Planned Program: System engineering efforts will continue in support of the Deputy Under Secretary of Defense for Research and Engineering (DUSDR&E C^3I) for U.S. participation in selected NATO C^2 programs. Principal activities will

include support to the European Theater Air Command and Control System (ETACCS) and the review of U.S./NATO C^2 interfaces. Additionally, technical assistance will be provided for developing U.S. DoD positions on military satellite communications matters.

4. Program to completion: This is a continuing project.

5. Milestones: Not applicable.

6. Explanation of Milestone Changes: Not Applicable.

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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: 3350 Title: Post-Attack Architecture
Project Element: #32019K Title: WWMCCS System Engineering
USDR&E Mission Area: Strategic C2 - #331 Budget Activity: #3 Strategic Programs

F. DETAILED BACKGROUND AND DESCRIPTION: Historically, WWMCCS architectural efforts have heavily concentrated on the deterrent and employment values of strategic offensive forces and the Command, Control and Communications (C^3) required in support of relevant national policy. Traditional scenarios have dealt with a relatively short span of conflict leading toward a termination of hostilities in terms favorable to the U.S. and its allies. However, recent insights, perceptions and intelligence have led

The proposition that victory in the long run is a means of terminating nuclear conflict significantly raises the need for endurable C^3 capabilities in support of the offensive and defensive forces. Thus, the development of an enduring C^3 architecture is an essential step in the development of C^3 capabilities to support the recovery, reconstitution and reemployment of the strategic forces.

This project provides for the development of an enduring C^3 architecture for the C^3 capabilities required during an extended nuclear conflict. This project includes the definition of scenarios, environment, operational concepts, and the development of programmatic recommendations for implementing and defining the capabilities identified in the evolving architecture.

G. RELATED ACTIVITIES: This project is related to the Enhanced C^3 Survivability and Endurance Project also being performed by the Defense Communications Agency.

H. WORK PERFORMED BY: IBM Corporation.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: This project was originally performed under the Enhanced Post Attack WWMCCS (EPAW) project. Major efforts which were initiated include: an architecture for post-attack C^3; detailed analyses of the design and cost tradeoffs associated with the reconstitution of critical warning satellite systems; and, the identification of communications uncertainties for highly survivable, endurable command facilities. The development of a concept of operations for the interaction of forces and supporting C^3I systems in the recovery, reconstitution and reemployment of strategic and defensive forces began and the analysis of alternative solutions for meeting post-attack C3 needs was initiated.

2. FY 1983 Program: The development and assessment of alternative architectures necessary to provide alternative levels of strategic capabilities to the U.S. for the conduct of strategic warfare over an extended period of time will be continued. An optimal set of strategic C^3 capabilities will be assessed and sufficiently defined to support acquisition consideration and decision.

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3. FY 1984 Planned Program: The development of an overall enduring C^3 architecture for improved C^3 during extended nuclear conflict will continue. Critical C^3 endurability needs will be analyzed to support the formulation of alternative solutions for enduring and integrated post-attack C^3 capabilities.

4. Program to Completion: This is a continuing project with an overall objective of providing the enhanced post-attack capabilities required to become a reconstitutable and enduring C^3 system.

5. Milestones: Not applicable.

6. Explanation of Milestone Changes: Not applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project: 3380 Title: Next Generation WWMCCS ADP
Project Element: #32019K Title: WWMCCS System Engineering
USDR&E Mission Area: Strategic C2 - #331 Budget Activity: #3 Strategic Programs

F. DETAILED BACKGROUND AND DESCRIPTION: This Next Generation WWMCCS ADP project supports the Defense Communications Agency's responsibilities for modernizing the current WWMCCS ADP systems (acquired from Honeywell Information Systems, Inc. in 1971) and developing an architectural foundation for a fully integrated WWMCCS Information System (WIS). The WIS is defined to encompass basic operational concepts, specific functional processing needs, information reporting requirements and procedures, data displays, communications, etc., as well as the ADP hardware/software assets which support command and control operations.

This project started as the "Research and Development in the Operational Utility of WWMCCS ADP." Orginally, experiments were designed to determine the operational utility of Automatic Data Processing (ADP) for WWMCCS. In response to Congressional direction, the Defense Communications Agency deleted the FY 1980 funding for the continuation of research and development efforts in the operational utility of WWMCCS ADP and, instead, established a new program entitled "Next Generation WWMCCS ADP Definition." The Next Generation WWMCCS ADP project's focus was to refine the operational and information requirements and evaluate potential components for the development of architectural alternatives for an integrated and responsive WIS. This effort was in direct support of the newly designated WIS Joint Program Manager (JPM) under the Air Force.

G. RELATED ACTIVITIES: The Command Information Subsystem of DCA, the Advanced Command, Control and Communications Technology program of the Defense Advanced Research Projects Agency, the Network Front-End program of DCA, the Computer Security Consortium of DUSD (C^3I), and the overall WIS Modernization Program.

H. WORK PERFORMED BY: The MITRE Corporation, TRW Corporation, and IBM Corporation.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: A Program Definition Plan for R&D in Operational Utility of ADP in support of the WWMCCS and a Technical Development Plan for execution of the program were published in FY 1977. A WWMCCS Information System Engineering Management Plan that provided a framework for the management and coordinated development of the WIS was published in early FY 1979. Security experiments were conducted in November 1980 which demonstrated potential security solutions for the current and future WWMCCS ADP systems. A progress report on modernizing the current ADP systems which support the WWMCCS was delivered to Congress in January 1981. A comparative analysis on data base management systems and techniques required to transition current WWMCCS data bases to the future system was initiated. The review of the WIS network capabilities, identification of functional WIS network requirements and synthesis of the planned WIS network capabilities were continued. The development of a WIS computer security architecture for different levels of classified information was continued. The development of a broad architecture for a more survivable and efficient Joint Reporting Structure network and a report on WIS requirements, modernization and architecture were completed. Support has been provided for the initiation of WIS

modernization efforts under the WIS Joint Program Manager.

2. FY 1983 Program: None. Ongoing WIS modernization efforts will be the responsibility of the Air Force WIS Joint Program Manager.

3. FY 1984 Program: None. Ongoing WIS modernization efforts will be the responsibility of the Air Force WIS Joint Program Manage.

4. Program to Completion: The WIS Joint Program Manager will continue as the central focal point for coordinating and controlling all WWMCCS ADP upgrading and modernization activities. The procurement of equipment for specific WIS sites and the development of command and site-unique portions of the WIS modernization will remain the responsibility of DCA and the Services.

5. Milestones: Not applicable.

6. Explanation of Milestone Changes: Not applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33131K
DoD Mission Area: Strategic Communications #333

Title: MEECN
Budget Activity: Strategic Program #3

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Total Additional To Completion	Estimated Cost
2181	MEECN Engineering	5791	6845	8050	8384	Continuing	N/A
2182	Strategic Connectivity Engineering	300	3000	4563	4697	Continuing	N/A
	TOTAL FOR PROGRAM ELEMENT	8791	9845	12613	13081		

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides the system engineering, development, test and evaluation, and technical support for the Minimum Essential Emergency Communications Network (MEECN). The MEECN is a diverse network of communications assets with the mission of providing highly reliable communications between the National Command Authorities (NCA) and the strategic forces deployed globally. The various component subsystems composing the MEECN are developed, operated, and maintained by the Services. This program element also supports the planning, engineering, and testing of the overall Strategic Connectivity Network which includes the functions of Tactical Warning/Attack Assessment, Conferencing, Emergency Action Message Dissemination, and Force Management.

C. BASIS FOR FY 1984 RDT&E REQUEST: This program element is comprised of two projects. MEECN Engineering provides the necessary analytical tools and studies to determine the technical and operational performance of the MEECN and MEECN Support Systems with regard to connectivity, survivability, and deficiencies in a simulated stressed environment. It provides for conduct of JCS and OSD (C^3I) assigned system and equipment studies. It provides for the technical and operational testing, evaluation, and analysis of overall MEECN; the Worldwide Airborne Command Post (WWABNCP) System; and MEECN Support Systems in a non-stressed environment and in configurations simulating severe stress and trans and post-attack damage. The annual MEECN Master Plan contains recommended improvements for consideration by the JCS, Services and Defense Agencies. New procedures, equipments and systems are assessed from a cost and effectiveness viewpoint for possible inclusion into the MEECN and developed. The Strategic Connectivity Engineering project develops a strategic connectivity capability which supports the command and control functions through all levels of nuclear conflict.

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Program Element: 33131K
DoD Mission Area: Strategic Communications #333

Title: MEECN
Budget Activity: Strategic Program #3

D. COMPARISON WITH FY83 DESCRIPTIVE SUMMARY: FY84 resources show a $2,768,000 increase from FY83 to FY84. $1,563,000 is due to increases in requirements of the Strategic Connectivity Engineering (SCE) projects including increased support to the Joint Strategic Connectivity Staff amd the Commander-in-Chief. MEECN is increased by $1,205,000 for more in-depth operational testing and evaluation of current MEECN assets with additional emphasis on HF communications with the CINCPAC theater.

E. OTHER APPROPRIATION FUNDS:

Project 2182	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
Procurement	0	6880	0	0
Operation and Maintenance	0	729	2014	2275

Project: 2181 Title: MEECN
Program Element: 33131K Budget Activity: Strategic Program #3
DoD Mission Area: Strategic Communications #333

F. (U) DETAILED BACKGROUND AND DESCRIPTION: On 10 May 1970 the OSD assigned the Minimum Essential Emergency Communications Network (MEECN) System Engineer's responsibility to DCA. This responsibility includes system planning, engineering analysis, testing and evaluation, and developing and updating such primary products as a MEECN Master Plan (MMP), a MEECN Communications Plan (MCP), a JCS Communicability Study, and programming, planning and budgeting for MEECN improvements on a yearly basis consistent with the evolving MEECN. In addition, test plans and test results for worldwide, system, special tests and JCS directed exercises are documented on a quarterly or as required basis yearly. Completion of a JCS Communicability analysis on a yearly basis and the OSD C^3 Net Assessment on an as assigned basis was tasked to DCA in 1978. In 1980, MEECN was assigned the responsibility of the VLF/LF 616A/VERDIN Advanced Systems Interoperability Manager. Since the primery users of MEECN Engineering products are the OSD, the JCS, the CINCs, the Services, the NSA and the DNA; and since the MEECN is a worldwide, diverse network of communications assets owned, operated or managed by the Services, MEECN system engineering must be of the highest quality and consistent with on-going Service and CINC operational analysis and technical studies and overall OJCS evaluations.

G. (U) RELATED ACTIVITIES: MEECN Systems and Supporting Systems are developed, acquired and operated by the CINC's and Services. MEECN threat data is developed by DoD Agencies and Services. Various strategic connectivity engineering efforts are conducted within the Strategic Connectivity Engineering project by the DCA and one closely coordinated with this project.

H (U) WORK PERFORMED BY: MITRE, TRW, ESI, DNA, USN, USAF, CSC, ITS.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY82 AND PRIOR ACCOMPLISHMENTS: Provided recommendations to the Services for improved interoperability and connectivity of the communication network comprising MEECN. These recommendations are contained in the annual MEECN Master Plan. Provided guidance in the conduct of C^3 Net Assessment for the SecDef. Performed VLF/LF, HF, VHF, UHF (including SATCOM), and Emergency Rocket Communications System Worldwide link and network tests and evaluations on a yearly basis. Investigated means to improve HF reconstitution and VLF/LF, VHF and UHF radio reliability, both for the Airborne Command Post and the Navy VLF/LF relay aircraft supported OJCS exercises.

2. (U) FY83 PROGRAM:

Provide analysis of MEECN capabilities for use in operational planning and develop methodology to characterize the post attack network and MEECN functions in extended conflict.

Support MEECN exercises and evaluations with planning, analyses, conduct and reporting of quarterly overall system tests, selected network evaluations, and worldwide technical tests.

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Project: 2181
Program Element: 33131K
DoD Mission Area: Strategic Communications #333

Title: MEECN
Budget Activitity: Strategic Program #3

2. (U) FY83 PROGRAM (Continued)

Produce the annual MEECN Communications Plan and System Description which provides the principal JCS policy and procedures for employment of the MEECN.

Produce the annual MEECN Master Plan which contains recommended improvements and guidance by JCS for formulating the programs of the Services and Agencies for the MEECN.

Provide assessments of evolving technology such as communications satellite systems, and adaptive radios.

Provide initiation or development of operational concepts for selected new governmental or industrial technologies previously determined to have potential for improving the MEECN.

Provide for fabrication and demonstration of terminals for a new class of adaptive radio in an operational environment.

Develop an operational concept for an Improved Emergency Rocket Communications System.

Complete laboratory evaluation of the performance of the Navy VERDIN and Air Force 616A VLF/LF modems.

3. (U) FY84 PLANNED PROGRAM:

Provide analysis of MEECN capabilities for use in operational planning, develop methodology to analyze the MEECN in extended conflict situations, and upgrade computer models.

Support MEECN exercises and evaluations with planning, analyses, conduct and reporting of quarterly overall system tests, selected network evaluations and worldwide technical tests.

Produce the annual MEECN Communications Plan and System Description.

Produce the annual MEECN Master Plan.

Provide assessments of evolving technology such as adaptive radios and satellite communications.

Provide operational concepts for advanced techniques, systems and technologies and determine suitability for MEECN.

Program Element: 33131K
DoD Mission Area: Strategic Communications #333

Title: MEECN
Budget Activity: Strategic Program #3

3. (U) FY84 PLANNED PROGRAM: (Continued)

Upgrade adaptive radio terminals and develop meteor burst radio capabilities.

Provide analysis of VERDIN/616A VLF/LF performance.

Develop an operational concept for a Large Rocket Repeater System.

Provide technical integration plans for (Improved Emergency Message Automatic Transmission System) IEMATS and EAM executive aids.

4. (U) FY85 PLANNED PROGRAM: Provide analysis of MEECN capabilities and update methodology to characterize the post-attack strategic communications network and MEECN functions.

Support MEECN exercises and evaluations with planning, analyses, conduct and reporting of quarterly overall system tests, selected network evaluations, and worldwide technical tests.

