UNCLASSIFIED

DEPARTMENT OF THE AIR FORCE

FISCAL YEAR 2000/2001 BIENNIAL BUDGET ESTIMATES

RESEARCH, DEVELOPMENT, TEST AND EVALUATION

DESCRIPTIVE SUMMARIES

FEBRUARY 1999

VOLUME I

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Fiscal Year 2000/2001 Biennial Budget Estimates
RDT&E Descriptive Summaries, Volume I
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INTRODUCTION AND EXPLANATION OF CONTENTS

1. (U) GENERAL. This document has been prepared to provide information on the United States Air Force (USAF) Research, Development, Test and Evaluation (RDT&E) program elements and projects in the FY2000/2001 President's Budget Submission (PB). All formats in this document are in accordance with the revised guidelines of the DoD Financial Management Regulation, Volume 2B, Chapter 5, with the exception of the R-3 exhibit. The Air Force could not support the new format matrix because our programs do not track their programs in the manner required to complete the exhibit.

a. Contents: Exhibits R-2, R-2a and R-3 provide narrative information for all RDT&E program elements and projects within the USAF FY1999 RDT&E program except the classified program elements. The formats and contents of this documents are in accordance with the guidelines and requirement of the Congressional committees insofar as possible.
b. The "Other Program Funding Summary" portion of the R-2 includes, in addition to RDT&E funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DOE) costs.
c. The Justification book has been assembled in accordance with DoD Financial Management Regulation 7000.14, Vol 2B Cpt 5, Sec 050302 with the exception of the R-1, Project Funding Listing which was distributed under a separate cover due to classification .

2. (U) CLASSIFICATION.

a. All R-2 and R-3 exhibits contained in Volumes I and II are UNCLASSIFIED. Classified R-2 and R-3 exhibits are not included in the submission due to the level of security classification and necessity of special security clearances.

PROGRAM ELEMENT COMPARISON SUMMARY

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Program Element	**Remarks**
BUDGET ACTIVITY 1: BASIC RESEARCH No changes	
BUDGET ACTIVITY 2: APPLIED RESEARCH DEVELOPMENT	
0602202F, Armstrong Lab Exploratory Development	Environmental noise portion of project 7757 has been realigned to Project 7184 in FY99. Studies in support of Distributed Mission Training has been realigned from Project 7184 to Project 1123 in FY00. Toxicology hazards research program will be realigned from Project 7757 to Project 1710 beginning in FY00. PE 62102F, Project 4349 will realign to project 1900 beginning in FY00.
0602203F, Aerospace Propulsion	Project 3012 terminates in FY00
0602269F, Hypersonic Technology Program	Project 1025 terminates in FY00
0602601F, Phillips Laboratory Exploratory Development	Spectral Sensing efforts currently in Project 3326 moves into Project 8809 in FY00
0602702F, Command, Control and Communication	Project 2338 terminates in FY99 and Project 4600 terminates in FY00.
0602805F, Dual Use Science & Technology	Project 4770 is a FY99 new start
BUDGET ACTIVITY 3: ADVANCE TECHNOLOGY DEVELOPMENT	
0603108F, Integrated Data Systems	Project 4427 realigns to PE 0708611F, Project 4427

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0603253F, Advanced Avionics Integration	Project 3833 realigns to Project 2735 beginning in FY99
0603302F, Space & Missile Rocket Propulsion	Project 6339 completes in FY00. Project 6339 terminates in FY00.
0603302F, Space and Missile Rocket Propulsion	Project 003 realigns to PE 0603401F, Project 1026 beginning in FY00.
0603401F, Advanced Spacecraft Technology	Project 4782 realigns to PE 0603856F, 4782 beginning in FY99. Spectal sensing work in PE 0603605F, Project 3150 realigns to Project 3784. Launch vehicle technology realigns form PE 0603302, Project 0003 to Project 1026.
0603707F, Weather Systems Technology	Project 2868 terminates in FY99
0603726F, C3 Subsystem Integration	Project 2863 realigns to Project 69CK, PE 0603203F beginning in FY01

BUDGET ACTIVITY 4: DEMONSTRATION AND VALIDATION

0603441F, Space Based IR Arch (Dem/Val) (Space)	Project 0007 realigns to PE 06044422F
0603690F, Information Operations Technology	Project 4822 is a FY00 new start
0603876F, Space Based Laser (SBL) (Space)	Prior to FY98 program funded in PE 0603173C
0604442F, Space Based IR Arch (EMD)(Space)	Project 4598 is a FY99 new start

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BUDGET ACTIVITY 5: ENGINEERING AND MANUFACTURING DEVELOPMENT

0604201F, Integrated Avionics Planning & Development	Project 2257 completes in FY01; Project 2258 completes in FY98
0604218F, Engine Model Derivative Program	Project 2634 completes in FY98
0604233F, Specialized Undergraduate Pilot Training	Project 4376 completes in FY00
0604270F, Electronic Warfare Development	Project 1011 completes in FY01
0604600F, Munitions Dispenser Development	Project 1015 completes in FY99
0604727F, Joint Standoff Weapons Systems	Project 1000 completes in FY01
0604851F, ICBM - EMD (GRP, PRP, MMRRT)	Project 4788 is an FY00 new start; Project 3085 completes in FY00; Project 4210 completes in FY00

BUDGET ACTIVITY 6: RDT&E MANAGEMENT SUPPORT

0604256F, Threat Simulator Development	Project 7500 is a FY00 new start
0603402F, Space Test Funding	Project 2617 realigns to PE 0605864F

BUDGET ACTIVITY 7: OPERATIONAL SYSTEM DEVELOPMENT

0101120F, Advanced Cruise Missile	Project 4798 is a FY00 new start

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0101122F, Air Launched Cruise Missile	Project 4797 is a FY00 new start
0102411F, North Atlantic Defense System (NADS)	Project 2980 completes in FY00
0102325F, Joint Surveillance System	Project 2996 completes in FY99
0102411F, North Atlantic Defense System	Project 2980 completes in FY99
0207131F, A-10 Squadrons	Project 4809 is a FY99 new start
02027253, Compass Call	Project 4804 is a FY00 new start
0207320F, Sensor Fused Weapons	Project 1016 completes in FY00
0207414F, Combat Intelligence System	Funding for the PE transfers to PE 0207438F, project 4790 in FY00.
0207423F, Advanced Communication System	Project 2982 completes in FY01
0207438F, Theater Battle Management (TMB) C4I	Projects 4287, 4288 and PE 27414, Project 4773 will be consolidated into project 4790 beginning in FY00. Project 4802 was previously funded in FY98 under PE 33152 and in FY99 under PE 33150.
0207601F, USAF Wargaming and Simulation	Projects 1011 and 4566 were transferred to PE 0308601F, beginning in FY99
0208019F, Integrated Broadcast Service	Realigns to PE 0603850F, Project 4778 beginning in FY00
0208031F, WRM-Equipment/Secondary Items	Project 4668 is a FY99 new start

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0302015F, E-4B National Airborne Ops Center	Project 4777 begins in FY99
0303131F, Minimum Essential Emergency Communications	Project 4521 consolidates DIRECT efforts previously being performed in PE 0603851F, Project 1024; 0604851F, Project 13C4; and PE 0303131F, Project 2832.
0303150F, WWMCCS/Global Command and Control Sys	PE 0303152 and 0303150F are consolidated beginning in FY99 and the program title has been changed to Global Command and Control System (GCCS). The DCAPES effort will be realigned to Project 4802 in PE 27438.
0305099F, Global Air Traffic Management (GATM)	Project 4690 was transferred to PE
0305138F, Inert Upper Stage (IUS)	Project 4053 transfers to PE 0305144Fbeginning in FY00.
0305205F, Endurance Unmanned Aerial Vehicles	FY98 and FY99 funds are in PE 0305205D, Endurance Unmanned Aerial Vehicles
0305206F, Advanced Technology Development	FY98 and FY99 funds are in PE 0305206D, Airborne Reconnaissance Advanced Development.
0305208F, Distributed Common Ground	FY98 and FY99 funds are in PE 03052086D, Distributed Common Ground Systems (DCGS)
0305906F, NCMC-TW/AA Systems	Project 4806 is a FY00 new start; Project 3880 completes in FY99; Project 4409 completes in FY99
0305910F, Spacetrack (Space)	Project 4791 is a FY00 new start; Project 4241 completes in FY99.