Produce the annual MEECN Communications Plan and System Description.

Produce the annual MEECN Master Plan.

Participate in the development and implementation of adaptive and meteor burst radio systems. Initiate a system definition study to determine Space Shuttle communications applicability to the MEECN . Continue to survey technology with potential for MEECN applications and select candidate for further development of operational concepts. Participate in design and implementation of the IEMCS/LAARS and the IEMATS.

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

Project: 2181
Program Element: 33131K
DoD Mission Area: Strategic Communications #333

Title: MEECN
Budget Activity: Strategic Program #3

6. (U) MILESTONES:

Support JCS POLO HAT exercises - Quarterly
Evualuate MEECN - Quarterly
Provide Communicability Study - Annually
Provide MEECN Master Plan - Annually
Provide MEECN Communications Plan and Description - Annually
Provide/Determine vulnerability Study - Annually
Evaluate Adaptive HF/VHF Systems - FY83
Define IEMCS OPS Concept - FY83
Assess SATCOM Technology - FY83
Assess New Technology for Applications - Annually
Analyze VERDIN-616A Performance - FY84

7. (U) RESOURCES ($ in Thousands)

FY82	FY83	FY84	FY85	FY86	FY87	FY88
5791	6845	8050	8384	10045	9283	9544

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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Elements: 63735K
USDR&E Mission Area: Strategic C2 - #331

Title: WWMCCS Architecture
Budget Activity: #3 Strategic Programs

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Total Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,020	1,262	1,227	1,288	Continuing	Continuing
3900	WWMCCS Architecture Support	1,020	1,262	1,227	1,288	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This project provides funding for the continuation of the WWMCCS Architecture Program initiated in 1974. The architecture effort as set forth in the Deputy Secretary of Defense Memorandum of 24 June 1976 directed the: (1) continual evaluation of the current and developmental capabilities of the WWMCCS to support the National Command authorities and Unified and Specified Commands in an environment of evolving policy, force structure, threat, and technology; (2) identification of developing insufficiencies and imbalances in WWMCCS capabilities and those of the supporting systems; (3) development of alternatives for architectural improvements and revisions. Since that time, the scope of the effort has expanded to provide a broader and more in-depth review and evaluation of Command, Control and Communications (C^3) architectures in view of changes in the environment, threat, force structure, technology and U.S. defense policy and the development of conceptual systems improvements/modifications in response to those changes. This capability is essential as an evaluation procedure and provides an overall architectural frame of reference which serves as a basis for identifying needs which can be translated into programs by the system engineering process.

C. BASIS FOR FY 1984 RDT&E REQUEST: The WWMCCS Architecture project is required to support the development of long-range plans and architectures to insure the orderly evolution of C^3 capabilities, derivation of of new C^3 capability needs in response to changes in national policy and threat, and review of advanced technology and concepts for future architectural changes resulting in needed C^3 improvements. The FY 1984 request will continue the development of a long-term end-to-end strategic connectivity architecture for improved command and control general nuclear war capabilities, permit the revision of the Strategic C^3 Long-Range as a means of providing a long-term perspective for strategic C^3 planning, and provide for the assessment of current command and control system capabilities for the orderly transition to recommended long range capabilities.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: This program is essentially a continuing level of effort for the continued architectual development and revisions necessary to ensure the systematic and orderly evolution of C^3 systems.

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E. OTHER APPROPRIATION FUNDS: None.

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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 21135K
DoD Mission Area: Theater Command & Control #251

Title: CINC COMMAND & CONTROL INITIATIVES
Budget Activity: #4 Theater Tactical Programs

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2719	700	2100	2152	Continuing	Continuing
2541	CINC C^2 INITIATIVES	2719	700	2100	2152	Continuing	Continuing

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The CINC Command and Control Initiatives program element was established during FY 82 in response to the need for unified and specified commanders to have the capability to adapt, modernize, and maintain their unique command and control systems. Funding under this program element permits the CINCs to tailor, by means of near-term, low-cost enhancements, their unique and dynamic command and control systems to their own particular missions, geographic areas of responsibility, and individual styles of command. All projects are validated by the JCS.

C. BASIS FOR FY 1984 RDT&E REQUEST: RDT&E funds are required to provide the CINCs with the capability to perform near-term, low-cost development and studies in order to adapt, evolve and improve their existing command and control systems to effect largely near term and unforeseen requirements. The RDT&E for enhancements instituted under this program will normally be completed within one fiscal year and are expected to result in discernable critical improvements in the combat readiness of the commands. Planned FY84 projects include developments to achieve EMP hardening of CINC and component commands C^3; test of electromagnetic interference of LF/VLF communications to SSBN's; study of use of RDV's to theater level reconstitution, CINC C^3 master planning; tests and evaluation of CINC C^3 systems.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: ($ in thousands)

In FY83 five projects were funded. In FY84, CINC's have proposed an increase in RDT&E primarily in the area of EMP hardening (development and test). Approximately fifteen low cost projects are planned for FY84.

E. OTHER APPROPRIATION FUNDS:

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate
Procurement	4800	6500	12270
Operations & Maintenance	3000	2662	3860

17 January 1983

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #33126K
USDR&E Mission Area: Common User Communications #363

Title: Long Haul Communications (DCS)
Budget Activity: Intelligence & Communications #5

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 82 Actual	FY 83 Estimate	FY 84 Estimate	FY 85 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL RESOURCES FOR PROGRAM ELEMENT	18200	18108	20523	18496	Continuing	Not Applicable
1012	AUTOVON/DSN	2953	4135	3350	3721	Continuing	Not Applicable
1032	Secure Voice Improvement Program	876	780	580	460	Continuing	Not Applicable
1053	Defense Data Communications Program	2650	3140	8390	6212	Continuing	Not Applicable
1070	Integrated Design & System Control	2387	1907	3184	2970	Continuing	Not Applicable
1110	Defense Satellite Communications System	2731	2773	2435	2420	Continuing	Not Applicable
1130	Terrestrial Transmission	853	1299	1253	1505	Continuing	Not Applicable
1170	Survivability & Facilities Design Criteria	678	870	1331	1208	Continuing	Not Applicable
3070	System Architecture & Integration	1095	749	*	*	Continuing	Not Applicable
4000	MILSATCOM Systems	1867	2455	*	*	Continuing	Not Applicable
1091	USDCFO	1010	**	**	**	Continuing	Not Applicable
9000	PD-53/NSC Initiatives	450	***	***	***	Continuing	Not Applicable
9500	Other Projects	650	0	0	0	0	Not Applicable

*To be transferred to PE 32019.
**To be transferred to O&M funding.
***To be transferred to PE 33127K.

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element supports the development and systematic improvement of the Defense Communications System (DCS) including the Defense Satellite Communications System (DSCS); and the development of architecture specifications and system design for the DoD end-to-end communications. The DCS is the worldwide strategic communications system for the day-to-day operation of the DoD, and is the core of the DoD wartime communications capability providing communications for the National Command Authorities (NCA), the Joint Chiefs of Staff (JCS), the Commanders in Chief (CINCs), and other critical subscribers. The efforts in this program element particularly emphasize the development of a DCS that is wartime endurable, capable of reacting to and operating well under a variety of crisis situations including war, and is still peacetime effective. The DCS must be designed as a robust telecommunications system, capable of continued support of its command and control function as long as a significant number of subscribers survive. This includes the capability to rapidly extend service to remote areas, quickly restore disrupted trunks, and transition smoothly from peacetime to wartime.

This program element also supports the Military Satellite Communications (MILSATCOM) Systems and System Architecture & Integration Projects through FY 83, and the USDCFO, PD-53 Initiatives and Other Projects through FY 82. The MILSATCOM Architecture will establish a single coordinated approach to the planning, development, acquisition, and operational deployment of secure, reliable, enduring and cost effective DoD satellite communications and provide maximum interoperability and compatibility among different DoD satellite systems and with other military and commercial communications systems. The USDCFO Project supports the engineering for the resolution of interface problems between the integrated communications systems of NATO and the DCS. This program element also supports the effort with AT&T to develop and implement standard design and maintenance criteria for protection of future fiber optics transmission system against nuclear effects as required under Presidential Directive-53, and the efforts on improving circuit reliability of WWMCCS Intercomputer Network and on improving survivability of certain White House Communications facilities.

C. BASIS FOR FY 84 RDT&E REQUEST: The major thrusts of the FY 1984 program are directed toward supplementing the in-house efforts in removing the deficiencies in endurability/survivability and responsiveness of the DCS, insuring the compatibility/integration of the various DoD telecommunications architectures, and improving the cost effectiveness of the DCS. Some illustrative tasks include: (1) Development of a rapidly extendable/reconfigurable, wartime endurable DCS design, including physical survivability, Electronic Warfare and High Altitude Electro-Magnetic Pulse (HEMP) considerations; with emphasis on solving the system control and interface issues among satellite and terrestrial communications and between the various elements of the Defense Switched Network (DSN). (2) Development of a Jam Resistant Secure Communications (JRSC) system to support critical users during crisis and wartime situations through the use of the DSCS Phase III satellite and earth terminal equipment and related ground communications equipment. (3) Design and development of Defense Data Network (DDN) to ensure wartime robustness and graceful degradation, recognizing that reductions in trunk capacities and rapid changes in traffic patterns must be expected. (4) Development of the DSN concept to strongly influence the common-user architectural efforts and provide guidance for near-term choices. (5) System engineering for the DSCS including formulation of concepts, development of system/subsystem performance specifications, interface analysis, and testing and evaluation of space, ground and control subsystems.

The DCS RDT&E expenditures in the above areas, although relatively small, will continue to exert the necessary high leverage guidance and direction on the subsequent subsystem and equipment expenditures by the military departments in support of the DCS.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: The scope of the FY 83 Project on AUTODIN Improvement Program has been increased and redirected to include the development of the Defense Data Network. The title of this Project has been changed to Defense Data Communications Program to reflect its broader scope. The FY 84, 85 resource estimates shown are, therefore, higher than FY 83.

E. OTHER APPROPRIATION FUNDS: None

3 December 1982

Project: #1053 Title: Defense Data Communications Program (DDCP)
Program Element: #33126K Title: Long-Haul Communications
USDR&E Mission Area: Common User Communications #363 Budget Activity: Intelligence and Communications #5

F. DETAILED BACKGROUND AND DESCRIPTION: The Defense Data Communications Program (DDCP) provides for the evolutionary implmentation of a common-user data communications system for the DoD. AUTODIN is the currently operational narrative/record message system. The DDN is the DoD common-user packet switched system and will provide a cost effective, survivable and secure service for critical ADP (query/response, interactive, and bulk) communications and transport of record communications. The Inter-Service/Agency AMPE (I-S/A AMPE) will provide modernized automatic message service in a more dispersed and survivable network configuration. Continued RDT&E will be required to accomplish the evolutionary development of these three DDCP components, and to accomplish the overall functional design for incorporating them into an end-to-end, secure, worldwide integrated system which addresses and includes the backbone, access, and local subscriber networking areas.

G. RELATED ACTIVITIES: The DDCP is one of the major components of the second generation DCS. Related efforts are performed in the AUTOVON/DSN, Secure Voice Improvement Program, Terrestrial Transmission, DSCS and Integrated Design & System Control Projects under this program element.

H. WORK PERFORMED BY: Booz-Allen, MITRE, Stanford Research Institute, Bolt-Beranek and Newman, System Development Corporation, System Consultants Inc., Army, Navy and DARPA.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: The overall architecture for the Integrated AUTODIN System has been completed and the associated functional specifications have been developed. Host level protocols for users have been developed, tested, and are now becoming standard. The Ada DoD High Order Language has been evaluated for application to the DCS. The principles of end-to-end security have been analyzed, and the areas of their applicability to DoD communications have been defined. Initiated development of Internet Private Line Interface (IPLI) which will form an integral part of the DDN.

2. FY 1983 Planned Program: DDN Management Engineering Plan and Work Plan will be completed. Developments in host hardware interfaces and protocols for DDN will be initiated. The Message Service Protocol for the I-S/A AMPE will be developed. Survivability will be achieved by increasing the numbers of packet switch nodes, dispersing them, and redistributing functions between the access and backbone areas. In addition, survivability will be enhanced by the development of gateways and standard interfaces to provide for interoperation between different networks such as the public data networks.

3. FY 1984 Planned Program: The design and development required for the first phase of the DDN will be completed. The previously developed Message Service Protocol will be implemented, tested, and evaluated. The effort to achieve an even more survivable distributed network will be expanded by integrating data communications into the DSN. The secure remote programming of switches will become a major effort, and the operational application of end-to-end data communications encryption will be initiated. Engineering models of End-to-End Encryption (E^3) devices will be used in a realistic system field test to evaluate a complete E^3 system design. Most of the functional designs will be completed and will be in the implementation phase.

4. Program to Completion: Particular attention will be paid to the closer integration of the DCS voice and data subsystems, and to the development of new services and capabilities, and associated protocols. The design and development required to make the remaining phases of the DDN operational will be accomplished. The entire thrust of the program will be to achieve a survivable and distributed data system by incorporating the technology of end-to-end encryption, reducing the size and manning of the switches, and achieving integration with other systems such as the DSN, packet radio networks, and satellite networks.

5. Milestones: Work under this program is a continuing effort.

6. Explanation of Milestone Changes: Not Applicable

J. TEST AND EVALUATION DATA: Not Applicable

FY 1984 RDT&E DESCRIPTIVE SUMMARY (U)

(U) Program Element*: # 33127K Title Support of the NCS
(U) DoD Mission Area: Support & Base Communications #362 Budget Activity Intelligence & Communications - #5

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROG ELEMENT						
9020	PD-53 and Other Technology-Related Initiatives	450*	1990	2877	4741	Continuing	Continuing

B. (C) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This project covers of the National Security Telecommunications Policy (PD-53) initiatives approved by the National Security Council for implementation by the National Communications System (NCS). It involves the development of techniques that will significantly

C. (U) BASIS FOR FY 1984 RDT&E REQUEST: During fiscal year 1984, the following actions will be taken:

(1) - Complete development, test, and evaluation, and begin installation of (where deficiencies have been identified); identify and begin development, test, and evaluation of

* Funded under Program Element 33126K, "Long Haul Communications."

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FY 1984 RDT&E DESCRIPTION SUMMARY (U)

(U) Program Element: # 33127K Title Support of the NCS
(U) DoD Mission Area: Support & Base Communications #362 Budget Activity Intelligence & Communications -

(3) (U) National, International, and Federal Standards - Development of standards compatible with PD-53 objectives.

(2) - Completion of 'for the Tl carrier/ Fiber Optic Transmission Systems; continue the design and development of standard design and maintenance practices for the

D. (U) COMPARISON WITH FY-83 DESCRIPTIVE SUMMARY: Logical extension of FY 1983 effort.

E. OTHER APPROPRIATION FUNDS

Operation and Maintenance	FY 82	FY 83	FY 84	FY 85
NCS TOTAL	27,395	50,992	87,139	114.035

F. (U) DETAILED BACKGROUND AND DESCRIPTION:

Its objectives are the identification, test, and evaluation of prototype

The objectives of this initiative are (1) to identify and assess the

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FY 1984 RDT&E DESCRIPTIVE SUMMARY (U)

(U) Program Element: # 33127K Title Support of the NCS
(U) DoD Mission Area: Support & Base Communications #362 Budget Activity Intelligence & Communications - #5

(2) develop and implement cost effective measures for these facilities on a
and (3) develop and cause to be implemented design and maintenance practices for new facilities

(U) Standards Development:

(U) This initiative focuses on two complementary objectives (1) influencing/expediting the development of interoperability-determinant national and international standards for telecommunication and information systems to include features compatible with PD-53 objectives, and (2) adopting such national and international standards as mandatory Federal satndards, where appropriate.

G. (U) RELATED ACTIVITIES: Presidential Directive 53, stipulates that "... It is essential to the security of the United States to have telecommunications facilities adequate to satisfy the needs of the nation during and after any national emergency. ..... Moreover, a survivable communications system is a necessary component of our deterrent posture for defense. ..." In response to PD-53, several initiatives are being pursued by the Office of the Manager, NCS, e.g., Class 4/5 Switch Study, Survivable Satellite Program, Network Management, Common Carrier Interconnect, and Policy Initiatives.

H. (U) WORK PERFORMED BY: AT&T, Harry Diamond Laboratories, National Telecommunications and Infomation Administration, Institute for Telecommunication Sciences, Computer Technology Associates, and Booz, Allen, and Hamilton.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: $450 funded under PE 33126K

2. FY 1983 Program: $1990 funded under PE 33127K

a) Complete development of T1 carrier/Fiber Optic Transmission Systems design criteria and maintenance practices.

b) Complete identification of key facilities

3. FY 1984 Planned Program:

a) Complete development, test, and evaluation of fixes.
b) Begin installation of fixes to
c) Identify deficient and begin development, test , and evaluation of fixes.

(U) National, International, and Federal Standards:

a) Development of modem to terminal interface (ISDN)

b) Development of alternative key distribution concepts for the Data Encryption Standard (DES)

c) Development of a procedure for power transfer across galvanically isolated equipment

4. FY 1985 Planned Program:

a) Complete installation of fixes.

b) Begin installation of fixes

FY 1984 RDT&E DESCRIPTIVE SUMMARY (U)

(U) Program Element: # 33127K Title Support of the NCS
(U) DoD Mission Area: Support & Base Communications #362 Budget Activity Intelligence & Communications - #5

Continue development of standard design and maintenance practices for facilities using or supplementing as necessary to the maximum possible extent.

(U) National, International, and Federal Standards

Continuation of FY 1984 effort.

5. (U) Program to Completion: CONTINUING

6. Milestones:

Complete development, test and evaluation of		Sept 83
Complete development, test, and evaluation of	fixes	Sept 84
Installation of Fixes		Sept 83 - Sept 84
Installation of Fixes		Sept 84 - Sept 85

Complete development of T1 carrier/Fiber Optic Transmission Systems Design and maintenance practices. Jan 1984

Identification Oct 83 - Sept 84

Development of standard design and maintenance practices for facilities. Continuing

FY 1984 RDT&E DESCRIPTIVE SUMMARY (U)

(U) Program Element: # 33127K Title Support of the NCS
(U) DoD Mission Area: Support & Base Communications #362 Budget Activity Intelligence & Communications - #5

7. (U) Resources:

($ in Thousands)	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88
	1990	2877	4741	4675	4595	5168

(U) National, International, and Federal Standards:

Complete development of alternate key distribution concepts	Oct 83 - Sept 85
Complete development of a procedure for power transfer across galvanically isolated equipment.	Oct 84
Development of modem to terminal interface (ISDN)	Oct 83 - Sept 85

J. (U) TEST AND EVALUATION DATA: Not Applicable.

1. (U) Development Test and Evaluation: Not Applicable.

2. (U) Operational Test and Evaluation: Not Applicable.

3. (U) System Characteristics: Not Applicable.

RESEARCH, DEVELOPMENT, TEST AND EVALUATION DEFENSE AGENCIES

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

DEFENSE INTELLIGENCE AGENCY

FY 1984

JANUARY 1984

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DEPARTMENT OF DEFENSE - MILITARY
DEFENSE INTELLIGENCE AGENCY
RDT&E, DEFENSE AGENCY

SUMMARY BY BUDGET ACTIVITY
(IN THOUSANDS OF DOLLARS)

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
5. Intelligence and Communications				
Total Program				

SUMMARY BY PROGRAM CATEGORY

3.1 Operational Systems Development				
Total Program				

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE INTELLIGENCE AGENCY
RDT&E, DEFENSE AGENCY
PROGRAM ELEMENT LISTING

(Dollars In Thousands)

Element Code	Project No.	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
5. Intelligence and Communications						
3.1	Operational Systems Development					
3.13.01.L		General Defense Intelligence Program				
3.13.98.L		General Defense Intelligence Program				
3.51.59.L		Defense Reconnaissance Support Program				

ADDITIONAL JUSTIFICATION MATERIAL FOR THE DEFENSE INTELLIGENCE AGENCY PROGRAMS IS CONTAINED IN THE GENERAL DEFENSE INTELLIGENCE PROGRAM SECTION OF THE NATIONAL FOREIGN INTELLIGENCE PROGRAM CONGRESSIONAL BUDGET JUSTIFICATION BOOKS WHICH ARE AVAILABLE AT A HIGHER CLASSIFICATION AND REQUIRE SPECIAL ACCESS.

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RESEARCH, DEVELOPMENT, TEST AND EVALUATION DEFENSE AGENCIES

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

DEFENSE LOGISTICS AGENCY

FY 1984

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DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
PROGRAM ELEMENT LISTING
(IN THOUSANDS OF DOLLARS)

Program-wide Management and Support

Element Code	Title	FY 1982 ACTUAL	FY 1983 ESTIMATE	FY 1984 ESTIMATE	FY 1985 ESTIMATE
65801S	Defense Technical Information Center	14,574	16,000	18,760	20,647
65802S	Information Analysis Centers	3,200	4,000	5,840	7,830
	Total - DIRECT	17,774	20,000	24,600	28,477
	REIMBURSEMENTS				
65801S	Defense Technical Information Center	1,330	1,500	1,500	1,500
65802S	Information Analysis Centers	2,639	3,000	3,300	3,300
	Total - REIMBURSEMENTS	3,969	4,500	4,800	4,800
	GRAND TOTAL	21,743	24,500	29,400	33,277

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

A. RESOURCES/PROJECT LISTING: ($ IN THOUSANDS)

Project Number	Title	FY 1982 ACTUAL	FY 1983 ESTIMATE	FY 1984 ESTIMATE	FY 1985 ESTIMATE	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT						
1.0	RDT&E Information Services	2,727	2,646	2,618	2,774	Continuing	Not Applicable
2.0	Technical Report Services	5,234	5,740	6,691	7,756		
3.0	Development	458	833	2,097	1,640		
4.0	Systems Maintenance and Operational Improvements	2,104	2,388	2,595	3,454		
5.0	Management and Support	4,051	4,393	4,759	5,023		

B. BRIEF DESCRIPTION OF ELEMENT:

The Department of Defense pursues a coordinated and comprehensive Scientific and Technical Information Program (STIP) to ensure that scientific and technical information (STI) provides maximum contribution to the advancement of science and technology; permits timely, effective, and efficient conduct and management of DoD research, engineering, and studies program; and eliminates unnecessary duplication of efforts and resources by encouraging and expediting the interchange and use of STI. The STIP provides for interchange of STI within and among DoD components and their contractors, federal agencies, their contractors, and the national and international scientific and technical community.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

The STIP is a basic and integral part of the Office of the Under Secretary of Defense for Research and Engineering (OUSDR&E) function. The Defense Technical Information Center is designated to provide a source of STIP services to assist in carrying out STIP policy and administration; to perform technical information support services for OUSDR&E and OSD Principal Staff Assistants; to operate DoD-wide STI systems; to act as a central coordinating point for DoD STI data bases and systems; and to explore and demonstrate new supporting technology.

The Defense Technical Information Center provides centralized operation of specific STIP functions such as technical document access and dissemination, data base and reference services, and coordination of the activities of assigned DoD Information Analysis Centers in order to improve both the scope and effectiveness of collecting, processing, and disseminating STI.

C. BASIS FOR FY 1984 RDT&E REQUEST:

The Defense Technical Information Center's mission consists of three basic and two support projects. Basic projects are: 1.0, RDT&E Information Services, providing for a centralized point for supporting the Department of Defense RDT&E Program with information on planned and current research efforts of both in-house and contractor activities; 2.0, Technical Report Services, providing a central source of documented results of research resulting from or pertinent to DoD RDT&E efforts; and 3.0, Development, for experimentation and study programs to increase research effectiveness and productivity, and to ensure that the Scientific and Technical Information Program is served by innovative and effective information systems that take advantage of new advances in information science and technology. Support efforts at DTIC include: 4.0, Systems Maintenance and Operational Improvements, providing ADP support to all DTIC data bases and the Defense Research On-Line System (DROLS), an extensive network of over 500 terminals in a DoD-wide interactive research information system; and 5.0, Management and Support, providing support to DTIC mission activities in common areas such as indexing and retrieval terminology control, maintenance of central authority files to control access to and dissemination of classified, limited, or proprietary data, and for normal organizational management and administrative support.

D. BASIS FOR INCREASE IN FY 1984 OVER 1983:

The FY 1984 program provides for program growth to match increasing workloads. DTIC's workloads have been growing at approximately 7% per year for the past 10 years, consistent with the Center's charter to improve the awareness, availability, accessibility, and utility of scientific and technical information. During the same

period, DTIC's funding has been reduced by approximately 30% in real terms, and personnel authorizations have remained fairly constant. The resultant productivity increases have been supported primarily by automation of processes and investment in productivity enhancing operating equipment. General fund reductions over the past 4 fiscal years, however, have permitted little or no investment in new or replacement equipment, and have severely constrained DTIC efforts to explore and demonstrate new supporting technology as mandated by the OUSDR&E. Backlogs that sometimes approach levels four times higher than program have resulted in missed production goals despite unprecedented levels of overtime use. Funding reductions have forced DTIC to take action to constrain the demand for its products and services despite the fact that such action is contrary to its stated mission of expanding the use of STI to promote RDT&E productivity growth.

The FY 1984 request provides for increased personnel to accommodate an expected increase of 10% in technical document distribution workloads, a 15% increase in bibliographic and reference services, and the addition of 75 new terminal sites to the 615 expected to be in the Defense Research On-Line System at the end of FY 1983. It provides for expanded efforts in the development of new information support technologies, with major emphasis on projects designed to enhance DTIC's role as a centralized DoD access point to scientific and technical information resident in other federal and selected commercial data bases, thereby reducing administrative costs and increasing the productivity of scientists, engineers and R&D managers throughout the DoD. It also provides funds for replacement of aged and worn operating equipment needed to support basic mission operations.

E. PERSONNEL IMPACT:

	RDT&E	Procurement	Total
The average number of employees supported with requested FY 1984 funds is as follows:			
(1) Federal Civilian Employees	475	0	475
(2) Contractor Employees	0	0	0
TOTAL	475	0	475

F. TERMINATION COST:

Not applicable.

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #1.0 Title: RDT&E Information Services

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

BACKGROUND AND DESCRIPTION: This program supports the planning, management, and conduct of DoD RDT&E Programs by providing comprehensive data bases of planned and current research and engineering efforts of both in-house and major contractor facilities. The data bases are an effective information resource for R&D planners, managers, scientists and engineers, and information professionals in DoD and the Defense-related industry and academic communities, and provide a resource for coordinating R&D efforts between DoD components, other Federal agencies, and their contractors. The exchange of knowledge on planned and on-going RDT&E efforts between DoD and its contractor base enables both DoD and industry capabilities to be focused on defense requirements in a complementary and nonduplicative manner. Centralization of the information reduces the overall cost of RDT&E by avoiding duplication, and increases productivity of the program by promoting collaboration, i.e., allowing managers and performers to identify others working in similar areas. Specifically included in this program are: the Research and Technology Work Unit Information System (R&TWUIS), a data base of all on-going Defense research at the work unit level; the Independent Research and Development (IR&D) data base which contains descriptions of planned and current independent research efforts of major Defense contractors; and the Manpower and Training Research Information System (MATRIS), which provides work unit level data and Congressionally-required reports on manpower and training research in DoD. Also included in this program is the support and operation of the Defense RDT&E On-Line System (DROLS) which provides interactive access to all DTIC data bases and supports a rapidly growing network of over 500 terminals across the country.