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0305911F, DSP (Space)	Project 3615 completes in FY01
0305917F, Space Architect	Funding prior to FY98 is in PE 0603855F
0305953F, Evolved Expendable Launch Vehicle	Project 4594 terminates in FY99
0308699F, Shared Early Warning System	Project 4838 established to standardize management of ongoing SEW program efforts
0302015F, E-4 National Airborne Operations Center	Project 4777 is a FY99 new start
0401119F, C-5 Airlift Squadrons	Project 4835 is a FY99 new start
0401214F, Air Cargo Materiel Handling	Project 5150 completes in FY00
0708026F, Product/Reliable/Avail/Maintain Prog	Project 4761 realigns to PE 0605011, Project 4685 beginning in FY 99
0708611F, Support Systems Development (SSD)	FY98 funds for Project 4654 is in PE 0603108F, Project 4427

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29	0603601F	Conventional Weapons Technology	321
30	0603605F	Advanced Weapons Technology	332
31	0603707F	Weather Systems Technology	344
32	0603723F	Environmental Engineering Technology	348
33	0603726F	C3 Subsystem Integration	352
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ALPHABETICAL LISTING

Program Element Title	PE	PAGE
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	188,216	209,731	209,505	177,513	178,523	182,013	186,185	200,020	Continuing	Continuing
2301	Physics	18,629	22,685	22,147	20,268	20,368	20,757	21,342	22,973	Continuing	Continuing
2302	Solid Mechanics and Structures	13,660	18,322	16,094	9,308	9,334	9,651	9,827	10,583	Continuing	Continuing
2303	Chemistry	24,185	25,826	27,536	24,641	24,805	25,262	25,707	27,701	Continuing	Continuing
2304	Mathematical and Computer Sciences	30,488	34,415	32,944	27,743	27,916	28,413	28,917	31,221	Continuing	Continuing
2305	Electronics	19,898	23,399	24,429	20,287	20,603	20,978	21,365	23,001	Continuing	Continuing
2306	Materials	10,116	12,122	13,257	13,380	13,556	13,773	14,093	15,099	Continuing	Continuing
2307	Fluid Mechanics	11,094	7,189	9,975	9,538	9,589	9,776	10,064	10,744	Continuing	Continuing
2308	Propulsion	12,757	14,629	17,263	16,553	16,633	16,950	17,447	18,755	Continuing	Continuing
2310	Atmospheric Sciences	5,584	5,544	5,661	5,082	5,106	5,207	5,365	5,721	Continuing	Continuing
2311	Space Sciences	5,103	6,805	8,625	8,541	8,540	8,691	8,932	9,514	Continuing	Continuing
2312	Biological Sciences	10,933	13,024	13,484	12,228	12,186	12,483	12,763	13,642	Continuing	Continuing
2313	Human Performance	10,500	12,528	13,212	9,944	9,887	10,072	10,363	11,066	Continuing	Continuing
4113	International Science Programs	15,269	13,243	4,878	0	0	0	0	0	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601102F Defense Research Sciences**

(U) A. Mission Description: This Basic Research program, managed by the Air Force Office of Scientific Research (AFOSR), supports Air Force research efforts comprised of in-house investigations in Air Force laboratories and extramural activities in academia and industry. The program element funds broad-based scientific and engineering basic research in technologies critical to the Air Force mission. These technologies include aerospace structures, aerodynamics, materials, propulsion, power, electronics, computer science, directed energy, conventional weapons, life sciences, and atmospheric and space sciences. All projects are coordinated through the Reliance process to harmonize efforts, eliminate duplication, and ensure the most effective use of funds. All technology areas are subject to long-range research planning and technical review by tri-Service scientific planning groups that interface and support the Defense Technology Area Planning process. Due to budget reductions in the Human Performance Program in 2001, research efforts in cognitive workload training and personnel selection and work related to cockpit design will be eliminated. Beginning in FY 2000, the Air Force will reduce funding in the International Education Science Programs due to higher priorities within the Science and Technology (S&T) Program.

(U) B. Budget Activity Justification: This program is Budget Activity 1, Basic Research, since it includes efforts of scientific study and experimentation directed toward increasing knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	196,251	209,395	228,104	230,992	Cont
(U) Appropriated Value	207,249	210,395			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-6,856	-664			
b. SBIR	-4,288				
c. Omnibus/Other Above Threshold Reprogrammings	-5,681				
d. Below Threshold Reprogrammings	-2,208				
(U) Adjustments to Budget Year Since FY 1999 PB			-18,599	-53,479	
(U) Current Budget Submit/FY 2000 PB	188,216	209,731	209,505	177,513	Cont

(U) Significant Program Changes: Changes to this program since the President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $5,524 identified as a source for SBIR

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2301

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2301 Physics	18,629	22,685	22,147	20,268	20,368	20,757	21,342	22,973	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $6,351 Performed research on laser and optical physics for aerospace applications, optical devices for spoofing and damaging infrared seeking missiles, countermeasures, and devices for directed energy weapons; directed studies toward developing optimum lasers for high image quality telescopes for space surveillance. Examined the physics of lethal and nonlethal directed-energy for speed-of-light target kill.
- (U) $3,987 Conducted plasma physics research for future directed-energy weapons, affordable low-observables, space communications and surveillance, and advanced explosive-driven power generators; examined the feasibility of using collisional ionized gas volumes to protect friendly assets from directed energy weapon threats.
- (U) $5,259 Studied atomic, molecular, and imaging physics to enhance space surveillance capabilities in the area of target detection and recognition. Developed advanced atomic molecular processes to produce ideal performance time standards.
- (U) $3,032 Performed basic research in adaptive optics for application in advanced ground-based telescopes.
- (U) $18,629 Total

(U) FY 1999 ($ in Thousands):

- (U) $9,397 Perform research on laser and optical physics for aerospace applications, optical devices for spoofing and damaging infrared seeking missiles, countermeasures, and devices for directed energy weapons; direct studies toward developing optimum lasers for high image quality telescopes for space surveillance. Examine the physics of lethal and nonlethal directed-energy for speed-of-light target kill.
- (U) $6,100 Conduct plasma physics research for future directed-energy weapons, affordable low-observables, space communications and surveillance, and advanced explosive-driven power generators; examine the feasibility of using collisional ionized gas volumes to protect friendly assets from directed energy weapon threats.
- (U) $6,590 Study atomic, molecular, and imaging physics to enhance space surveillance capabilities in the area of target detection and recognition. Develop advanced atomic molecular processes to produce ideal performance time standards.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2301

- (U) $598 Identified as a source for SBIR.
- (U) $22,685 Total

(U) FY 2000 ($ in Thousands):

- (U) $9,422 Perform research on laser and optical physics for aerospace applications, optical devices for spoofing and damaging infrared seeking missiles, countermeasures, and devices for directed energy weapons; direct studies toward developing optimum lasers for high image quality telescopes for space surveillance. Examine the physics of lethal and nonlethal directed-energy for speed-of-light target kill.
- (U) $6,117 Conduct plasma physics research for future directed-energy weapons, affordable low-observables, space communications and surveillance, and advanced explosive-driven power generators; examine the feasibility of using collisional ionized gas volumes to protect friendly assets from directed energy weapon threats.
- (U) $6,608 Study atomic, molecular, and imaging physics to enhance space surveillance capabilities in the area of target detection and recognition. Develop advanced atomic molecular processes to produce ideal performance time standards.
- (U) $22,147 Total

(U) FY 2001 ($ in Thousands):

- (U) $8,519 Perform research on laser and optical physics for aerospace applications, optical devices for spoofing and damaging infrared seeking missiles, countermeasures, and devices for directed energy weapons. Examine the physics of lethal and nonlethal directed-energy for speed-of-light target kill.
- (U) $5,676 Conduct plasma physics research for future directed-energy weapons, affordable low-observables, space communications and surveillance, and advanced explosive-driven power generators.
- (U) $6,073 Study atomic and molecular physics to enhance space surveillance capabilities in the area of target detection and recognition. Develop advanced atomic molecular processes to produce ideal performance time standards.
- (U) $20,268 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2301

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2302

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2302 Solid Mechanics and Structures	13,660	18,322	16,094	9,308	9,334	9,651	9,827	10,583	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $5,470 Studied thermomechanical behavior of advanced structural materials, including micromechanics of high-temperature composite materials for aerospace structural systems and coatings. Investigated the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications.
- (U) $5,105 Modeled development of materials for aerospace structures, including dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems. Developed fundamental understanding of the behavior of aeroelastic structures and conducted research into the behavior of actuator/structure interaction for control of shell structures in vibro/acoustic environments.
- (U) $3,085 Sought fundamental particulate mechanics knowledge, including quantitative relationships to describe the fundamental mechanics governing the behavior of geomaterial systems. Investigated the fundamental relationship of geomaterials undergoing high strain rate loadings with increasing confining pressures, as occurs when impacted by penetrating weapons.
- (U) $13,660 Total

(U) FY 1999 ($ in Thousands):

- (U) $6,557 Study thermomechanical behavior of advanced structural materials, including micromechanics of high-temperature composite materials for aerospace structural systems and coatings. Investigate the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2302

– (U) $6,022 Model development of materials for aerospace structures, including dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems. Develop fundamental understanding of the behavior of aeroelastic structures and conduct research into the behavior of actuator/structure interaction for control of shell structures in vibro/acoustic environments.

– (U) $5,261 Seek fundamental particulate mechanics knowledge, including quantitative relationships to describe the fundamental mechanics governing the behavior of geomaterial systems. Investigate the fundamental relationship of geomaterials undergoing high strain rate loadings with increasing confining pressures, as occurs when impacted by penetrating weapons.

– (U) $482 Identified as a source for SBIR.

– (U) $18,322 Total

(U) FY 2000 ($ in Thousands):

– (U) $5,915 Study thermomechanical behavior of advanced structural materials, including micromechanics of high-temperature composite materials for aerospace structural systems and coatings. Investigate the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications.

– (U) $5,432 Model development of materials for aerospace structures, including dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems. Develop fundamental understanding of the behavior of aeroelastic structures and conduct research into the behavior of actuator/structure interaction for control of shell structures in vibro/acoustic environments.

– (U) $4,747 Seek fundamental particulate mechanics knowledge, including quantitative relationships to describe the fundamental mechanics governing the behavior of geomaterial systems. Investigate the fundamental relationship of geomaterials undergoing high strain rate loadings with increasing confining pressures, as occurs when impacted by penetrating weapons.

– (U) $16,094 Total

(U) FY 2001 ($ in Thousands):

– (U) $5,289 Study thermomechanical behavior of advanced structural materials, including micromechanics of high-temperature composite materials for aerospace structural systems and coatings. Investigate the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications.

– (U) $3,149 Model development of materials for aerospace structures, including dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems. Develop fundamental understanding of the behavior of aeroelastic structures and conduct research into the behavior of actuator/structure interaction for control of shell structures in vibro/acoustic environments.