RELATED ACTIVITIES: No similar centralized Department of Defense program exits.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #1.0 Title: RDT&E Information Services

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

WORK PERFORMED BY: Systems and procedures for input to and output from the data bases are controlled in-house by the Defense Technical Information Center. In keeping with Department of Defense policy for handling sensitive and proprietary data, the computer programs that control input and output operations within the program are written and maintained in-house.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments:

a. Since FY 1972 output services have been available from the Research and Technology Work Unit System data base, the Research and Development Program Planning data bank and the Independent Research and Development data bank. In 1973, operational status of the Defense RDT&E On-Line System was achieved which permitted remote terminal access into the data collections of the Defense Technical Information Center. At the end of FY 1981, there were 322 terminals connected to the DROLS network including 69 dedicated/classified, 40 dedicated/unclassified, 167 dial-up/unclassified, and 46 in-house terminals. In FY 81, there were 110,766 transactions to create or change data base records, 25,483 printed outputs and 325,043 on-line interrogations.

b. In FY 1982, expansion of the Research, Development, Test, and Evaluation On-Line System continued. A total of 540 terminals were utilized for retrieval. Workloads, including changes to the data base records, were 588,000 transactions, including 450,000 searches from remote terminal users.

c. During FY 1982, DTIC supported an effort to review and revise the R&TWUIS. A proposed R&TWUIS regulation, now in coordination, is expected to strengthen the R&TWUIS reporting requirement and improve the currency and content of the data base. Similar effort was initiated to improve control of and input to the IR&D data base.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #1.0 Title: RDT&E Information Services

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

2. FY 1983 Planned Program

a. In FY 1983, 85 terminals will be added to the Research, Development, Test, and Evaluation On-Line System. The estimated workload to be performed is 660,000 transactions, including 520,000 remote terminal searches.

b. FY 1983 is the first year of operating the Manpower and Training Research Information System at DTIC.

c. Effort will continue in FY 83 to improve the R&TWUIS. Changes to the data structure of the data base will be proposed to improve the recording and retrieval of R&D program data and to accommodate planning data. A significant increase in size and activity of the IR&D data base is anticipated.

3. FY 1984 Planned Program

a. Estimated workload is 737,000 transactions including 585,000 remote terminal searches. Seventy-five terminals will be added to the system.

b. Funding requirements for FY 84 are not significantly changed from FY 83 requirements.

4. Program to Completion

This is a continuing program.

RESOURCES: (IN THOUSANDS OF DOLLARS)	FY 1982	FY 1983	FY 1984	FY 1985	Additional to Completion	Total Estimated Cost
RDT&E Funds: Information Services	2,727	2,646	2,618	2,774	Continuing	Not Available

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #2.0 — Title: Technical Report Services

Program Element 65801S — Title: Defense Technical Information Center

Mission Area 610 — Budget Activity: #6 Program-wide Management and Support

BACKGROUND AND DESCRIPTION: The Defense Technical Information Center is the central facility of the Department of Defense for acquisition and dissemination of documentation of research sponsored by or pertinent to the DoD Research, Development, Testing and Evaluation Program. Over one and a half million documents are available to registered users depending on their level of security clearance and field of interest. The collection represents the investment of hundreds of billions of dollars in research and engineering spent over the past 40 years in the DoD, and exists primarily to ensure that benefits of prior research are used to full advantage and to prevent duplication of research activities. The availability of newly accessioned documents are announced every 2 weeks. A data base that includes full cataloging information and an abstract for each document is searchable interactively by users of the Defense Research On-Line System (DROLS). Services provided within this project also include dissemination of bibliographies and/or full text copies of reports in full size or microimage formats. Services are provided on request or automatically based on profiles of subject area interest.

RELATED ACTIVITIES: Initial distribution of domestic technical documents is made by the performing military service to Department of Defense research and development engineering and scientific personnel and their contractors. Acquisition and storage of these documents at the Defense Technical Information Center provide a facility for centralized secondary distribution of unclassified, limited, and classified documents to other Department of Defense research and development activities and their contractors when they are registered with Defense Technical Information Center. DTIC provides the centralized service for the Department of Defense.

WORK PERFORMED BY: The Defense Technical Information Center provides and performs services for input, announcement and retrieval of unclassified, limited, and classified documentation in-house. Composition for Defense Technical Information Center's announcement publications are performed by the Government Printing Office (GPO), while printing is performed in-house. Composition and printing of Annual Indexes is performed by the Government Printing Office.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #2.0 Title: Technical Report Services

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments:

a. In FY 1981, as well as in prior years, the acquisition and secondary distribution of Department of Defense technical reports were accomplished by the Defense Technical Information Center.

b. New information transfer capabilities are allowing substantial success to be achieved in this project. Workloads in input and changes remain fairly constant at approximately 60,000 documents. Workloads in report distribution are up 8% over last year to 1.1 million. The number of bibliographies provided was up 20% to 70,000. External interrogations of the Technical Report Data Base were up 40% to 402,000.

2. FY 1983 Planned Program:

a. Workloads in input and changes are expected to increase moderately. Output workloads are expected to continue their substantial growth with report distribution increasing about 10% to 1.2 million, bibliographies up 15% to 81,000 and external interrogations up 20% to 480,000.

b. Increase in funding in FY 83 is required to support workload growth and to finance Oct 82 pay raise.

3. FY 1984 and FY 1985 Planned Programs:

a. Workloads are expected to continue growth at the rates programed in FY 1983.

b. Increased funding requirements in FYs 1984 and 1985 result from an increase in personnel costs to support workload growth and planned purchase of replacement and automatic data processing equipment (ADPE).

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #2.0 — Title: Technical Report Services

Program Element 65801S — Title: Defense Technical Information Center

Mission Area 610 — Budget Activity: #6 Program-wide Management and Support

4. Program to Completion:

This is a continuing program.

RESOURCES: (IN THOUSANDS OF DOLLARS)

	FY 1982	FY 1983	FY 1984	FY 1985	Additional to Completion	Total Estimated Cost
RDT&E Funds: Technical Report Services	5,234	5,740	6,691	7,756	Continuing	Not Applicable

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #3.0 Title: Development

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

BACKGROUND AND DESCRIPTION: This program is directed toward increasing the availability and transfer of Defense Scientific and Technical Information (STI) among DoD scientists, engineers, and R&D managers, thereby increasing productivity and effectiveness of Defense Research, Development, Test, and Evaluation (RDT&E) efforts. Continued development of improved STI systems, products, and services is a vital part of the Defense RDT&E program and will ensure that DoD scientists, engineers, and R&D managers will have an adequate and responsive flow of information to support new RDT&E efforts. The development program has produced many significant improvements that enable the more effective access and use of DoD's highly valuable asset, its technology base. They include (1) a Defense-wide capability to access classified and unclassified RDT&E data bases via remote telecommunications terminals (DROLS system). This reduced the time for a researcher to obtain answers to technical inquiries from weeks to minutes; (2) a computer time sharing service (DTSS) that allows experimentation with and rapid building of new data bases to support Defense program managers controlling major Defense programs such as manufacturing technology and manpower and training research. This service is accessible using dial-up computer terminals through regular telephone lines or TYMNET, a commercial data communications network; (3) experimentation and development of a free-text search capability within DoD RDT&E management data bases maintained at DTIC. Free text searching provides additional flexibility and more comprehensive search results; (4) experiments with remote direct input of data into DTIC maintained data bases resulted in reduced overall system costs. The Shared Bibliographic Input Network (SBIN), as it is now called, is expanding in both participants and capabilities.

RELATED ACTIVITIES: DTIC provides unique STINFO services within the DoD.

WORK PERFORMED BY: The development effort is performed in-house for the most part; however, the Defense Technical Information Center does contract for short-term, one-time development efforts for which it would be uneconomical to hire and maintain in-house staff and equipment capabilities on a continuing basis.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #3.0 Title: Development

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments:

In prior years, the Defense Technical Information Center's development effort resulted in:

a. The Defense Research, Development, Test, and Evaluation (RDT&E) On-Line System (DROLS) which provides interactive access to DTIC-maintained DoD data bases of Research, Development, Test, and Evaluation data via a nationwide network of remote telecommunications terminals. This system now provides access to DoD-sponsored RDT&E information to over 500 remote sites and enables its users to significantly reduce the time and expense of researching prior RDT&E and avoid duplication of expensive RDT&E effort.

b. An Information Analysis Center service support program to allow the Information Analysis Center (IACs) to share the centralized document and automated data processing facilities of the Defense Technical Information Center. This resource sharing offsets the need for each IAC to have its own automated systems and to take advantage of this technology at DTIC.

c. Development and implementation of a Shared Bibliographic Input Network (SBIN) that is reducing data input costs for DoD data bases maintained at DTIC through the concept of resource sharing. The SBIN now includes 30 separate DoD sites and is expanding its participants and capabilities.

d. Development of a project to assist DoD laboratories/libraries to gain access to commercial on-line services providing broader information resources not previously available to them.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #3.0 Title: Development

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

e. Direct assistance to DUSDR&E in developing and obtaining specific improvements to the DoD Technical Information Program and assisting in the experimentation with the implementation of improved electronic information systems and devices to support the DUSDR&E requirements. Included was the planning and implementation of a DoD-wide technical information conference for R&D managers.

f. Implemented free text (i.e., not constrained by a dictionary of index terms) retrieval capabilities for RDT&E management data bases. This provided a capability for retrieval which allows greater flexibility and more thorough coverage of the technical subject.

g. Developed a Defense ADP Time Sharing Service to meet information system design support and operational needs of R&D program managers. It also provides interactive data base design support for DTIC that is not available on DTIC's primary computer because of security constraints.

2. FY 1983 Planned Program:

a. To establish programs and services to enable DTIC to function as a single point of access for scientific and technical information (STI) within DoD:

(1) Complete development of the DoD Data Base of Data Bases which is designed to provide a comprehensive and time saving reference index to access computer-readable DoD-sponsored R&D data bases located at other than the Defense Technical Information Center.

(2) Continue development of an intelligent gateway computer system (IGCS) which will allow DoD components convenient access to previously inaccessible information relevant to the DoD mission that is resident in other government and commercial data bases. The IGCS will allow post processing of this information to meet user needs and thus add value and extract intelligence from data retrieved.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #3.0 Title: Development

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

(3) Continue to investigate alternatives for replacing the management planning data base and develop plans for implementation of a new system that will better meet the planning needs of industry and in-house management.

(4) Provide direct support to the OUSDR&E-sponsored annual Technical Information Conference with the objective of broadening the base of STI requirements within the DoD/Industry community.

(5) Complete efforts to assess the current and long term advantages/disadvantages to DTIC in joining ARPANET.

b. To improve the usefulness of Defense scientific and technical information products and services:

(1) As part of SBIN refinement, initiate a project to develop a local automation model that can be used by all SBIN sites to establish a standardized local file capability that will permit individual site control of selected records in a format compatible with DROLS. Expected benefits include reduced costs through the development of a standardized system for all SBIN sites.

(2) Demonstrate the feasibility of using microcomputers at remote sites to access the DTIC data bases and reformat the data according to customer needs. This capability will provide reports which are now compiled manually.

(3) Implement and assess free text retrieval capability for the unclassified title field in the Technical Report file (DD 1473). This capability will substantially reduce the time necessary for an individual to search for specific documents when limited identification is available. This will also improve DTIC's ability to locate and acquire new DoD technical reports in support of the RDT&E effort.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #3.0 Title: Development

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

(4) Continue refinement of the DTIC ADP Time Sharing Service by strengthening control mechanisms and procedures to ensure that system resources are used in an efficient and effective manner and in accordance with DTIC policy statements.

c. To improve the processes involved in collecting, storing and disseminating STI:

(1) Develop and implement a capability for computer assisted instruction for DROLS. This system should help reduce costs now incurred under the present method of training.

(2) Complete the feasibility study and implement procedures for selective prototype alternatives to hard copy document input. Specifically, DTIC will develop a new system to accept microfiche and other media in lieu of paper copies and will modify existing systems. Benefits expected include reduced reproduction costs, quicker input to DTIC, more timely dissemination to users, and increased acquisition for the DTIC Technical Report file.

(3) Complete a study which will identify optical character recognition applications at DTIC, determine the feasibility and cost effectiveness and procure recommended equipment if justified.

(4) Develop procedures to provide access to individually authored papers within unclassified/unlimited proceedings, symposia, annals, etc., which are submitted to DTIC for input into the Technical Reports Data Base.

d. The FY 83 program supports continuation of three minor ongoing contractual efforts and a moderate increase in in-house development staff. Most projects in both FY 82 and FY 83 that required contractual or equipment support were deferred until FY 84.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #3.0 Title: Development

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

3. FY 1984-85 Planned Program:

a. Continue expanding Defense Technical Information Center's role in providing convenient access within DoD to STINFO-related services or resources.

(1) Continue analysis of and experimentation with exploitable new technologies and concepts for information transfer.

(2) Identify and assess new or changed requirements, trends, or priorities for the use of technical information or information services, explore methods to characterize and analyze information needs and practices of principal activities and target groups within the information user and generator communities.

(3) Acquire equipment to support the intelligent gateway computer system.

(4) Complete investigation and begin implementation of system to replace the program planning data base.

b. Continue to improve the usefulness of Defense STI programs and services.

(1) Continue to explore new ways of sharing resources amoung the DoD, military services, and other government agencies, including local automation models, local microcomputing capabilities, full text storage and retrieval studies, and networking feasibility for the above.

(2) Continue investigation of innovative techniques to enhance the scope and effectiveness of DoD document and data base systems, services and products.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #3.0 Title: Development

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

c. Continue to improve the processes involved in collecting, storing, and disseminating STI:

(1) Investigate techniques and equipment for converting technical information, including graphics, to digital bit streams for storage, retrieval, and transmission.

(2) Complete cooperative efforts with DoE, NASA and DoC for standardizing technical data elements.

d. Increase in FY 1984 funding is required to initiate projects to explore and develop new supporting technologies as mandated by OUSDR&E. General fund reductions in previous years essentially restricted effort in this mission area to projects that required no contractual or equipment support. Funding requirement in FY 84 incorporates one-time purchase of equipment, reducing the level of funding needed in FY 85.