– (U) $870 Investigate and integrate material and structural behavior for future aerospace structures such as multifunctional systems as necessary for the development of smart structures and MEMS. Develop fundamental understanding of the energy dissipation mechanisms within these materials and structures.

– (U) $9,308 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2302

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2303

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2303 Chemistry	24,185	25,826	27,536	24,641	24,805	25,262	25,707	27,701	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $7,080 Studied chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance by investigating the long-term durability of polymers that operate in extreme environments. Developed organic coatings for aircraft protection applications and created functional polymers for optical signal processing and control of phased-array radar and laser radar.
- (U) $6,372 Investigated a chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems by formulating an atomistic model for corrosion prevention in aluminum aircraft components. Developed new vapor phase lubricants for operations in extreme temperature environments.
- (U) $10,733 Performed research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications by investigating high-energy, metastable molecular states, and by developing and applying methods for simulating molecular energy transfer in extreme aerospace environments to predict and interpret aircraft and spacecraft signatures. Investigated the formation and stability of molecular clusters for use as nanoscale sensors in aircraft, spacecraft, and air vehicles.
- (U) $24,185 Total

(U) FY 1999 ($ in Thousands):

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2303

– (U) $7,544 Study chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance by investigating the long-term durability of polymers that operate in extreme environments. Develop organic coatings for aircraft protection applications and create functional polymers for optical signal processing and control of phased-array radar and laser radar.

– (U) $7,041 Investigate a chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems by formulating an atomistic model for corrosion prevention in aluminum aircraft components. Develop new vapor phase lubricants for operations in extreme temperature environments.

– (U) $10,561 Perform research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications by investigating high-energy, metastable molecular states, and by developing and applying methods for simulating molecular energy transfer in extreme aerospace environments to predict and interpret aircraft and spacecraft signatures. Investigate the formation and stability of molecular clusters for use as nanoscale sensors in aircraft, spacecraft, and air vehicles.

– (U) $680 Identified as a source for SBIR.

– (U) $25,826 Total

(U) FY 2000 ($ in Thousands):

– (U) $8,261 Study chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance by investigating the long-term durability of polymers that operate in extreme environments. Develop organic coatings for aircraft protection applications and create functional polymers for optical signal processing and control of phased-array radar and laser radar.

– (U) $7,710 Investigate a chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems by formulating an atomistic model for corrosion prevention in aluminum aircraft components. Develop new vapor phase lubricants for operations in extreme temperature environments.

– (U) $11,565 Perform research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications by investigating high-energy, metastable molecular states, and by developing and applying methods for simulating molecular energy transfer in extreme aerospace environments to predict and interpret aircraft and spacecraft signatures. Investigate the formation and stability of molecular clusters for use as nanoscale sensors in aircraft, spacecraft, and air vehicles.

– (U) $27,536 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2303

(U) FY 2001 ($ in Thousands):

- (U) $7,146 Study chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance by investigating the long-term durability of polymers that operate in extreme environments. Create functional polymers for optical signal processing and control of phased-array radar and laser radar.
- (U) $6,603 Investigate a chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems by formulating an atomistic model for corrosion prevention in aluminum aircraft components.
- (U) $10,892 Perform research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications by investigating high-energy, metastable molecular states, and by developing and applying methods for simulating molecular energy transfer in extreme aerospace environments to predict and interpret aircraft and spacecraft signatures. Investigate the formation and stability of molecular clusters for use as nanoscale sensors in aircraft, spacecraft, and air vehicles.
- (U) $24,641 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 2304

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2304 Mathematical and Computer Sciences	30,488	34,415	32,944	27,743	27,916	28,413	28,917	31,221	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $10,113 Studied physical mathematics, control and signal processing, and modeling of advanced materials including composites and smart skins in support of the Air Force's New World Vista (NWV) programs. Developed modeling, identification, control, and signal processing capabilities necessary for the integrated control of jet engines, aerodynamics, and combustor instabilities.
- (U) $10,962 Performed research on computer software and systems for battlespace information management. Expanded research in transportable agent technology to support defensive information warfare applications and real-time problem solving strategies to support dynamic planning and execution.
- (U) $9,413 Investigated computational science for improved design and simulation of advanced aerospace systems. Integrated new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines and other aerospace components. Developed algorithms incorporating active control procedures.
- (U) $30,488 Total

(U) FY 1999 ($ in Thousands):

- (U) $11,393 Study physical mathematics, control and and signal processing, and modeling of advanced materials including composites and smart skins in support of the Air Force's NWV programs. Develop modeling, identification, control, and signal processing capabilities necessary for the integrated control of jet engines, aerodynamics, and combustor instabilities.
- (U) $12,064 Perform research on computer software and systems for battlespace information management. Expand research in transportable agent technology to support defensive information warfare applications and real-time problem solving strategies to support dynamic planning and execution.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2304

- (U) $10,052 Investigate computational science for improved design and simulation of advanced aerospace systems. Integrate new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines and other aerospace components. Develop algorithms incorporating active control procedures.
- (U) $906 Identified as a source for SBIR.
- (U) $34,415 Total

(U) FY 2000 ($ in Thousands):

- (U) $12,200 Study physical mathematics, control and signal processing, and modeling of advanced materials including composites and smart skins in support of the Air Force's New World Vista (NWV) programs. Develop modeling, identification, control, and signal processing capabilities necessary for the integrated control of jet engines, aerodynamics, and combustor instabilities.
- (U) $11,861 Perform research on computer software and systems for battlespace information management. Expand research in transportable agent technology to support defensive information warfare applications and real-time problem solving strategies to support dynamic planning and execution.
- (U) $9,883 Investigate computational science for improved design and simulation of advanced aerospace systems. Integrate new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines and other aerospace components. Develop algorithms incorporating active control procedures.
- (U) $32,944 Total

(U) FY 2001 ($ in Thousands):

- (U) $11,228 Study physical mathematics, control and signal processing, and modeling of advanced materials including composites and smart skins in support of the Air Force's NWV programs. Develop modeling, identification, control, and signal processing capabilities necessary for the integrated control of jet engines, aerodynamics, and combustor instabilities.
- (U) $8,884 Perform research on computer software and systems for battlespace information management. Continue research in transportable agent technology to support defensive information warfare applications and real-time problem solving strategies to support dynamic planning and execution.
- (U) $7,631 Investigate computational science for improved design and simulation of advanced aerospace systems. Integrate new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines and other aerospace components. Develop algorithms incorporating active control procedures.
- (U) $27,743 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2304

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences	PROJECT: 2305

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2305 Electronics	19,898	23,399	24,429	20,287	20,603	20,978	21,365	23,001	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $11,137 Studied semiconductor electronic materials, advanced devices, interface control, and stability for improved laser and detector applications. Investigated methods to electronically tailor compound semiconductors and examined high-temperature electronics for use in hostile environments.
- (U) $6,052 Sought fundamental understanding of optoelectronic information processing and storage. Investigated advanced communications, signal processing, and computing; and examined novel micro-lasers and ultra-high density information storage and retrieval.
- (U) $2,709 Investigated superconducting and nanoscopic materials, devices, and applications for advanced communications and higher speed signal processing and denser memory. Created high current, high temperature, superconducting materials for power generation and storage on space platforms.
- (U) $19,898 Total

(U) FY 1999 ($ in Thousands):

- (U) $12,279 Study semiconductor electronic materials, advanced devices, interface control, and stability for improved laser and detector applications. Investigated methods to electronically tailor compound semiconductors and examine high-temperature electronics for use in hostile environments.
- (U) $6,559 Seek fundamental understanding of optoelectronic information processing and storage. Investigate advanced communications, signal processing, and computing; and examine novel micro-lasers and ultra-high density information storage and retrieval.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2305

- (U) $3,945 Investigate superconducting and nanoscopic materials, devices, and applications for advanced communications and higher speed signal processing and denser memory. Create high current, high temperature, superconducting materials for power generation and storage on space platforms.
- (U) $616 Identified as a source for SBIR.
- (U) $23,399 Total

(U) FY 2000 ($ in Thousands):

- (U) $13,167 Study semiconductor electronic materials, advanced devices, interface control, and stability for improved laser and detector applications. Investigate methods to electronically tailor compound semiconductors and examine high-temperature electronics for use in hostile environments.
- (U) $7,034 Seek fundamental understanding of optoelectronic information processing and storage. Investigate advanced communications, signal processing, and computing; and examine novel micro-lasers and ultra-high density information storage and retrieval.
- (U) $4,228 Investigate superconducting and nanoscopic materials, devices, and applications for advanced communications and higher speed signal processing and denser memory. Create high current, high temperature, superconducting materials for power generation and storage on space platforms.
- (U) $24,429 Total

(U) FY 2001 ($ in Thousands):

- (U) $11,395 Study semiconductor electronic materials, advanced devices, and stability for improved detector applications. Investigate methods to electronically tailor compound semiconductors and examine high-temperature electronics for use in hostile environments.
- (U) $4,634 Examine novel micro-lasers and ultra-high density information storage and retrieval.
- (U) $4,258 Investigate superconducting and nanoscopic materials, devices, and applications for advanced communications and higher speed signal processing and denser memory. Create high current, high temperature, superconducting materials for power generation and storage on space platforms.
- (U) $20,287 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2305

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2306

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2306 Materials	10,116	12,122	13,257	13,380	13,556	13,773	14,093	15,099	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $5,152 Performed fundamental studies of very-high temperature, non-metallic materials for air-breathing engine and space vehicle applications. Investigated coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for engine blade applications and ultra-high temperature materials systems based on carbides for rocket propulsion applications.
- (U) $4,032 Performed research on metallic systems for engines and airframe applications. Studied thermal and mechanical stability of refractory metal systems for very-high temperature applications and investigated functionally gradient structures for thermal barrier coatings.
- (U) $932 Studied life and reliability of polymeric composites by researching non-destructive evaluation techniques on adhesive-bonded structures. Investigated free-volume effect in controlling moisture absorption mechanisms and rates in polymer matrix composites.
- (U) $10,116 Total

(U) FY 1999 ($ in Thousands):

- (U) $6,373 Perform fundamental studies of very-high temperature, non-metallic materials for air-breathing engine and space vehicle applications. Investigate coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for engine blade applications and ultra-high temperature materials systems based on carbides for rocket propulsion applications.
- (U) $4,248 Perform research on metallic systems for engines and airframe applications. Study thermal and mechanical stability of refractory metal systems for very-high temperature applications and investigate functionally gradient structures for thermal barrier coatings.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2306

– (U) $1,181 Study life and reliability of polymeric composites by researching non-destructive evaluation techniques on adhesive-bonded structures. Investigate free-volume effect in controlling moisture absorption mechanisms and rates in polymer matrix composites.
– (U) $320 Identified as a source for SBIR.
– (U) $12,122 Total

(U) FY 2000 ($ in Thousands):
– (U) $7,159 Perform fundamental studies of very-high temperature, non-metallic materials for air-breathing engine and space vehicle applications. Investigate coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for engine blade applications and ultra-high temperature materials systems based on carbides for rocket propulsion applications.
– (U) $4,772 Perform research on metallic systems for engines and airframe applications. Study thermal and mechanical stability of refractory metal systems for very-high temperature applications and investigate functionally gradient structures for thermal barrier coatings.
– (U) $1,326 Study life and reliability of polymeric composites by researching non-destructive evaluation techniques on adhesive-bonded structures. Investigate free-volume effect in controlling moisture absorption mechanisms and rates in polymer matrix composites.
– (U) $13,257 Total

(U) FY 2001 ($ in Thousands):
– (U) $7,225 Perform fundamental studies of very-high temperature, non-metallic materials for air-breathing engine and space vehicle applications. Investigate coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for engine blade applications and ultra-high temperature materials systems based on carbides for rocket propulsion applications.
– (U) $4,816 Perform research on metallic systems for engines and airframe applications. Study thermal and mechanical stability of refractory metal systems for very-high temperature applications and investigate functionally gradient structures for thermal barrier coatings.
– (U) $1,339 Study life and reliability of polymeric composites by researching non-destructive evaluation techniques on adhesive-bonded structures. Investigate free-volume effect in controlling moisture absorption mechanisms and rates in polymer matrix composites.
– (U) $13,380 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2306

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2307

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2307 Fluid Mechanics	11,094	7,189	9,975	9,538	9,589	9,776	10,064	10,744	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):
- (U) $2,262 Conducted external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems. Developed fluid/structural interaction models based on flow field interaction research. Investigated novel concepts for hypersonic flow control to reduce the size and weight of new hypersonic air vehicles.
- (U) $5,467 Performed turbulence and flow control research to enhance air vehicle stability, performance, and control. Developed microelectromechanical systems (MEMS) actuators and sensors for micro-air vehicle systems and investigated the use of MEMS devices on swept wing air vehicles.
- (U) $3,365 Conducted internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems. Developed MEMS devices for turbine engine control and Large Eddy Simulation (LES) methodology for turbomachinery flows.
- (U) $11,094 Total

(U) FY 1999 ($ in Thousands):
- (U) $1,610 Conduct external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems. Develop fluid/structural interaction models based on flow field interaction research. Investigate novel concepts for hypersonic flow control to reduce the size and weight of new hypersonic air vehicles.
- (U) $3,342 Perform turbulence and flow control research to enhance air vehicle stability, performance, and control. Develop MEMS actuators and sensors for micro-air vehicle systems and investigate the use of MEMS devices on swept wing air vehicles.
- (U) $2,048 Conduct internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems. Develop MEMS devices for turbine engine control and LES methodology for turbomachinery flows.
- (U) $189 Identified as a source for SBIR.
- (U) $7,189 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 2307

(U) FY 2000 ($ in Thousands):

- (U) $2,294 Conduct external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems. Develop fluid/structural interaction models based on flow field interaction research. Investigate novel concepts for hypersonic flow control to reduce the size and weight of new hypersonic air vehicles.
- (U) $4,762 Perform turbulence and flow control research to enhance air vehicle stability, performance, and control. Develop microelectromechanical systems (MEMS) actuators and sensors for micro-air vehicle systems and investigate the use of MEMS devices on swept wing air vehicles.
- (U) $2,919 Conduct internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems. Develop MEMS devices for turbine engine control and Large Eddy Simulation (LES) methodology for turbomachinery flows.
- (U) $9,975 Total

(U) FY 2001 ($ in Thousands):

- (U) $2,262 Conduct external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems. Develop fluid/structural interaction models based on flow field interaction research. Investigate novel concepts for hypersonic flow control to reduce the size and weight of new hypersonic air vehicles.
- (U) $4,399 Perform turbulence and flow control research to enhance air vehicle stability, performance, and control. Develop MEMS actuators and sensors for micro-air vehicle systems and investigate the use of MEMS devices on swept wing air vehicles.
- (U) $2,877 Conduct internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems. Develop MEMS devices for turbine engine control and LES methodology for turbomachinery flows.
- (U) $9,538 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2307

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2308

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2308 Propulsion	12,757	14,629	17,263	16,553	16,633	16,950	17,447	18,755	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $5,922 Performed research on space and rocket propulsion and power through the development of supercritical combustion models for rocket propulsion and model predictions of mini-satellite propulsion and performance for high precision clusters of cooperating autonomous microsatellite operations. Performed experimental and numerical studies of high altitude ultraviolet (UV) and infrared (IR) signatures to protect space assets.
- (U) $5,357 Studied airbreathing combustion for propulsion systems for hypersonic flight capability by examining combustion product formation in gas turbine engines and exploring supercritical fuel behavior under high temperatures and pressure conditions. Studied the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine and scramjet engines.
- (U) $1,478 Investigated propulsion diagnostics of new propulsion system concepts through data reduction and interpretation approaches. Extended diode-laser spectroscopic technique for on-board control of propulsion system operation and performance.
- (U) $12,757 Total

(U) FY 1999 ($ in Thousands):

- (U) $5,697 Perform research on space and rocket propulsion and power through the development of supercritical combustion models for rocket propulsion and model predictions of mini-satellite propulsion and performance for high precision clusters of cooperating autonomous microsatellite operations. Perform experimental and numerical studies of high altitude UV and IR signatures to protect space assets.
- (U) $7,790 Study airbreathing combustion for propulsion systems for hypersonic flight capability by examining combustion product formation in gas turbine engines and explore supercritical fuel behavior under high temperatures and pressure conditions. Study the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine and scramjet engines.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2308

– (U) $756 Investigate propulsion diagnostics of new propulsion system concepts through data reduction and interpretation approaches. Extend diode-laser spectroscopic technique for on-board control of propulsion system operation and performance.
– (U) $386 Identified as a source for SBIR.
– (U) $14,629 Total

(U) FY 2000 ($ in Thousands):
– (U) $6,906 Perform research on space and rocket propulsion and power through the development of supercritical combustion models for rocket propulsion and model predictions of mini-satellite propulsion and performance for high precision clusters of cooperating autonomous microsatellite operations. Perform experimental and numerical studies of high altitude ultraviolet (UV) and (IR) signatures to protect space assets.
– (U) $9,441 Study airbreathing combustion for propulsion systems for hypersonic flight capability by examining combustion product formation in gas turbine engines and explore supercritical fuel behavior under high temperatures and pressure conditions. Study the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine and scramjet engines.
– (U) $916 Investigate propulsion diagnostics of new propulsion system concepts through data reduction and interpretation approaches. Extend diode-laser spectroscopic technique for on-board control of propulsion system operation and performance.
– (U) $17,263 Total

(U) FY 2001 ($ in Thousands):
– (U) $6,992 Perform research on space and rocket propulsion and power through the development of supercritical combustion models for rocket propulsion and model predictions of mini-satellite propulsion and performance for high precision clusters of cooperating autonomous microsatellite operations. Perform experimental and numerical studies of high altitude UV and IR signatures to protect space assets.
– (U) $4,906 Study airbreathing combustion for propulsion systems for hypersonic flight capability by examining combustion product formation and explore supercritical fuel behavior under high temperature and pressure conditions. Examine the impact of weakly ionized flows on hypersonic propulsion.
– (U) $4,655 Study the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine engines. Investigate reduced models for turbulence/chemistry interactions affecting combustor system operations and performance.
– (U) $16,553 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2308

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 2310

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2310 Atmospheric Sciences	5,584	5,544	5,661	5,082	5,106	5,207	5,365	5,721	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $1,521 Improved space weather specification and forecast models, and studied the coupling between the solar wind, the interplanetary magnetic field (IMF), and the earth's magnetosphere by using satellites to analyze the IMF and solar wind ions. Developed a Coordinated Community Modeling Center to bring researchers directly in touch with the DoD user community.
- (U) $1,038 Analyzed atmospheric physics to understand and exploit the aerospace environment and improved atmospheric radiative transfer models to estimate the impacts of weather limitations on the employment of directed energy weapons. Investigated gravity wave interactions with ambient atmospheric vorticity fields that affect optical atmospheric emissions observed from orbit.
- (U) $3,025 Studied ionospheric physics to enhance global surveillance capability and investigated ionosphere phenomena. Examined signatures of solar activity which disrupt global radio communications and space surveillance.
- (U) $5,584 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,658 Improve space weather specification and forecast models, and study the coupling between the solar wind, the IMF, and the earth's magnetosphere by using satellites to analyze the IMF and solar wind ions. Develop a Coordinated Community Modeling Center to bring researchers directly in touch with the DoD user community.
- (U) $1,132 Analyze atmospheric physics to understand and exploit the aerospace environment and improved atmospheric radiative transfer models to estimate the impacts of weather limitations on the employment of directed energy weapons. Investigate gravity wave interactions with ambient atmospheric vorticity fields that affect optical atmospheric emissions observed from orbit.