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

RESOURCES: (IN THOUSANDS OF DOLLARS)

		FY 1982	FY 1983	FY 1984	FY 1985	Additional to Completion	Total Estimated Cost
RDT&E Funds:	Development	458	833	2,097	1,640		

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #4.0 Title: Systems Maintenance & Operational Improvement

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

BACKGROUND AND DESCRIPTION: This is a continuing program which provides for the effort associated with the developmental functions of conceptual design, systems analysis and programing for all ADP systems as well as applying existing techniques, equipment and technology to operating systems to extend their capabilities or to improve their performance. The purpose of this effort is to provide technical personnel in direct support of the Defense Technical Information Center's Automatic Data Processing Application Systems. These systems are developed and maintained solely by DTIC ADP personnel and involve use of sophisticated and advanced concepts. Major automatic data processing applications include the Defense Research, Development, Test, and Evaluation On-Line System, the DTIC ADPE Time Sharing Service, Technical Report System (DD 1473), Work Unit Information System (DD 1498), Research and Development Program Planning (DD 1634) System, and the Independent Research and Development System with functional subsystems for input, update, file maintanance, retrieval, announcement/publication, reports generation, inventory, and demand and automatic distribution. The On-Line System provides direct access to data stored on the DTIC ADP systems to over 500 DoD and governmental activities. The Defense Technical Information Center application systems, which operate against four Defense Research, Development, Test, and Evaluation data banks and related ancillary/reference files, encompass some 15 subsystems and a computer program inventory of over 500 production programs. Included also is the effort to maintain data files and monitor operational readiness and availability of automatic data processing systems, control cryptographic equipment, and monitor the on-line system. In addition, efforts for the test and assemblies of new or changed procedures or programs are included.

RELATED ACTIVITIES: None.

WORK PERFORMED BY: Effort is performed in-house at the Defense Technical Information Center; however, the Defense Technical Information Center does contract for short-term, one-time efforts for which it would be uneconomical to hire and maintain in-house staff.

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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #4.0 Title: Systems Maintenance & Operational Improvements

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments:

a. Supported the acquisition and expansion of Information Analysis Center (IAC) data bases. This reduced the overall cost of operating these centers while providing greatly expanded access to this data to DoD activities and other government agencies.

b. Implemented a Shared Bibliographic Input System that provides DTIC On-Line users the capability of inputting formatted data into the Technical Report System data bank. This capability allows remote DTIC users the opportunity to store and retrieve cataloging data directly into and from the data bank thereby eliminating the need for duplicate systems and reducing the overall cost for storing this data.

c. Implemented unclassified dial-up access to optimize the use of the Defense Research, Development, Test and Evaluation On-Line System. This capability provided a low cost means to access the on-line system thereby greatly expanding the availability of needed scientific and technical information to the DoD community.

d. Added a limited text search capability, title searching, and tape cassette output capability to the Defense Research On-Line System (DROLS). This enhanced the users ability to find needed information when searching on-line.

e. Continued system and programing support for maintenance and other operational improvements of all Defense Technical Information Center Automatic Data Processing Applications.

f. Expanded On-Line System Automatic Data Processing capability consistent with the needs of the Defense Research, Development, Test and Evaluation On-Line System.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #4.0 Title: Systems Maintenance & Operational Improvements

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

g. Implemented Defense Research, Development Test and Evaluation On-Line System interface with a generalized Data Base Management System.

h. Implemented DTIC Time Sharing Facility (DTSF) which provides remote access to the 1108 system at DTIC for interactive program and data base development. This will reduce the cost to DoD activities of creating and maintaining data files.

i. Installed a high speed electronic printing system which substantially reduced print time at a lower cost. This system permits the placement of data on forms electronically, thereby eliminating the need for preprinted forms.

j. Installed and began acceptance testing on a Front End Processor for use with the Defense Research, Development, Test and Evaluation On-Line System. This state-of-the-art equipment will provide more flexible service to users.

2. FY 1983 Planned Programs:

a. Continue system and programing support for maintenance and other operational improvements of all automatic data processing applications.

b. Continue conversion of programs to a higher order programing language using a Data Base Management System.

c. Commence conceptual redesign of the Defense RDT&E On-Line System.

3. FY 1984 Planned Programs:

a. Continue system and programing support for maintenance and other operational improvements of all automatic data processor applications.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #4.0 Title: Systems Maintenance & Operational Improvements

Program Element 65801S Title: Defense Technical Information Center

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

b. Installation of replacement cryptographic equipment.

c. Begin acquisition process for competitive replacement of ADP systems.

4. FY 1985 Planned Programs:

a. Continue system and programming support for maintenance and other operational improvements of all automatic data processing applications.

b. Prepare competitive procurement for replacement ADP systems.

c. Plans for contractual assistance preparatory to the ADPE replacement system and planned purchase of terminals increase the FY 1985 funding requirements.

5. PROGRAM TO COMPLETION:

This is a continuing program.

RESOURCES: (IN THOUSANDS OF DOLLARS)		FY 1982	FY 1983	FY 1984	FY 1985	Additional to Completion	Total Estimated Cost
RDT&E Funds:	Systems Maintenance and Operational Improvements	2,104	2,388	2,595	3,454	Continuing	Not Applicable

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #5.0 — Title: Management and Support

Program Element 65801S — Title: Defense Technical Information Center

Mission Area 610 — Budget Activity: #6 Program-wide Management and Support

BACKGROUND AND DESCRIPTION: This program provides support to DTIC mission activities in common areas such as technical terminology and vocabulary control, central authority files for dissemination of classified and limited information, and normal organizational management and administrative support.

RELATED ACTIVITIES: None.

WORK PERFORMED BY: Technical terminology and central registry functions are performed in-house. Administrative and management operations are performed in-house with the exception of support functions that can be provided on a station-wide basis. These services are provided by the Defense Logistics Agency Administrative Support Center at Cameron Station, Alexandria, Virginia, on a reimbursable or common service basis.

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: Emphasis will continue to be placed on obtaining administrative support and logistic functions at the most efficient level to accomplish the Defense Technical Information Center's mission. Decreased effort will be expended on the Technical Terminology Program as editing of the Natural Language Data Base terms has been completed. Effort in the Scientific and Technical Information Central Registry will remain at the same level.

An increase in funds is required in FY 1983 for replacement of the security alarm system and for the pay raise effective 1 Oct 82.

Construction and maintenance support from Corps of Engineers is planned in FY 1984 for improvement in environmental conditions and energy conservation in working areas of the R&D facility, particularly in support of ADP operations.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #5.0

Title: Management and Support

Program Element 65801S

Title: Defense Technical Information Center

Mission Area 610

Budget Activity: #6 Program-wide Management and Support

PROGRAM TO COMPLETION: This is a continuing program

RESOURCES: (IN THOUSANDS OF DOLLARS)

	FY 1982	FY 1983	FY 1984	FY 1985	Additional to Completion	Total Estimated Cost
RDT&E Funds: Management and Support	4,051	4,393	4,759	5,023	Continuing	Not Applicable

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element 65802S | Title: Information Analysis Centers

Mission Area 610 | Budget Activity: #6 Program-wide Management and Support

A. RESOURCES/PROJECT LISTING ($ IN THOUSANDS)

Project Number	Title	FY 1982 ACTUAL	FY 1983 ESTIMATE	FY 1984 ESTIMATE	FY 1985 ESTIMATE	Additional to Completion	Total Est. Cost
1.0	TOTAL FOR PROGRAM ELEMENT	$3,200	$4,000	$5,840	$7,830	Continuing	N/A

B. BRIEF DESCRIPTION OF ELEMENT: This program element provides funding for ten contractor-operated Information Analysis Centers (IACs). The role of an IAC in national defense is to assure that the Department of Defense (DoD) carries out its mission timely and effectively by serving as a focal point for authoritative expertise and maintaining a national data base within its scope of coverage. The IACs are, by their very nature, very close to the leading edge of technology and in several cases bear directly or indirectly on DoD designated high thrust areas. They provide responses to direct technical inquiries, as well as technical handbooks and data books, state-of-the-art reports, critical reviews, and technology assessments in their assigned areas of technology. The aim of these services is to improve weapons reliability, engineering decisions, and development lead time and provide a means for increasing the productivity of defense scientists and engineers through reduction of duplication and evaluation programs. These centers are contractor operated.

C. BASIS FOR FY 1984 RDT&E REQUEST: During FY 1984 the efforts to increase the effectiveness of the centers and enhance their capability to meet identified user needs will be continued. Technical areas of primary emphasis will include carbon-carbon composite materials, metal-matrix materials and applications, and support of the manufacturing technology program. During the year the centers will collectively acquire more than 35,000 new sources of technical information, answer approximately 1,300 technical inquiries, and update, expand, or complete more than 30 handbook/databook volumes. The centers will also complete a variety of state-of-the-art reports, critical reviews, and technology assessments within their specialized area of technology.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element 65802S | Title: Information Analysis Centers

Mission Area 610 | Budget Activity: #6 Program-wide Management and Support

D. BASIS FOR DATA BASE INCREASE IN 1984 OVER 1983: One of the nation's problems currently being highlighted is the need to improve the productivity of the nation's industrial base and particularly, the defense industrial base. During the next five years the DoD Manufacturing Technology Program (MTP) will invest roughly $1.3+ billion in advanced Manufacturing Technology (MT) needed for the production of DoD weapons systems. In order for DoD and the nation to take fullest advantage of these investments, the output of the MTP products must be conveniently available to the defense industrial base. In support of this need $0.46 million was added to support the establishment of the Manufacturing Technology Information Analysis Center. Additionally, during a period of general inflation in the economy, the basic level of funding for IACs has been straight-lined. Negative real growth has curtailed the effectiveness of the nine existing IACs. To prevent further reduction in the component of professional technical analysis in IACs and enable the IACs to accomplish the requirements imposed by DLA/DTIC in the Statement of Work in current contracts, a five percent inflation factor is added in FY 1984.

E. PERSONNEL IMPACT:

The average number of employees supported with requested FY 1984 RDT&E Funds is as follows:

	RDT&E	Procurement	Total
(1) Federal Civilian Employees	-	-	-
(2) Contractor Employees	120	-	120

F. TERMINATION COST:

	FY 1983 & Prior Funds	FY 1984 Funds	Total
(1) Estimated Government Liability Financed with:	N/A	N/A	N/A

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #1.0

Program Element 65802S

Title: Information Analysis Centers

Mission Area 610

Budget Activity: #6 Program-wide Management and Support

BACKGROUND AND DESCRIPTION: This program element provides funding for the operation of ten contractor operated Information Analysis Centers. The centers collect, review, and analyze the results of research and development in certain well defined areas of technology. These areas include chemical propulsion, engineering properties of materials, infrared physics, metal matrix composites, reliability data on electronic components, software technology, manufacturing technology, and tactical weapons guidance and control systems. Based on their review and analysis, the scientists and engineers at the centers synthesize, repackage, and disseminate the information in a format most useful to Department of Defense scientists and engineers. The services provided by the centers include responses to inquiries in their fields of special competence; preparation, publication, and updating of engineering reference works; products and services of the centers are provided on a service-charge basis to DoD components, contractors and grantees, U.S. Government agencies, and, to the extent practical, the private sector. The income thus obtained is reintroduced into the program for the development of additional products and services. The aim of these services is to improve weapons reliability, engineering decisions, and development lead time and to provide a means of increasing the productivity of defense scientists and engineers through reduction of duplicative test and evaluation programs.

RELATED ACTIVITIES: There are ten other designated DoD centers, managed by other DoD components, which provide similar services within other well defined technical areas such as hydraulic engineering, plastics, soil mechanics, and concrete technologies.

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #1.0

Program Element 65802S

Title: Information Analysis Centers

Mission Area 610

Budget Activity: #6 Program-wide Management and Support

WORK PERFORMED BY: (FY 1983)

INFORMATION ANALYSIS CENTER	CONTRACTOR & CENTER LOCATION
Chemical Propulsion Information Agency	Applied Physics Laboratory, Johns Hopkins Univ, Laurel, MD
Infrared Information & Analysis Center	Environmental Research Institute of Michigan, Ann Arbor, MI
Metals and Ceramics Information Center	Battelle Memorial Institute, Columbus, OH
Nondestructive Testing Information Analysis Ctr	Southwest Research Institute, San Antonio, TX
Reliability Analysis Center	IIT Research Institute, Rome, NY
Tactical Weapon Guidance and Control Information Analysis Center	IIT Research Institute, Chicago, IL
Thermophysical & Electronic Properties Information Analysis Center	Purdue University, West Lafayette, IN
Metal-Matrix Composites Information Analysis Ctr	Kaman-Tempo, Santa Barbara, CA
Data and Analysis Center for Software	IIT Research Institute, Rome, NY

DEPARTMENT OF DEFENSE - MILITARY
DEFENSE LOGISTICS AGENCY
RESEARCH, DEVELOPMENT, TEST & EVALUATION, DEFENSE AGENCIES
FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #1.0

Program Element 65802S

Title: Information Analysis Centers

Mission Area 610

Budget Activity: #6 Program-wide Management and Support

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments: The FY 1982 program emphasized the modification of center scopes, products, and services intended to increase the effectiveness of the centers in meeting the identified priority evaluated information needs of DoD scientists and engineers. The number of documents in the DLA Information Analysis Centers files reached an aggregate of 650,000 records. Significant publications include the Guidance Law Handbook for Classical Proportional Navigation, the Infrared Handbook, the Nondestructive Testing Handbook, the Structural Alloys Handbook, and a new addition of the Machining Data Handbook. Additionally, a new center specializing in information relative to metal-matrix materials was established.

2. FY 1983 Planned Program: The FY 1983 program will be conducted in substantially the same manner as the FY 1982 program with a continuation of modifications intended to enhance the value of the centers to the overall defense RDT&E program and to increase the operating efficiency of the centers. During the year, the centers will acquire approximately 35,000 new sources of technical information, answer approximately 1,200 technical inquiries, and complete and disseminate a variety of handbooks, databooks, state-of-the-art reports, and special studies.

3. FY 1984 Planned Program: During FY 1984 the implementation of required modifications will continue and emphasis will be placed on the development of information identified as priority needs of DoD. DTIC will assume responsibility for the management of the Data and Analysis Center for Software and the Manufacturing Technology Information Analysis Center will be established. Efforts in support of metal-matrix composite materials will be intensified.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Project #1.0

Program Element 65802S Title: Information Analysis Centers

Mission Area 610 Budget Activity: #6 Program-wide Management and Support

4. FY 1985 Planned Program: During FY 1985, the efforts indicated in FY 1984 will be continued, and operational control and funding responsibility for the survivability/vulnerability information analysis center (SURVIAC) for aircraft systems will be transferred to DTIC from the Joint Logistics Commanders.