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BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2310

- (U) $2,608 Study ionospheric physics to enhance global surveillance capability and investigate ionosphere phenomena. Examine signatures of solar activity which disrupt global radio communications and space surveillance.
- (U) $146 Identified as a source for SBIR.
- (U) $5,544 Total

(U) FY 2000 ($ in Thousands):

- (U) $1,739 Improve space weather specification and forecast models, and study the coupling between the solar wind, the interplanetary magnetic field (IMF), and the earth's magnetosphere by using satellites to analyze the IMF and solar wind ions. Develop a Coordinated Community Modeling Center to bring researchers directly in touch with the DoD user community.
- (U) $1,187 Analyze atmospheric physics to understand and exploit the aerospace environment and improved atmospheric radiative transfer models to estimate the impacts of weather limitations on the employment of directed energy weapons. Investigate gravity wave interactions with ambient atmospheric vorticity fields that affect optical atmospheric emissions observed from orbit.
- (U) $2,735 Study ionospheric physics to enhance global surveillance capability and investigate ionosphere phenomena. Examine signatures of solar activity which disrupt global radio communications and space surveillance.
- (U) $5,661 Total

(U) FY 2001 ($ in Thousands):

- (U) $1,222 Improve space weather specification and forecast models, and study the coupling between the solar wind, the IMF, and the earth's magnetosphere by using satellites to analyze the IMF and solar wind ions. Develop a Coordinated Community Modeling Center to bring researchers directly in touch with the DoD user community.
- (U) $1,168 Analyze atmospheric physics to understand and exploit the aerospace environment and improved atmospheric radiative transfer models to estimate the impacts of weather limitations on the employment of directed energy weapons. Investigate gravity wave interactions with ambient atmospheric vorticity fields that affect optical atmospheric emissions observed from orbit.
- (U) $2,692 Study ionospheric physics to enhance global surveillance capability and investigate ionosphere phenomena. Examine signatures of solar activity which disrupt global radio communications and space surveillance.
- (U) $5,082 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2310

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 2311

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2311 Space Sciences	5,103	6,805	8,625	8,541	8,540	8,691	8,932	9,514	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $1,864 Analyzed physics of solar magnetic fields, flares, and coronal mass ejections to provide a physical basis for predictive models of the effects of solar disturbances on near-Earth space to predict the state of the interplanetary medium using solar magnetic field and coronal data that can be related to disturbances.
- (U) $1,739 Studied the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the Earth's magnetosphere and evaluated techniques to study solar source regions and infer the magnetic structures of interplanetary disturbances. Tested solar wind shock detection algorithms.
- (U) $1,500 Studied magnetospheric and radiation belt processes to eliminate operational deficiencies, and fluid and particle dynamics to determine criteria for substorm onset and modeled rapid variations in the interaction between the solar wind and magnetosphere using diffusion coefficients estimated from electric field propagation studies.
- (U) $5,103 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,953 Analyze physics of solar magnetic fields, flares, and coronal mass ejections to provide a physical basis for predictive models of the effects of solar disturbances on near-Earth space to predict the state of the interplanetary medium using solar magnetic field and coronal data that can be related to disturbances.
- (U) $2,670 Study the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the Earth's magnetosphere and evaluate techniques to study solar source regions and infer the magnetic structures of interplanetary disturbances. Test solar wind shock detection algorithms.

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BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2311

– (U) $2,003 Study magnetospheric and radiation belt processes to eliminate operational deficiencies, and fluid and particle dynamics to determine criteria for substorm onset and model rapid variations in the interaction between the solar wind and magnetosphere using diffusion coefficients estimated from electric field propagation studies.
– (U) $179 Identified as a source for SBIR.
– (U) $6,805 Total

(U) FY 2000 ($ in Thousands):
– (U) $2,542 Analyze physics of solar magnetic fields, flares, and coronal mass ejections to provide a physical basis for predictive models of the effects of solar disturbances on near-Earth space to predict the state of the interplanetary medium using solar magnetic field and coronal data that can be related to disturbances.
– (U) $3,476 Study the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the Earth's magnetosphere and evaluate techniques to study solar source regions and infer the magnetic structures of interplanetary disturbances. Test solar wind shock detection algorithms.
– (U) $2,607 Study magnetospheric and radiation belt processes to eliminate operational deficiencies, and fluid and particle dynamics to determine criteria for substorm onset and model rapid variations in the interaction between the solar wind and magnetosphere using diffusion coefficients estimated from electric field propagation studies.
– (U) $8,625 Total

(U) FY 2001 ($ in Thousands):
– (U) $2,749 Analyze physics of solar magnetic fields, flares, and coronal mass ejections to provide a physical basis for predictive models of the effects of solar disturbances on near-Earth space to predict the state of the interplanetary medium using solar magnetic field and coronal data that can be related to disturbances.
– (U) $3,759 Study the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the Earth's magnetosphere and evaluate techniques to study solar source regions and infer the magnetic structures of interplanetary disturbances. Test solar wind shock detection algorithms.
– (U) $2,033 Study magnetospheric and radiation belt processes to eliminate operational deficiencies, and fluid and particle dynamics to determine criteria for substorm onset and model rapid variations in the interaction between the solar wind and magnetosphere using diffusion coefficients estimated from electric field propagation studies.
– (U) $8,541 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2311

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences	PROJECT: 2312

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2312 Biological Sciences	10,933	13,024	13,484	12,228	12,186	12,483	12,763	13,642	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):
- (U) $6,638 Studied toxicology of biohazardous agents to investigate molecular and biochemical effects in the brain and the neurobehavioral correlates associated with the inhalation of JP-8 jet fuel; and developed mathematical models to predict retinal damage. Used molecular biological techniques for modifying microbial enzyme capacity to engineer bio-catalysis of reactions in the synthesis and manufacture of materials.
- (U) $3,074 Investigated biological mechanisms responsible for circadian rhythmicity by examining individual differences in circadian systems to predict effects of night operations and jet lag on military personnel.
- (U) $1,221 Performed research in mechanisms of animal sensing systems through investigation of insect infrared systems.
- (U) $10,933 Total

(U) FY 1999 ($ in Thousands):
- (U) $6,333 Study toxicology of biohazardous agents to investigate molecular and biochemical effects in the brain and the neurobehavioral correlates associated with the inhalation of JP-8 jet fuel; and develop mathematical models to predict retinal damage. Use molecular biological techniques for modifying microbial enzyme capacity to engineer bio-catalysis of reactions in the synthesis and manufacture of materials.
- (U) $5,065 Investigate biological mechanisms responsible for circadian rhythmicity by examining individual differences in circadian systems to predict effects of night operations and jet lag on military personnel.
- (U) $1,283 Perform research in mechanisms of animal sensing systems through investigation of insect infrared systems.
- (U) $343 Identified as a source for SBIR.
- (U) $13,024 Total

(U) FY 2000 ($ in Thousands):

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2312

- (U) $6,734 Study toxicology of biohazardous agents to investigate molecular and biochemical effects in the brain and the neurobehavioral correlates associated with the inhalation of JP-8 jet fuel; and develop mathematical models to predict retinal damage. Use molecular biological techniques for modifying microbial enzyme capacity to engineer bio-catalysis of reactions in the synthesis and manufacture of materials.
- (U) $5,385 Investigate biological mechanisms responsible for circadian rhythmicity by examining individual differences in circadian systems to predict effects of night operations and jet lag on military personnel.
- (U) $1,365 Perform research in mechanisms of animal sensing systems through investigation of insect infrared systems.
- (U) $13,484 Total

(U) FY 2001 ($ in Thousands):

- (U) $5,364 Use molecular biological techniques for modifying microbial enzyme capacity to engineer bio-catalysis of reactions in the synthesis and manufacture of materials.
- (U) $5,475 Investigate biological mechanisms responsible for circadian rhythmicity by examining individual differences in circadian systems to predict effects of night operations and jet lag on military personnel.
- (U) $1,389 Perform research in mechanisms of animal sensing systems through investigation of insect infrared systems.
- (U) $12,228 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 2313

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2313 Human Performance	10,500	12,528	13,212	9,944	9,887	10,072	10,363	11,066	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $3,168 Performed sensory and perceptual system analysis for human-machine interface and image exploitation by developing image representation theory and investigating algorithms for visual attention to improve performance in command and control environments; also supported model-based predictions of limits in speech communication.
- (U) $4,065 Conducted cognitive workload analysis for crew training and performance enhancement by examining cognitive performance models, developing a theory of cognitive workload, and extending the cognitive models to include characterization of on-line job aiding systems used in command and control environments.
- (U) $3,267 Studied synthetic task environments for baseline performance measurement and conducted experiments leading to a more general theory of utility for performance enhancement techniques. Extended experimental techniques for command and control team performance and developed multi-ship modeling for unmanned aerial vehicles (UAVs) surveillance and targeting.
- (U) $10,500 Total

(U) FY 1999 ($ in Thousands):

- (U) $3,254 Perform sensory and perceptual system analysis for human-machine interface and image exploitation by developing image representation theory and investigating algorithms for visual attention to improve performance in command and control environments; also support model-based predictions of limits in speech communication.
- (U) $4,684 Conduct cognitive workload analysis for crew training and performance enhancement by examining cognitive performance models, developing a theory of cognitive workload, and extending the cognitive models to include characterization of on-line job aiding systems used in command and control environments.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2313

– (U) $4,260 Study synthetic task environments for baseline performance measurement and conduct experiments leading to a more general theory of utility for performance enhancement techniques. Extend experimental techniques for command and control team performance and develop multi-ship modeling for unmanned aerial vehicles (UAVs) surveillance and targeting.

– (U) $330 Identified as a source for SBIR.

– (U) $12,528 Total

(U) FY 2000 ($ in Thousands):

– (U) $3,524 Perform sensory and perceptual system analysis for human-machine interface and image exploitation by developing image representation theory and investigating algorithms for visual attention to improve performance in command and control environments; also support model-based predictions of limits in speech communication.

– (U) $5,074 Conduct cognitive workload analysis for crew training and performance enhancement by examining cognitive performance models, developing a theory of cognitive workload, and extending the cognitive models to include characterization of on-line job aiding systems used in command and control environments.

– (U) $4,614 Study synthetic task environments for baseline performance measurement and conduct experiments leading to a more general theory of utility for performance enhancement techniques. Extend experimental techniques for command and control team performance and develop multi-ship modeling for UAV surveillance and targeting.

– (U) $13,212 Total

(U) FY 2001 ($ in Thousands):

– (U) $2,094 Perform sensory and perceptual system analysis for human-machine interface and image exploitation by developing image representation theory and investigating algorithms for visual attention to improve performance in command and control environments; also support model-based predictions of limits in speech communication.

– (U) $3,172 Conduct cognitive workload analysis for crew training and performance enhancement by examining cognitive performance models, developing a theory of cognitive workload, and extending the cognitive models to include characterization of on-line job aiding systems used in command and control environments.

– (U) $4,678 Study synthetic task environments for baseline performance measurement and conduct experiments leading to a more general theory of utility for performance enhancement techniques. Extend experimental techniques for command and control team performance and develop multi-ship modeling for UAV surveillance and targeting.

– (U) $9,944 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences
	PROJECT 2313

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 4113

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4113 International Science Programs	15,269	13,243	4,878	0	0	0	0	0	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $4,924 Funded international science and personnel exchange programs and technology liaison missions in Europe and Asia to support scientists and engineers performing laboratory research in foreign countries. Provided Air Force share of funding for NATO-affiliated research institutes.
- (U) $5,956 Supported science and technology personnel exchanges within the United States, through various exchange programs for faculty, students, and researchers at the Air Force Research Laboratory.
- (U) $4,389 Conducted fellowship awards program and roundtable on national science and technology policy for senior leaders from industry, government, and academia to formulate a national science technology policy. Funded outstanding university research scientists to pursue research relevant to Air Force Research Laboratory issues.
- (U) $15,269 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences / PROJECT: 4113

(U) FY 1999 ($ in Thousands):
- (U) $4,254 Fund international science and personnel exchange programs.
- (U) $5,057 Support technology liaison missions in Europe and Asia to support scientists and engineers performing laboratory research in foreign countries.
- (U) $3,583 Provide Air Force share of funding for NATO-affiliated research institutes.
- (U) $349 Identified as a source for SBIR.
- (U) $13,243 Total

(U) FY 2000 ($ in Thousands):
- (U) $1,611 Fund international science and personnel exchange programs.
- (U) $1,913 Support technology liaison missions in Europe and Asia to support scientists and engineers performing laboratory research in foreign countries.
- (U) $1,354 Provide Air Force share of funding for NATO-affiliated research institutes.
- (U) $4,878 Total

(U) FY 2001: Not Applicable.

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

	COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	65,628	73,855	63,334	69,521	68,517	70,467	71,964	73,511	Continuing	Continuing
4347	Materials for Structures, Propulsion, and Subsystems	39,766	43,862	37,946	40,752	39,659	40,587	41,785	42,989	Continuing	Continuing
4348	Materials for Electronics, Optics, and Survivability	13,140	15,231	8,575	9,050	8,526	8,811	8,696	8,590	Continuing	Continuing
4349	Materials Technology for Sustainment	12,722	14,762	16,813	19,719	20,332	21,069	21,483	21,932	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Applied Research program is the primary source of advanced materials and processes to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems. Structural, propulsion, and sub-systems materials and processes are developed for aircraft, missile, space, satellite, and launch systems applications. Electronic and optical, advanced electromagnetic, and laser protection materials and processes are developed for application in Air Force aircraft, missile, space, and personnel protection systems. Advanced nondestructive materials evaluation methods, materials design data, pollution prevention materials, materials failure analysis, and materials repair methods are developed to improve the sustainment of Air Force systems for the current and future warfighters. Note: In FY 1999, Congress added $2.0 million for inorganic/organic optical limiters, $1.2 million for friction stir welding, $1.5 million for environmentally safe aircraft coatings, and $8.0 million for advanced materials research which explains the perceived decrease in FY 2000.

(U) B. Budget Activity Justification: This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602102F Materials**

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	69,339	62,578	63,927	70,330	Cont
(U) Appropriated Value	73,224	75,278			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-2,915	-1,423			
b. SBIR	-1,036				
c. Omnibus/Other Above Threshold Reprogrammings	-2,504				
d. Below Threshold Reprogrammings	-1,141				
(U) Adjustments to Budget Year Since FY 1999 PB			-593	-809	
(U) Current Budget Submit/FY 2000 PB	65,628	73,855	63,334	69,521	Cont

(U) Significant Program Changes: Not Applicable.

FY1999: $1,288 indentified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials / PROJECT: 4347

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4347 Materials for Structures, Propulsion, and Subsystems	39,766	43,862	37,946	40,752	39,659	40,587	41,785	42,989	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $7,552 Developed C-C and thermal protection material (TPM) technologies to improve performance, affordability, and operational capability of strategic and tactical systems.
- (U) $5,703 Developed nonstructural materials (such as fluids, lubricants, seals, greases, and coatings) for improved system performance, reduced toxicity, and reduced life cycle costs.
- (U) $10,831 Developed advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures.
- (U) $7,891 Developed and transitioned affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems.
- (U) $7,789 Developed ceramic matrix composites to develop an understanding of material response to service life environments and to characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.
- (U) $39,766 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials / PROJECT: 4347

(U) FY 1999 ($ in Thousands):

- (U) $8,332 Develop carbon-carbon (C-C) and thermal protection material (TPM) technologies to improve performance, affordability, and operational capability of strategic and tactical systems.
- (U) $7,187 Develop nonstructural materials (such as fluids, lubricants, seals, greases, and coatings) for improved system performance and reduced life cycle costs.
- (U) $9,556 Develop advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures.
- (U) $9,654 Develop and transition affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems.
- (U) $8,368 Develop ceramic matrix composites to develop an understanding of material response to service life environments and to characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.
- (U) $765 Identified as a source for SBIR.
- (U) $43,862 Total

(U) FY 2000 ($ in Thousands):

- (U) $3,046 Develop C-C and advanced thermal management materials to improve performance, affordability, and operational capability of aircraft and future space vehicles.
- (U) $5,948 Develop nonstructural materials (such as fluids, lubricants, seals, greases, and coatings) for improved system performance and reduced life cycle costs.
- (U) $11,897 Develop advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures.
- (U) $9,518 Develop and transition affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems.
- (U) $7,537 Develop ceramic matrix composites to develop an understanding of material response to service life environments and to characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.
- (U) $37,946 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials / PROJECT: 4347

(U) FY 2001 ($ in Thousands):

- (U) $3,364 Develop carbon-carbon (C-C) and advanced thermal management materials to improve performance, affordability, and operational capability of aircraft and future space vehicles.
- (U) $6,373 Develop nonstructural materials (such as fluids, lubricants, seals, greases, and coatings) for improved system performance and reduced life cycle costs.
- (U) $12,746 Develop advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures.
- (U) $10,197 Develop and transition affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems.
- (U) $8,072 Develop ceramic matrix composites to develop an understanding of material response to service life environments and to characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.
- (U) $40,752 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 4348

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4348 Materials for Electronics, Optics, and Survivability	13,140	15,231	8,575	9,050	8,526	8,811	8,696	8,590	Continuing	Continuing

(U) A. Mission Description: Develops materials technologies for space sensor systems, radars, and subsystems for aircraft, missile, and space applications. This project also develops new materials for protection of aircrews, sensors, aircraft, and space systems from laser threats. Radar modules, microwave devices, infrared (IR) detectors, and infrared countermeasures are used in target detection, electronic warfare, active aircraft protection, and communications. The performance of these systems is constrained by the quality and physical characteristics of these materials. Materials are developed in this project that enable radars and sensors with higher operating speeds, greater tunability, higher output power, improved thermal management, (including higher operating temperatures), greater sensitivity, and extended dynamic range. The improved materials also increase production quality, increase yields, and reduce costs for radar and sensor systems. Protection from lasers is dependent upon the power level and wavelength or color emanating from the laser device and the susceptibility of the material or system being lased. Additionally, protection schemes are dependent on other characteristics of the laser such as variability of the wavelength and mode of operation (continuous wave or pulsed). Materials are optimized to counter the most prominent threat wavelengths and new materials are developed to respond to emerging threat wavelengths and ultimately to reject laser energy independent of threat wavelengths.