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

RESOURCES: ($ IN THOUSANDS)

	FY 1982 ACTUAL	FY 1983 ESTIMATE	FY 1984 ESTIMATE	FY 1985 ESTIMATE	Additional to Completion	Total Estimated Cost
Total for Program Element	$3,200	$4,000	$5,840	$7,830	Continuing	Not Applicable

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RESEARCH, DEVELOPMENT, TEST AND EVALUATION DEFENSE AGENCIES

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

UNIFORMED SERVICES UNIVERSITY OF HEALTH SCIENCES

FY 1984

JANUARY 1984

SUMMARY BY PROGRAM CATEGORY
UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
($ In Thousands)

		FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
6.1	Research	1,650	1,800	1,800	1,874
6.2	Exploratory Development				
6.3	Advanced Development				
6.4	Engineering Development				
6.5	Management and Support				
	Total Research and Development (Program 6)	1,650	1,300	1,800	1,874
	Total Operational Systems Program	-	-	-	-
	Total RDT&E - Direct	1,650	1,800	1,800	1,874
	Reimbursements	2,018	4,000	5,000	5,500
	TOTAL PROGRAM	$3,668	$5,800	$6,800	7,374

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SUMMARY BY BUDGET ACTIVITY
UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
($ IN THOUSANDS)

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
1. Technology Base	1,650	1,800	1,800	1,874
2. Advanced technology development				
3. Strategic programs				
4. Tactical programs				
5. Communications and electronics				
6. Defense-wide mission and support				
TOTAL RDT&E - DIRECT	1,650	1,800	1,800	1,874
Reimbursements	2,018	4,000	5,000	5,500
TOTAL PROGRAM	$3,668	$5,800	$6,800	$7,374

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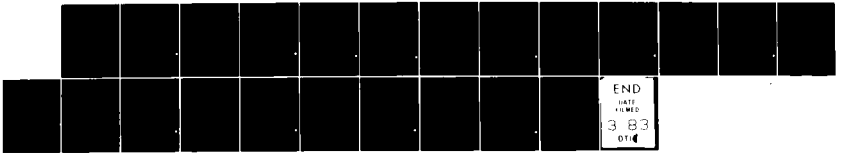

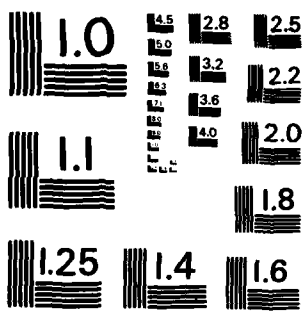

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: #61101W
DoD Mission Area: #310 Defense Research

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

A. RESOURCES: (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	$1,650	$1,800	$1,800	$1,874	Continuing Programs	Continuing Programs

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:

The research program is designed to answer basic medical questions of importance to the mission of the Department of Defense. This program currently includes research in the areas of: Combat Casualty Care, Systems Biotechnology, Infectious Diseases, and Ionizing Radiation Bioeffects.

C. BASIS FOR FY 1983 RDT&E REQUEST:

The USUHS Research Program, being an integral part of the teaching mission of the USUHS, is a continuing program. The FY 1983 request will allow for the continuation of research that is currently ongoing. It will also provide for an expansion of those programs and the beginning of investigations into other fields of importance to the military mission.

D. COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY:

RDT&E	FY 1982	FY 1983	FY 1984	Additional to Completion	Estimated Cost
Funds (current requirements)	1,650	1,800	1,800	Continuing	N/A
Funds (as shown in the FY 1983 submission)	1,650	1,800	1,824	Continuing	N/A

E. OTHER APPROPRIATION FUNDS: N/A

F. DETAILED BACKGROUND AND DESCRIPTION:

The faculty of the Uniformed Services University of the Health Sciences conducts basic biomedical research in the health sciences. Faculty involved in the teaching programs must engage in research in their own areas of expertise to remain current with the advances in scientific knowledge. Students acquire a foundation for continuing self-education by observation of scientific methods and direct exposure to working professionals.

G. RELATED ACTIVITIES:

Some of this investigative effort is in collaboration with Walter Reed Army Medical Center; Walter Reed Army Institute of Research; National Naval Medical Center; the Naval Medical Research Institute; the Armed Forces Radiobiology Research Institute; and the National Institutes of Health. However the bulk of the effort is specialty-oriented research conducted in the basic sciences of the University laboratories.

H. WORK PERFORMED BY:

All work performed in this Program Element is done in-house. Research activities are coordinated at DoD level in an attempt to avoid duplication of effort with other medical research programs within the Agency. Special efforts are made to coordinate with the appropriate service where lead agency status has been established in specific areas of medical research.

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1982 and Prior Accomplishments:

a. COMBAT CASUALTY CARE

Description of technique to preserve heart function in irreversible shock; refinement of vein grafting techniques; characterization of skin components important in wound healing; evaluation of new approaches to treatment of ocular trauma; determination of effects of route of administration of morphine upon respiration; determination of anesthetic agent effects on catecholamine release; establishment of concept, theory, and feasibility of non-invasive technology for monitoring cumulative exposure to chemicals such as alcohol, organophosphates, drugs of abuse, and medicinal agents; description of an airway resistance model and determination of factors which limit ventilatory performance; establishment of a ballistics study to characterize trauma to the genitourinary tract; examination of clotting characteristics of blood vessel graft materials and prevention of such clotting; elucidation of role of vasoactive peptides in hemorrhagic and toxic shock; determination of enhancement of wound surgical healing using collagen; description of techniques using prosthetic arteries; description of subcellular process active in nerve regeneration; and evaluation of factors which contribute to serious bacterial infections in wound patients due to predisposing factors such as devitalized tissue and foreign debris.

b. SYSTEMS BIOTECHNOLOGY

Characterization of the role of endorphins in reaction to stress, pain and injury; characterization of action of drug metabolizing enzymes on toxic substances; description of effects of heavy metals and other toxic substances such as PCBs on liver, lung, and kidney function; evaluation of effects of alcohol on drug metabolism in the liver; characterization of cardiac performance under stressful conditions; description of hematologic and cardiovascular changes induced by exercise and physical conditioning; and description of process of muscle contraction to following nerve excitation.

c. INFECTIOUS DISEASES

Description of host factors that control natural resistance or susceptibility to typhoid fever; determination of role of modified human immunoglobulin in streptococcal immunity; characterization of acute and chronic upper respiratory infections caused by coronavirus; characterization of relationship between virulence and toxin production in cholera infections; characterization of virulence of bacteria commonly responsible for "travelers' diarrhea" syndrome; evaluation of biochemical approaches to chemotherapy of African trypanosomiasis (sleeping sickness); description of mechanisms of immunity in malaria; and characterization of antigenic and serologic relationships among strains of parasites causing leishmaniasis.

d. IONIZING RADIATION BIOEFFECTS

Description of cardiovascular malfunction due to exposure to radiation.

2. FY 1983 Program:

The FY 1983 program will continue funding productive research efforts currently underway and begin new studies of military relevance. New efforts will include the description of mechanisms of action by interferon against viruses; determination of the role of various neurotransmitter substances in the onset of anaphylactic shock; and evaluation of drugs to reduce vomiting in patients undergoing radiation therapy.

3. FY 1984 Planned Program:

Continuation in the areas of basic research outlined in the FY 1983 program is planned.

4. FY 1985 Planned Program:

Continuation in the areas of basic research outlined in the FY 1983 program is planned.

5. Program to Completion:

This is a continuing program.

499 474

500B

DIRECTOR OF TEST AND EVALUATION, DEFENSE

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

FY 1984

JANUARY 1984

501
502B

APPROPRIATION LANGUAGE

Director of Test and Evaluation, Defense

For expenses, not otherwise provided for, of independent activities of the Director of Defense Test and Evaluation in the direction and supervision of test and evaluation: and performance of joint testing and evaluation: and administrative expenses in connection therewith: [$55,000,000] $56,,800,000 to remain available for obligation until September 30, [1984] 1985. (Department of Defense Appropriation Act, 1983; additional authorizing legislation to be proposed.)

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RESEARCH, DEVELOPMENT, TEST AND EVALUATION
DIRECTOR OF TEST AND EVALUATION, DEFENSE APPROPRIATION

PROJECT LISTING
(Thousands of Dollars)

Budget Activity 6 - Defensewide and Mission Support
Program Category 6.5 - Management and Support

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate
PE 65804D	42,100	43,400	45,000	47,875
PE 65111D	10,900	11,600	11,800	12,373
Total Program	53,000	55,000	56,800	60,248

DESCRIPTIVE SUMMARIES FOR
THE DIRECTOR OF TEST AND EVALUATION, DEFENSE APPROPRIATION

FY 1984 BUDGET REQUEST

FY 1985 AUTHORIZATION REQUEST

*** JANUARY 1983 ***

NARRATIVE DESCRIPTION

The Descriptive Summaries for Program Elements 65804D and 65111D support the responsibilities of the Director Defense Test and Evaluation, Office of the Under Secretary of Defense for Research and Engineering, for independent activities in the direction and supervision of test and evaluation, for joint testing, for study efforts to improve the effectiveness and efficiency of the 19 DoD Major Ranges and Test Facilities, and for a continuing program for technical and/or operational evaluation of foreign nations' weapon systems, equipment, and technologies.

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DIRECTOR OF TEST AND EVALUATION, DEFENSE APPROPRIATION
FY 1984 RDT&E Descriptive Summary

Program Element: #65804D
DoD Mission Area: 450 - Test and Evaluation

Title: Test and Evaluation
Budget Activity: 6 - Defensewide Mission Support

A. RESOURCES: ($ in Thousands)	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
Total for Program Element	42,100	43,400	45,000	47,875	Continuing	N/A

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element supports responsibilities of the Director Defense Test and Evaluation (DDTE), Office of the Under Secretary of Defense for Research and Engineering, for independent activities in the direction and supervision of test and evaluation, for joint testing, and for study efforts to improve the effectiveness and efficiency of the 19 DoD Major Ranges and Test Facilities. These responsibilities evolved from the Blue Ribbon Defense Panel Report of 1970 which made several recommendations concerning test and evaluation and specifically commented on the requirement for conducting much-needed, productive joint operational tests and evaluations. Major effort is devoted to reimbursing the Services for unique costs incurred in conducting joint tests, those selected by the DDTE in coordination with OSD elements, the JCS, and the Services, and those directed by the Secretary of Defense or the Congress.

C. BASIS FOR FY 1984 RDT&E REQUEST: Continue six (6) joint tests initiated in prior years (Command, Control, and Communications Countermeasures; Data Link Vulnerability; Electro-Optical Guided Weapons Countermeasures/Counter-Countermeasures; Forward Area Air Defense; Identification of Friend, Foe, or Neutral; and Joint Logistics Over-The-Shore II). Since no joint tests will be initiated in FY 1984, a total of six will be funded. Conduct feasibility determinations on joint tests proposed by the Services, the Joint Chiefs of Staff, the Unified/Specified Commanders, and OSD elements for initiation in FY 1985.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: The decrease in the FY 1984 request as compared to the FY 1984 estimate made a year ago ($45,000 thousand vs $50,556 thousand) is due primarily to a deliberate slow-down in committing funds to several large and complicated tests until basic planning indicates acceptable risk levels.

E. OTHER APPROPRIATION FUNDS: The Services participating in these joint tests provide, without reimbursement, equipment and weapon systems for tests as well as operational military forces which are required. The Services are reimbursed for unique costs incurred as a result of a directed test but not for normal operation and maintenance costs incurred in support of joint tests.

Program Element: #65804D
DoD Mission Area: 450 - Test and Evaluation

Title: Test and Evaluation
Budget Activity: 6 - Defensewide Mission Support

F. DETAILED BACKGROUND AND DESCRIPTION: The main effort of this program element is the support of joint tests. In carrying out the joint test responsibilities, the DDTE identifies candidate projects for joint tests in coordination with OSD elements, the JCS, and the Services. These joint tests are structured to evaluate system performance under realistic operational conditions with two or more Services participating on interrelated/interacting weapons systems as well as to resolve technical development problems. The data from these tests are used for evaluating system suitability for the intended mission; for force structure planning; for definition of requirements; for weapons improvements; and for assistance in making decisions in the acquisition process. The costs incurred under this program element are those which are unique to the needs of a joint test, such as: a determination of whether a proposed test is feasible; the provision for test design and planning support for joint tests selected; the development, procurement, installation, and operation of special instrumentation; transportation, travel, and per diem costs for the Test Director's staff; the modification of test articles to be suitable as surrogates and to permit obtaining test data; transportation of equipment from permanent bases to the test site and return; and the provision of data collectors and services for data collection, data reduction, analysis, and test reporting. The Services provide available equipment, weapon systems, and manpower for the tests without reimbursement.

G. RELATED ACTIVITIES: The Services conducting or assisting in joint tests provide for the expenses of operational military forces which are assigned to participate in the joint tests and evaluations.

H. WORK PERFORMED BY: Feasibility determination and test designs for joint tests and evaluations will be performed by the Institute for Defense Analyses (IDA) or other qualified Government Research Centers, or by qualified contractor personnel under the guidance of OSD test and evaluation personnel. For each joint test conducted a Military Service is designated the lead and is assisted by other appropriate Services. The test data will be evaluated and reported upon separately by the Test Director and by IDA or other responsible contractors directly to the OSD elements. The study efforts for improving the major ranges and test facilities will be accomplished primarily by the MITRE Corporation.

Program Element: #65804D
DoD Mission Area: 450 - Test and Evaluation

Title: Test and Evaluation
Budget Activity: 6 - Defensewide Mission Support

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1983 and Prior Accomplishments and FY 1984 Planned Program: Since the initiation of the E-O MAVERICK joint test in 1972, twenty-nine (29) additional joint tests have been started. Of these, six (6) have been terminated and seventeen (17) have been completed. Included here are termination of the Joint Direction Finding and Theater Air Defense Joint Tests and completion of the Central Region Airspace Control Plan (CRACP) Evaluation in FY 1982. No new joint tests were started in FY 1982, leaving only seven (7) tests underway in FY 1983. One (1) joint test Electronic Warfare During Close Air Support is to be completed in FY 1983. No new joint tests are to be started in FY 1984. Thus, in FY 1984 there will be six (6) joint tests underway.

Electronic Warfare during Close Air Support (EW/CAS) Joint Test: The EW/CAS Joint Test was conducted in two phases. Phase I, the Tactical Communications Jamming Phase, completed in March 1980, was devoted to investigating the effectiveness of Soviet jamming of U.S. tactical communications associated with conducting close air support operations (with both fixed-wing aircraft and attack helicopters). Phase II, designated as the Air Support Operations Phase, was completed at Nellis Air Force Base, Nevada in November 1981. The general objective of Phase II was to assess the relative effectiveness or contribution of electronic countermeasures, defense suppression, and tactics on close air support and attack helicopter operations. The Joint Test Director's final report for Phase II has been distributed. The independent analysis by the Institute for Defense Analyses will be completed by April, 1983.

FY 1984 Planned Program: This program will be completed in 1983.

PE 65804D

Test and Evaluation Activities (Cont'd)

Command, Control, and Communications Countermeasures (C3CM) Joint Test: The objective of this joint operational test program is to assess the effectiveness of current and planned US forces in countering Soviet Command, Control, and Communications. The test program will support the development of tactics and assist hardware developers to identify system requirements or improvements that would enhance US C3CM capabilities. Test concept definitions were undertaken in 1978 by four selected contractors. The FY 1979 program included funding for a single unified test concept based on the four contractor studies. The FY 1980 program funded analyses of Soviet equipment and tactics, US C3CM capabilities, and development of C3CM scenarios for testing. In FY 1981, tasks were assigned to the Joint Electronic Warfare Center, addressing scenario validation, the role of computer modeling and simulation, Blue C3CM material systems and current Service C3CM concepts and activities; these were completed in FY 1982. FY 1982 funding supported the establishment and operation of the Joint Test Directorate and conduct of the initial test planning. FY 1983 efforts continue on test planning, simulation and analysis, and site preparation.

FY 1984 Planned Program: The design of a modeling and simulation evaluation system will be completed and plans for equipment and data management will be developed.

Data Link Vulnerability Joint Test: The objective of this joint test is to develop and validate a methodology to assess the performance of data links when employed in a hostile electronic environment. This methodology will be designed to evaluate the anti-jam characteristics of the data links against known and predicted levels of jamming to include the effects of alternative tactics, multiple jammer scenarios and techniques, atmospheric propagation effects, non-intentional jamming, and man-machine interfaces. Tests to validate the methodology are being accomplished in as realistic a threat electronic countermeasures (ECM) environment as feasible. This program, originally restricted to tactical data links, was expanded in 1979 to include typical digital weapon control; command, control, and communications (C3); and reconnaissance (I) data links. A field test of the WALLEYE glide bomb was conducted in FY 1979 to evaluate selected measures of effectiveness. The results showed that additional studies to define improved measures of effectiveness were needed. These additional studies are continuing. Simulations have been designed to evaluate data link hardware performance against the previously defined variables. Field tests are being designed and conducted to validate simulation results, update the test methodology, and provide the basis of documentation.

FY 1984 Planned Program: This program will be completed in 1984.

PE 65804D

Test and Evaluation Activities (Cont'd)

Electro-Optical Guided Weapons Countermeasures Joint Test: The objectives of this joint test are to determine the operational effectiveness of our electro-optical (EO) guided weapons (Ultra-Violet (UV), Infrared (IR), TV, and LASER) in a countermeasures (CM) environment, to provide information to developers for effective countercounter-measures (CCM) actions, and to evaluate the effectiveness of countermeasures techniques and devices against selected electro-optical guided weapon systems. This program was initiated in FY 1976 by using the existing Joint Test Force personnel, Mobile Instrumentation Facility (MIF), other instrumentation devices, and data base asembled during the earlier OSD-sponsored LASER Guided Weapons Countermeasures Joint Test program. Emphasis continues on static, captive-flight, and dynamic field testing of E-O weapon systems, developments of CM techniques and devices, and susceptibility/vulnerability analyses of EO guided weapons in realistic environments.

FY 1984 Planned Program: This continuing effort is sponsored by the Director Defense Test and Evaluation to maintain the effectiveness of current operational and developmental E-O guided weapons in an increasingly sophisticated countermeasures environment.

Forward Area Air Defense Evaluation: The objective of this test program is to improve the effectiveness of SHORAD assets and reduce friendly air casualties from friendly fire by focusing on the command and control of SHORAD crews and air assets. The test will place emphasis on communication, crew performance, and airspace management in evaluating the interface between SHORAD assets and Army and Air Force aircraft. To accomplish this objective, the joint test is: investigating design and construction of a manned field environmental simulator which could provide a tool for repeatable analyses of the interface between equipment and operators under all kinds of combat conditions; investigating design and implementation of a structured computer model which could allow rapid analysis of the effects of doctrine and system capabilities on a division size force; and planning and conducting several small scale field tests to gather data not available by other means and to verify concepts developed within the manned simulator and the computer model. The FY 1979 JT&E program included funding for a Joint Battlefield Airspace Control (JBAC) feasibility study in which strawman FAAD test design was performed and preliminary estimates were made of required resources and funding. The FY 1980 program included funds to begin the long lead time planning for the dedicated field tests and the initiation of the test design. During FY 1981 a concept definition study was initiated by IDA. During FY 1982 a coordinated, joint service concept definition was developed with the Army in the lead service role. A field test office was established at Ft. Bliss, TX. Modeling efforts were begun and additional work was done on the test design. In FY 1983 a study to determine feasibility of using manned simulators in lieu of field testing will be conducted. Further literature search will be conducted and a test plan will be written. Preliminary field testing will be conducted and assessed prior to full scale field testing.

FY 1984 Planned Program: Additional field testing will be conducted while the manned simulator and computer model are being constructed and validated.

'F 65804D

Test and Evaluation Activities (Cont'd)

dentification Friend, Foe, or Neutral (IFFN) Joint Test: This program has two fundamental objectives: first, to establish aseline IFFN performance under varying conditions; second, to test candidate improvements to IFFN techniques that will enhance he ability of the Air Defense System Controllers to accurately and swiftly identify, and to respond appropriately to, airborne argets. Specifically, the test is to: evaluate NATO Air Defense capability to perform the IFFN function within the command and ontrol system; determine weak nodes; and assess near-term procedural and equipment improvements. The test is oriented to the IATO Central European area. A Joint Test Force (JTF) has been formed and will accomplish the test. A centrally controlled, eographically distributed testbed utilizing actual manned weapon and command and control systems will be employed. A Central imulation Facility (CSF) located at Kirtland AFB, NM will control the testbed and include simulations required to represent the rincipal identification information sources projected for a NATO environment in the 1985-1990 timeframe. The testbed will be uilt in stages beginning with Army HIMADS and air defense C2 nodes. Subsequent stages will integrate Air Force and Navy systems nto the testbed. Testbed design definition and source selection were completed in September 1981. Testbed system design was ompleted in August 1982. Development of the testbed began in November 1982. In FY 1983 development and procurement of hardware nd software will continue for the CSF and Army systems.

FY 1984 Planned Program: Procurement for CSF will be completed. Tests of the Army systems will commence and development of ir Force and NATO systems will begin.

oint Logistics Over-The-Shore II. Logistics-Over-The-Shore (LOTS) was conducted in 1977 at Fort Story, Virginia under calm sea onditions. JLOTS II was approved as a FY 82 joint test with trials in FY 84 to determine the impact and effectiveness of ver-The-Shore Discharge of Containers (OSDOC) and further movement ashore into a Temporary Container Discharge Facility (TCDF). his will demonstrate the Services' ability to discharge containerships at locations which do not have specialized port acilities, and will test the capability of improved containership discharge equipment. This equipment and the concept will be ested in a joint Service RDF environment at a site with state three seas. An Army Transportation Battalion, a Naval Beach Troop, nd a Marine Support Element will be required. The test involves compatibility and suitability determination of containerships, ighter Aboard Ship (LASH) vessels, motion compensating cranes, causeways, Delong Piers, and Army and Navy lighters and support ehicles. The test was nominated by the Navy, which was designated lead Service with the Army and Marine Corps as participants. he Navy prepared an outline test concept, recommended potential test sites, and determined test support requirements to allow ormulation of cost estimates and budgeting. The Joint Test Directorate has been activated at the Naval Amphibious Base, Little reek, Virginia, has drafted an overall Test Design, has chosen a test site, and is continuing planning and cost estimates for he operational phases of the test. The first phase of operations is to be accomplished in FY 1983. This phase is oriented toward eployment operations, using merchant ships to deploy major items of Service equipment required for LOTS-type operations. It will lso include initial tests of roll-on roll-off (RO-RO) ship discharge capability in more benign sea states.

FY 1984 Planned Program: The throughput phase is planned for fourth quarter FY 1984 and first quarter FY 1985. This test ill determine operational problems, develop hardware, develop doctrine and procedures, clarify roles and missions, and provide ubstantial training in the complex over-the-shore joint service environment.

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PE65804D

Test and Evaluation Activities (Cont'd)

Feasibility Determinations for Joint Tests: Feasibility determinations are required to decide if the desired test objectives are achievable, to provide a preliminary estimate of required resources by type and costs, and to provide a list of special and pacing test support needs. These determinations, after coordination with the Services and other OSD elements, provide the basis for designing and planning additional joint tests. Proposed joint tests are analyzed in considerable depth to determine if the test results will resolve current weapon systems problems or provide required information in the design of future weapon systems. These test results must be accomplished within a reasonable time frame so as to provide benefit to the Services and not require excessive funding. As feasibility determinations are completed, decisions are made as to whether proposed joint tests should be pursued or cancelled. It is necessary each year to review carefully the need for future joint tests under realistic two-sided operational conditions.

FY 1984 Planned Program: The FY 1984 effort will result in determining which tests will be conducted in the FY 1986 to FY 1987 timeframe.

Test and Evaluation Independent Activities: In the supervision of test and evaluation, requirements for independent assessments arise on tests conducted by the Services either singly/jointly or with other nations. These assessments are usually directed by either Congressional committees or the Secretary of Defense. There is also an occasional need for assistance in examining certain program issues and in reviewing special aspects of the test and evaluation program. In FY 1982 and FY 1983 independent activities in these categories included the following: assessment of cruise missile survivability test results; development of guidelines for the test and evaluation of computer software; preparation of an independent T&E assessment of the DSCS III program; development of a concept for networking three types of simulation (computer, testbed and prototype) to improve test and evaluation capability; assessment of the military applicability of the Tactical Computer System; and development of a test and evaluation requirements analysis capability.

FY 1984 Planned Program: In FY 1984 emphasis will continue on compatibility of U.S. and NATO weapon systems and the assurance that joint tests conducted by the Services on interacting weapon systems are meeting DoD goals. Funds are required to undertake these independent evaluations as directed by Congress or the Secretary of Defense.

PE 65804D

Test and Evaluation Activities (Cont'd)

T&E Facility, Instrumentation, and Procedures Studies: In prior years, this activity conducted studies and analyses in support of the development and sizing of the DoD Major Range and Test Facility Base (MRTFB), with particular emphasis on instrumentation and aerial target requirements and capabilities. The object was to assure that the needed capabilities were available for planned test and evaluation activities and the costs incurred were minimized. As part of this activity The MITRE Corporation conducted specific technical analyses and studies associated with instrumentation and aerial targets, with emphasis on multiple target state vector tracking system capabilities, range radar performance improvements, and force-on-force engagement scoring system concepts. In addition, MITRE conducted studies of infrared aerial target realism, target radar cross section, target concepts for testing High Energy Laser (HEL) weapons, and vector miss distance measurement capabilities with advanced radar techniques. Other studies included range ship fleet sizing alternatives, anti-ship missile target alternatives, full-scale and sub-scale aerial target realism comparisons, and satellite application to test range support. Technical and economic analytical support has been given to the Strategic Systems Test Support Study (SSTSS) ad hoc committee. Current activities include: continuation of the independent cost estimate for the Modular Automated Integrated Systems Interoperability Test and Evaluation program operating costs, assessment of vector miss-distance scoring techniques, continuation of the support to the multiple object tracking radar effort (including specification review), assessment of using the Global Positioning System data for test and training, and further assessment of instrumentation support provided to the Electronic Warfare during Close Air Support (EW/CAS) joint test by the Range Measurement System.

FY 1984 Planned Program: The effort in FY 1984 will include: assessment of range instrumentation issues that will affect joint tests, assessment of transition actions required in the use of the Global Positioning System data for test and training, and assessment of on-board equipment needed on aerial targets.

Program Element: #65804D
DoD Mission Area: 450 - Test and Evaluation

Title: Test and Evaluation
Budget Activity: 6 - Defensewide Mission Support

2. FY 1985 Planned Program: Funding is required to continue design, planning, and analysis support and to provide for administrative and contractual support to Test Directors and their staffs as well as other costs associated with field testing in progress for the following on-going joint tests:

Command, Control and Communications Countermeasures
Data Link Vulnerability
Electro-Optical Guided Weapons Countermeasures/ Counter-Countermeasures
Forward Area Defense Evaluation
Identification of Friend, Foe, or Neutral
Joint Logistics Over-The-Shore II

Proposed FY 1985 joint tests will be coordinated with the other OSD elements, the Joint Chiefs of Staff, and the Services. Selected candidates will be subjected to feasibility determinations to ascertain if the test objectives are achievable, the tests can be accomplished within a reasonable timeframe, and the tests will not require excessive funding. Based on these determinations, two new joint tests will be selected and funded in the FY 1985 program. With these two new joint tests, there will be a total of seven (7) joint tests underway in FY 1985.

Funds will also be required to provide for Feasibility Determinations of joint tests proposed for subsequent years; Independent Activities in the direction and supervision of test and evaluation; and T&E Facility, Instrumentation, and Procedure Studies to continue improving the test facilities base, analyzing and planning instrumentation systems, and responding as necessary to meet new requirements.