(U) FY 1998 ($ in Thousands):
- (U) $5,714 Developed new materials and processes to provide improved performance, affordability, and operational capability for Air Force radar and space sensor systems.
- (U) $5,820 Developed materials to enhance the safety and survivability of aircrews against laser threats and heat seeking IR missiles.
- (U) $1,606 Developed materials to enhance the survivability and mission effectiveness of air and space sensor systems against laser threats.
- (U) $13,140 Total

(U) FY 1999 ($ in Thousands):
- (U) $7,512 Develop new materials and processes to provide improved performance, affordability, and operational capability for Air Force radar and space sensor systems.
- (U) $5,624 Develop materials to enhance the safety and survivability of aircrews against laser threats and heat seeking IR missiles.
- (U) $1,830 Develop materials to enhance the survivability and mission effectiveness of air and space sensor systems against laser threats.
- (U) $265 Identified as a source for SBIR.
- (U) $15,231 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials
PROJECT 4348	

(U) FY 2000 ($ in Thousands):
- (U) $3,773 Develop new materials and processes to provide improved performance, affordability, and operational capability for Air Force radar and space sensor systems.
- (U) $4,111 Develop materials to enhance the safety and survivability of aircrews against laser threats and heat seeking infrared (IR) missiles.
- (U) $691 Develop materials to enhance the survivability and mission effectiveness of air and space sensor systems against laser threats.
- (U) $8,575 Total

(U) FY 2001 ($ in Thousands):
- (U) $3,982 Develop new materials and processes to provide improved performance, affordability, and operational capability for Air Force radar and space sensor systems
- (U) $4,343 Develop materials to enhance the safety and survivability of aircrews against laser threats and heat seeking IR missiles.
- (U) $725 Develop materials to enhance the survivability and mission effectiveness of air and space sensor systems against laser threats.
- (U) $9,050 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) PE 0602202F, Human Effectiveness Applied Research.
- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0603211F, Aerospace Structures.
- (U) Tri-Service Laser Hardening Materials and Structures Group.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 4349

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4349 Materials Technology for Sustainment	12,722	14,762	16,813	19,719	20,332	21,069	21,483	21,932	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $4,509 Developed NDI/E technologies to evaluate and characterize damage in complex, low-observable materials and structures, and to inspect and maintain integrity of aging aerospace structures and propulsion systems.
- (U) $6,520 Developed support capabilities, information, and processes to resolve problems in the use of materials, in conducting failure analysis of components, in materials repair of aircraft structures, and in reducing corrosion in aircraft structures.
- (U) $1,693 Developed alternative materials, processes, and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance, and repair of aerospace systems.
- (U) $12,722 Total

(U) FY 1999 ($ in Thousands):

- (U) $5,122 Develop NDI/E technologies to evaluate and characterize damage in complex, low-observable materials and structures, and to inspect and maintain integrity of aging aerospace structures and propulsion systems.
- (U) $7,392 Develop support capabilities, information, and processes to resolve problems in the use of materials, in conducting failure analysis of components, in materials repair of aircraft structures, and in reducing corrosion in aircraft structures.
- (U) $1,990 Develop alternative materials, processes, and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance, and repair of aerospace systems.
- (U) $258 Identified as a source for SBIR.
- (U) $14,762 Total

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(U) FY 2000 ($ in Thousands):

- (U) $5,377 Develop non-destructive inspection/evaluation (NDI/E) technologies to evaluate and characterize damage in complex, low-observable materials and structures, and to inspect and maintain integrity of aging aerospace structures and propulsion systems.
- (U) $7,568 Develop support capabilities, information, and processes to resolve problems in the use of materials, in conducting failure analysis of components, in materials repair of aircraft structures, and in reducing corrosion in aircraft structures.
- (U) $3,868 Develop alternative materials, processes, and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance, and repair of aerospace systems.
- (U) $16,813 Total

(U) FY 2001 ($ in Thousands):

- (U) $6,310 Develop NDI/E technologies to evaluate and characterize damage in complex, low-observable materials and structures, and to inspect and maintain integrity of aging aerospace structures and propulsion systems.
- (U) $8,873 Develop support capabilities, information, and processes to resolve problems in the use of materials, in conducting failure analysis of components, in materials repair of aircraft structures, and in reducing corrosion in aircraft structures.
- (U) $4,536 Develop alternative materials, processes, and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance, and repair of aerospace systems.
- (U) $19,719 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials / PROJECT: 4349

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	55,734	64,063	43,898	47,142	54,016	61,289	64,970	67,136	Continuing	Continuing
2401	Structures	14,939	17,407	16,728	16,959	16,876	18,703	20,407	17,448	Continuing	Continuing
2402	Vehicle Equipment	9,787	11,682	3,759	4,848	5,566	7,016	9,549	8,896	Continuing	Continuing
2403	Flight Controls and Pilot-Vehicle Interface	15,808	17,492	10,592	11,740	12,531	14,955	14,731	15,947	Continuing	Continuing
2404	Aeromechanics and Integration	14,736	16,123	11,372	12,306	18,352	18,392	18,122	22,402	Continuing	Continuing
4397	Air Base Technology	464	1,359	1,447	1,289	691	2,223	2,161	2,443	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

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

(U) B. Budget Activity Justification: This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary aerospace vehicle technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	57,446	64,932	63,212	63,305	Cont
(U) Appropriated Value	60,509	64,932			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-2,461	-869			
b. SBIR	-698				
c. Omnibus/Other Above Threshold Reprogrammings	-1,695				
d. Below Threshold Reprogrammings	79				
(U) Adjustments to Budget Year Since FY 1999 PB			-19,314	-16,163	
(U) Current Budget Submit/FY 2000 PB	55,734	64,063	43,898	47,142	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $696 identified as a source for SBIR

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics	PROJECT 2401

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2401 Structures	14,939	17,407	16,728	16,959	16,876	18,703	20,407	17,448	Continuing	Continuing

(U) A. Mission Description: This project develops advanced aerospace structures; investigates new structural concepts and design techniques which exploit new materials and fabrication processes to strengthen and extend the life of manned and unmanned aerospace vehicle structures while reducing weight and cost; and develops adaptive structures that will improve operability and maintainability of aerospace vehicles.

(U) FY 1998 ($ in Thousands):

- (U) $609 Designed, developed, and tested advanced structures that incorporated distributed vibration suppression technologies for life extension and exploit wing warping, camber shaping, and adaptive structures technologies that enhance aerospace vehicle performance. These technologies included distributed vibration suppression techniques and adaptive structural concepts.
- (U) $2,288 Developed advanced structural design methods that enhanced affordability and decreased vulnerability for upgraded, derivative, and future aircraft. Design methods included assessment of advanced composite structures technologies and analytical techniques to provide design guidance for active aeroelastic wings.
- (U) $11,040 Extended usable structural lives and/or reduced costs of aging aircraft through techniques that accounted for life, risk, repairs, and dynamic loads. Technology development consisted of assessment of widespread fatigue damage and assessment of weapon bay acoustic suppression techniques.
- (U) $1,002 Improved durability for existing and future stealth vehicles structures operating in extreme environments such as temperature, noise, and vibration caused by engine exhaust which resulted in increased life and decreased cost. Improved durability resulted from assessment of high performance ceramic matrix composite technology and through active structural control concepts.
- (U) $14,939 Total

(U) FY 1999 ($ in Thousands):

- (U) $875 Continue design, development, and test of advanced structures that incorporate distributed vibration suppression technologies for life extension and exploit wing warping, camber shaping, and adaptive structures technologies that enhance air vehicle performance. Technologies under development include distributed vibration suppression techniques, and evaluation and assessment of wing twisting and control surface warping.
- (U) $1,601 Develop composite structures that enhance affordability and survivability of future aircraft. Develop fail safe design criteria for translaminar reinforced composite structures to reduce inspection and repair costs. Integrate aerodynamics, flight control, and electromagnetics (radar/infrared) analyses into multi-disciplinary structural design methods to reduce design costs and improve accuracy.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
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	PROJECT 2401

– (U) $1,723 Develop multifunctional adaptive structures that sense aeromechanical loads, control structural response, and integrate subsystem functionality to reduce system level manufacturing costs and increase tactical performance of aerospace vehicles.

– (U) $11,669 Extend usable structural lives and/or reduce costs of aging aircraft with technologies that account for life, risk, repairs, and dynamic loads. Structural lives can be extended by development of bonded composite repairs of metallic structures and evaluation of techniques to assess risk of failure of structural components due to corrosion and widespread fatigue damage**.**

– (U) $1,350 Improve durability for existing and future aerospace vehicle structures by developing technologies that incorporate advanced materials as well as passive and active cooling to withstand the extreme environments of high temperatures, vibrations, and acoustic noise to reduce cost and increase life of aerospace vehicle structures. Durability technologies include advanced thermal protection systems and an integrated thermal energy management/structure design.

– (U) $ 189 Identified as a source for SBIR

– (U) $17,407 Total

(U) FY 2000 ($ in Thousands):

– (U) $840 Continue design, development, and test of advanced structures that incorporate distributed vibration suppression technologies for life extension and exploit wing warping, camber shaping, and adaptive structures technologies that enhance aerospace vehicle performance. Technologies under development include distributed vibration suppression techniques, and evaluation and assessment of wing twisting and control surface warping of manned and unmanned aerospace vehicles.

– (U) $1,511 Develop unitized composite and metallic concepts that reduce manufacturing costs of future aerospace vehicles. Verify design criteria for translaminar reinforced composites to reduce inspection and repair costs. Develop integrated multidisciplinary design methods to reduce design time.

– (U) $1,679 Continue development of multifunctional structures that tailor structural response, and integrate subsystem functionality to reduce system level manufacturing costs and increase tactical performance of future aerospace vehicles.

– (U) $10,851 Extend usable structural lives and/or reduce costs of aging aircraft, and unmanned aerospace vehicles with technologies that account for life, risk, repairs, and dynamic loads. Structural lives can be extended by development of bonded composite repairs of metallic structures and evaluation of techniques to assess risk of failure of structural components. Dynamic loads can be reduced through active suppression techniques.