3. PROGRAM TO COMPLETION: This program supports about seven (7) to nine (9) joint test activities each year on a continuing basis. Generally, completion of a joint test activity requires about four years: 15-18 months for planning and contracting of any new instrumentation; 15-18 months for check test and preparation for a full-scale test; and 9-12 months for the full-scale test and its evaluation and reporting. Feasibility determinations are conducted each year to determine those joint test activities that should be undertaken in future years. T&E Independent Activities are undertaken to evaluate joint Service tests and US Service/Foreign tests on weapon systems as directed by Congress and the Secretary of Defense. Test facilities, instrumentation, and test and evaluation practices must be improved on a continuing basis to meet specific joint requirements. The estimated costs to complete the various joint test activities underway in FY 1983 and planned for FY 1984 and FY 1985 are shown in the attached resources funding chart.

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Research, Development, Test and Evaluation
Director of Test and Evaluation, Defense Appropriation

Budget Activity 6 - Defensewide Mission Support
RDT&E Category 6.5 - Management and Support

Resources: ($ in Thousands)

	FY 1982 Program	FY 1983 Program	FY 1984 Program	FY 1985 Program	Additional to Completion	Total Estimated Cost
PE 65804D						
Tests Completed or Terminated in FY 1982						
Central Region Airspace Control Plan	-	-	-	-	-	565
Joint Direction Finding	-	-	-	-	-	-
Theater Air Defense	-	-	-	-	-	232
Test to be Completed in FY 1983						
Electronic Warfare During close Air Support	4,986	400	-	-	-	63,213
Tests Ongoing in FY 1984						
Command, Control, and Communications Countermeasures	2,015	5,000	3,400	5,800	53,033	70,465
Data Link Vulnerability	3,336	1,300	500	-	-	18,063
Electro-Optical Guided Weapons Countermeasures/ Counter-Countermeasures	5,825	4,400	4,600	4,975	-	-
Forward Area Air Defense	677	5,300	11,300	11,600	36,450	65,706
Identification Friend, Foe, or Neutral	18,327	17,400	12,900	14,200	27,613	95,208
Joint Logistics Over-The-Shore II	3,000	6,700	9,500	3,200	-	22,400
New Starts						
Two new starts in 1985	-	-	-	5,000	50,000	55,000
Other						
Feasibility Determinations	165	700	700	800	-	-
T&E Independent Activities	2,976	1,300	1,200	1,300	-	-
T&E Facility, Instrumentation and Procedure Studies	793	900	900	1,000	-	-
TOTAL PE 65804D Funds	42,100	43,400	45,000	47,875	-	488 - 515

DATE: 21 January 1983

DIRECTOR OF TEST AND EVALUATION, DEFENSE APPROPRIATION
FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65111D
DoD Mission Area: 460 - International Cooperative RDT&E

Title: Foreign Weapons Evaluation
Budget Activity: 6 - Defensewide Mission Support

A. RESOURCES: ($ in Thousands)

	FY 1982 Actual	FY 1983 Estimate	FY 1984 Estimate	FY 1985 Estimate	Additional to Completion	Total Estimated Costs
Total for Program Element	10,900	11,600	11,800	12,373	Continuing	N/A

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This continuing program provides for technical and/or operational evaluation of foreign nations' weapon systems, equipment, and technologies to determine their potential use to elements of the Department of Defense. The bases for selecting a candidate for evaluation include its potential to satisfy an operational need, its ability to meet a deficiency in the current inventory, and its contribution of a component or technology for which there is no similar US alternative. This program element directly supports the policy of the United States that equipment procured for use by personnel of the Armed Forces of the United States stationed in Europe under the terms of the North Atlantic Treaty be standardized or at least interoperable with equipment of other members of the North Atlantic Treaty Organization. This program also provides potential for significant resource savings by avoiding unnecessary duplication in development and identifies viable potential offsets for Foreign Military Sales programs.

C. BASIS FOR FY 1984 RDT&E REQUEST: Funds from this program element are provided directly to Service testing facilities to support the test and evaluation of foreign weapons and technology programs nominated by the Services and approved by OSD. Use of these funds includes lease or purchase of test articles, modification of test articles or directly related equipment, technical and operational test support, test data reduction, engineering studies, and refurbishing costs related to returning test or test support articles to original configurations. Specific expenditures will support continuation of evaluation programs initiated in FY 1983, assuming that these efforts are progressing satisfactorily, and will support new efforts initiated in FY 1984. The FY 1984 FWE program nomination and review cycle will start in June 1983 and will be completed on 30 September 1983.

D. COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: The decrease in the FY 1984 equest as compared to the FY 1984 estimate made a year ago ($11,800 thousand vs $13,146 thousand) is due primarily to self-imposed limits on budget growth, rather than to a decreased need. Added emphasis given by the Services to this program, however, has resulted in FY 1983 requests in excess of $17.0M against the FY 1983 program of $11.6M. Even with the careful screening process, which selects only the most promising candidates, a legacy of $6.8M is being carried over into FY 1984, thus placing a severe constraint on the number of new programs which may be selected in FY 1984.

Program Element: #65111D
DoD Mission Area: 460 - International Cooperative RDT&E

Title: Foreign Weapons Evaluation
Budget Activity: 6 - Defensewide Mission Support

E. OTHER APPROPRIATION FUNDS: None.

F. DETAILED BACKGROUND AND DESCRIPTION: This was a new program element in FY 1980. In FY 1979 the DoD budget for foreign weapons evaluation totalled $6.1 million in three Service program elements. During its review of these funds the House and Senate Armed Services Committees conferees suggested that, in the interests of more stringent control, any request for foreign weapons evaluation funds for FY 1980 be placed in the Under Secretary of Defense Research and Engineering (USDRE) budget instead of in separate Service budgets. To accommodate this Congressional guidance, funds for foreign weapons evaluation have been deleted from the Service program elements and placed in USDRE program element 65111D under the direct cognizance of the Director Defense Test and Evaluation. The House Armed Services Committee, in reporting on the DoD Authorization Act for FY 1980, recommended that future authorization requests for Foreign Weapons Evaluation be included in the budget of the Director Defense Test and Evaluation. Accordingly, the request for Foreign Weapons Evaluation funds (PE 65111D) is combined with that of Test and Evaluation (PE 65804D) in the Director of Test and Evaluation, Defense Appropriation.

G. RELATED ACTIVITIES: None

H. WORK PERFORMED BY: Foreign Weapons Evaluation activities are carried out within the potentially benefitting Service. The evaluation of most Army materiel is conducted by the US Army Test and Evaluation Command, Aberdeen Proving Ground, MD, in coordination with the development command or separate laboratory of the US Army Materiel Development and Readiness Command having responsibility for counterpart US materiel. Army commands and agencies representing user, training, and logistics interests are tasked in a support role appropriate to evaluation requirements. For foreign weapons systems having naval applications, evaluations are monitored by the Office of the Assistant Secretary of the Navy (Research, Engineering and Systems), the Office of the Chief of Naval Operations, and Headquarters, U.S. Marine Corps. Work is performed in various Navy laboratories and test centers such as the Naval Weapons Center, China Lake, CA; the Naval Surface Weapons Center, Dahlgren, VA; the Naval Ship Weapons System Engineering Station, Port Hueneme, CA; and the Naval Ordnance Station, Louisville, KY. For Air Force systems, evaluations are under the management of the Air Force Systems Command, Andrews AFB, MD, and are carried out by its subsidiary units such as the Air Force Flight Test Center, Edwards AFB, CA; the Air Force Avionics Laboratory, Wright-Patterson AFB, OH; and the Armament Development and Test Center, Eglin AFB, FL. Depending on the specific equipment and the arrangements made for its evaluation, foreign companies or governments may provide test articles, spare parts, and support equipment or services as requested.

Program Element: #65111D
DoD Mission Area: 460 - International Cooperative RDT&E

Title: Foreign Weapons Evaluation
Budget Activity: 6 - Defensewide Mission Support

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1983 and Prior Accomplishments: Since initiation of the Foreign Weapons (FWE) program the Services have adopted eight systems for procurement:

The German MAN truck is being procured by the Army as the primary support vehicle for the Pershing II missile, while the Air Force also is procuring the vehicle as the prime mover of the Ground Launched Cruise Missile (GLCM) system. The logistics advantages to be gained by using German trucks for these European based systems are exceptionally cost effective. Over 460 units are programmed for procurement.

The Swedish BV 202-206 over-snow vehicle was selected for procurement to support Army requirements in Arctic climates. These vehicles represent an off-the-shelf capability that was tested and acquired in minimal time for use by both regular and reserve Army units. Over 260 vehicles are being procured.

In order to allow additional time for the Army to develop a Light Anti-Tank Weapon (LAW), the FWE program examined the Norwegian M72A3 LAW as an interim weapon. This program resulted in the procurement of 100,000 rounds at a unit cost of $137.00.

The U.K. Combat Support boat was successfully evaluated and has been procured as the Army bridge erection boat, which is used extensively by the U.S. Army Corps of Engineers. Four hundred thirty units are being procured.

Evaluation of German Plastic Training Ammunition (PTA) in both .50 caliber and 5.56mm has resulted in significant advantages to the Army. The rounds, now being procured, permit the use of smaller ranges, eliminate many ricochet safety hazards, and avoid the significant environmental hazard of lead contamination. Over 23 million rounds of each caliber are programmed for procurement.

Army evaluation and adoption of the British .22 cal tank training rounds have substantially increased the number of locations at which armored units can train without large geographic safety range requirements. Twenty-four million rounds are slated for procurement.

The Nuclear-Biological-Chemical (NBC) contamination warning kit used by the German forces was evaluated and adopted by the Army for U.S. forces. Over 30,000 units are being procured.

Following extensive testing the Air Force initiated procurement of over 10,000 French DURANDAL runway attack weapons. DURANDAL was rejected for procurement by the Navy due to unsatisfactory safety characteristics for shipboard storage and handling.

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The Army currently has fifteen programs in process. These are: The Norwegian SANATOR Decontamination System; The German HAWK Decoy System; The British Chemical Agent Monitoring System; The German Personal Dosimeter Device; The British Modular Field Shelter; Canadian, Japanese, and British candidates to replace current smoke pot devices; The German Mortar Training Device; a British designed 6000 pound rough terrain forklift; German large caliber Bore Brushes; an improved safety German grenade fuze; a German diesel powered low noise generator set; a French Aerial Radiac (radiation mapping) system; a German 105mm Target Practice round; the British Kinetic Energy Recovery Device; and Yugoslavian medical field equipment.

The Navy is currently evaluating the following systems: The British Searchwater Radar is a candidate for upgrading of P-3B Anti-submarine Warfare aircraft. The Norwegian Penquin Infra-red Anti-ship missile system is being evaluated in its latest configuration and the French TELEMIR covert Inertial Navigation System calibration system appears to offer distinct advantages over current cable systems. The British Integrated Communications System offers potential of improving future naval ship systems. In the area of mine warfare and countermeasures, the Navy is completing evaluations of the French PAP-104 mine neutralization system and the British OSBORN mine detection system. Various subcomponents of foreign mine systems are being studied for potential application to U.S. systems. French engines for target applications have been evaluated and rejected, while Belgian Jet Assisted Take Off (JATO) bottles are under evaluation for other target applications.

The Air Force programs currently include evaluation of: German and British airfield attack munitions and aerial denial mines; Israeli munitions handling equipment; Norwegian multipurpose ammunition in both 20mm and 30mm calibers; a French Remote Color Map Reader to save cockpit space; Low Altitude Dispenser technologies from Britian, Germany, and other European nations; a French nuclear-biological-chemical protective shelter system for European bases; German and Canadian Chemical Defense garments; and rapid runway repair equipment from Germany and the Netherlands.

Current Marine Corps programs include a survey of anti-tank weapons as alternatives to Viper, and an evaluation of the Israeli 120mm Tampella mortar.

Program Element: #65111D
DoD Mission Area: 460 - International Cooperative RDT&E

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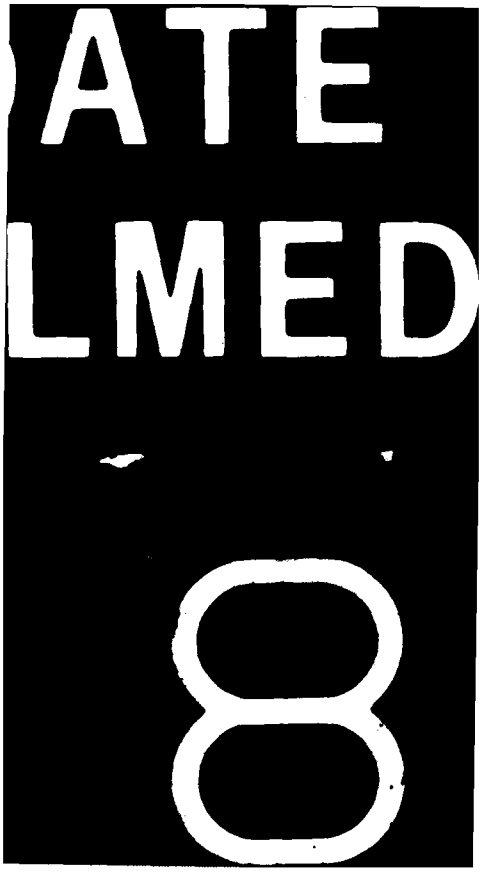
Budget: ivity: 6 - Defensewide Mission Support

2. FY 1984 PLANNED PROGRAM: Continued emphasis will be given to the selection of candidate programs with maximum interoperability and standardization potential in order to increase the readiness posture of our forces. The FY 1984 request is the minimum required to support continuation of current programs and allow the initiation of a very few new programs in FY 1984. Continued emphasis will be placed on use of existing Memorandums of Understanding and Data Exchange Agreements which provide for exchange of T&E data and the loan or lease (vice purchase) of test hardware whenever possible. Expenditures in FY 1984 will support continuation of the programs previously mentioned and initiation of new programs considered in conjunction with continuing programs in September 1983.

3. FY 1985 PLANNED PROGRAM: Evaluations begun in FY 1984 will be continued based on the merits of their progress. New programs proposed by the Services will be reviewed by OSD and selected based on Service operational requirements and technology data base needs.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