– (U) $1,847 Continue durability improvements for existing and future aerospace structures by developing concepts that incorporate advanced materials as well as passive and active cooling to withstand the extreme environments of high temperatures, cryogenic temperatures, vibrations, and acoustic noise to reduce cost and increase life of aerospace vehicle structures. Durability technologies include advanced thermal protection systems, high temperature composite structures, and integrated thermal subsystems/structures.

– (U) $16,728 Total

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	PROJECT 2401

(U) FY 2001 ($ in Thousands):

- (U) $849 Evaluate the design of advanced structures/concepts that incorporate distributed vibration suppression technologies for life extension and exploit wing warping, camber shaping, and adaptive structures technologies that enhance aerospace vehicle performance.
- (U) $1,528 Continue development of unitized structural concepts and multidisciplinary optimization methodologies that enhance affordability and decrease vulnerability for future aerospace vehicles. Develop integrated design architecture to reduce design time and improve performance.
- (U) $1,698 Evaluate the integration of multifunctional structures that tailor structural response, and integrate subsystem functionality to reduce system level manufacturing costs and increase tactical performance of future aerospace vehicles.
- (U) $11,018 Extend usable structural lives and/or reduce costs of aging aircraft and unmanned aerospace vehicles with technologies that account for life, risk, repairs, and dynamic loads. Structural lives can be extended by development of bonded composite repairs of metallic structures, and evaluation of techniques to assess risk of failure of structural components. Dynamic loads can be reduced through active suppression techniques.
- (U) $1,866 Improve durability of existing and future aerospace vehicle structures by developing technologies that incorporate advanced materials as well as passive and active cooling to withstand the extreme environments of high temperatures, vibrations, and acoustic noise to reduce cost and increase life of aerospace vehicle structures. Concepts under development consist of design, fabrication, and assessment of high temperature composite aerospace vehicle structures.
- (U) $16,959 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics	PROJECT 2402

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2402 Vehicle Equipment	9,787	11,682	3,759	4,848	5,566	7,016	9,549	8,896	Continuing	Continuing

(U) A. Mission Description: This project develops technologies to reduce subsystem and component life cycle costs in operational environments and improve subsystem performance for current and future manned and unmanned aerospace vehicles.

(U) FY 1998 ($ in Thousands):

- (U) $3,478 Developed and assessed component combat damage repair technologies, deflagration suppression techniques, hydrodynamic ram tolerance techniques, and critical component armoring techniques that decrease aerospace vehicle vulnerability. Assessed techniques including methodology for lightweight armoring of critical components and analytical models that predicted aerospace vehicle vulnerability.
- (U) $2,940 Developed and evaluated subsystem technologies that enhance aerospace vehicle protection. Developed technologies including a methodology that verified compliance of transparency designs and conducted dust erosion tests that predicted transparency coating performance.
- (U) $3,369 Developed and studied technologies for aircraft internal energy management systems which reduced aerospace vehicle size and weight. Fabricated full-scale advanced composite material heat exchanger and assessed aircraft subsystem energy interactions.
- (U) $9,787 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,709 Develop and assess component combat damage repair technologies, deflagration suppression techniques, and hydrodynamic ram tolerance techniques, that decrease aerospace vehicle vulnerability. Techniques to be developed include analytical tools to define and reduce vulnerability to missile and ballistic threats on critical components. Develop and validate new criteria for selecting deflagration suppression techniques in internal munitions bays and engine nacelles.
- (U) $1,906 Develop and evaluate affordable subsystem technologies that enhance aerospace vehicle safety and reliability and reduce cost. Complete study to assess the feasibility of applying electric actuation to utility subsystems to reduce aircraft maintenance costs. Initiate program to develop technologies required to apply electric actuation to manned and unmanned aerospace vehicles.
- (U) $4,681 Develop and evaluate process for affordable structural life for an increase in maintenance/durability of existing and future aerospace vehicles. Process includes, but is not limited to, noise suppression techniques as well as development of composite repair process for damaged or cracked components.
- (U) $2,259 Develop and assess technologies for aerospace vehicle internal energy management systems to reduce cost and weight. Complete development of a full-scale advanced composite material heat exchanger to demonstrate a 50% reduction in heat exchanger weight.
- (U) $ 127 Identified as a source for SBIR.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 2402

– (U) $11,682 Total

(U) FY 2000 ($ in Thousands):

– (U) $1,035 Develop and assess component combat damage repair technologies, deflagration suppression techniques, and hydrodynamic ram tolerance techniques that decrease aerospace vehicle vulnerability. Techniques to be developed include analytical tools to define and model hydrodynamic ram effects on composite fuel tanks.

– (U) $767 Develop and evaluate process for affordable structural life for an increase in maintenance/durability of existing and future aerospace vehicles. Process includes noise suppression techniques as well as development of a composite repair process for damaged or cracked components.

– (U) $153 Develop and assess affordable subsystem technologies that enhance aerospace vehicle safety and reliability and reduce cost. Continue to develop and assess technologies required to apply electric actuation to manned and unmanned aerospace vehicles.

– (U) $1,804 Develop and assess technologies for aerospace vehicle energy management systems and components to reduce vehicle size and weight by developing high efficiency, lightweight thermal energy components and advanced heat transport techniques.

– (U) $3,759 Total

(U) FY 2001 ($ in Thousands):

– (U) $1,607 Develop and assess component combat damage repair technologies, deflagration suppression techniques, and hydrodynamic ram tolerance techniques that decrease aerospace vehicle vulnerability. Techniques to be developed include rapid repair methods for combat damaged low-observable aerospace vehicles which allow swift return of combat assets to the commander for use without restriction.

– (U) $183 Develop and assess affordable subsystem technologies that enhance aerospace vehicle safety and reliability and reduce cost. Continue to develop technologies required to apply electric actuation to manned and unmanned aerospace vehicles through full-scale hardware development and testing.

– (U) $3,058 Develop and assess technologies for manned and unmanned aerospace vehicle energy management systems and components to reduce vehicle size and weight by integrating previously developed advanced heat transfer techniques and materials, and developing enabling technologies for storable thermal management systems.

– (U) $4,848 Total

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 2402

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)			DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics		PROJECT: 2403

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2403 Flight Controls and Pilot-Vehicle Interface	15,808	17,492	10,592	11,740	12,531	14,955	14,731	15,947	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $5,011 Developed and evaluated advanced flight control techniques which provided air combat advantage with increased performance and decreased vulnerability with decreased cost and air vehicle supportability requirements. Specific developments included strategies that enabled interactive flights of manned and unmanned aircraft and global operational analyses for advanced optical air data sensors.
- (U) $4,010 Studied and developed new flight control design methods and criteria that provided air combat advantage with increased performance and decreased vulnerability and cost. Improved methodology including criteria and standards for flight control systems that prevented pilot-induced control problems; also developed technologies for global range transport aircraft.
- (U) $1,999 Developed enhanced pilot-vehicle surface integration technologies for improved overall weapon systems performance and exploited real-time on-board/off-board data for enabling human-machine interface technologies.
- (U) $3,111 Developed control integration technologies and simulations for the ability to deploy unmanned combat air vehicles in combat environments, as well as developed display requirements for integrated in-flight mission planning.
- (U) $1,677 Developed capabilities to evaluate ways for increased aerospace vehicle performance through high angle of attack air combat.
- (U) $15,808 Total

(U) FY 1999 ($ in Thousands):

- (U) $4,470 Develop and demonstrate advanced flight control techniques for manned and unmanned aerospace vehicles to provide air combat advantage by increasing performance while decreasing vulnerability, cost, and supportability requirements. Continue to develop flight test hardware of optical air data system that eliminates need for non-stealthy, expensive air data probes, vanes, and ports. Initiate development of advanced vehicle management system that exploits photonics to improve manned and unmanned aerospace vehicles subsystem communication data rates and life cycle upgrade potential.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 2403

- (U) $4,467 Develop new flight control design methods and criteria that provide air combat advantage by increasing performance and decreasing vulnerability and cost. Complete algorithm development for battle-damage resistant flight control system for manned and unmanned aerospace vehicles and initiate development of unsteady aerodynamic modeling techniques for use in flight control system design.
- (U) $2,058 Develop enhanced vehicle-pilot integration technologies to improve overall weapon systems performance and exploit real-time on-board/off-board data for human-machine technology interface. Specific technologies include advanced pilot air-to-air situation awareness and integrated technologies for in-flight mission planning and automated low-level flight.
- (U) $3,475 Develop capabilities to evaluate technologies for increased aerospace vehicle performance and decreased vulnerability and cost and improving probability of mission success. Initiate simulations to assess new unmanned aerospace vehicle technologies and confirm mission effectiveness and flight safety.
- (U) $2,832 Initiate control technology development that addresses the automatic maneuvering of unmanned aerospace vehicles in the terminal area to improve flight safety and combat effectiveness.
- (U) $ 190 Identified as a source for SBIR.
- (U) $17,492 Total

(U) FY 2000 ($ in Thousands):

- (U) $3,197 Develop and demonstrate advanced flight control techniques for manned and unmanned aerospace vehicles to provide air combat advantage by increasing performance while decreasing vulnerability, cost, and supportability requirements. Complete flight demonstration of optical air data system and transition the capability to user. Continue development of advanced vehicle management system architecture concepts and identify key component demonstrations.
- (U) $2,813 Develop new flight control design methods and criteria that provide air combat advantage by increasing performance and decreasing vulnerability and cost. Complete algorithm development for on-board pilot-induced oscillation prevention.
- (U) $2,451 Develop capabilities to evaluate technologies for increased aerospace vehicle performance and decreased vulnerability and cost, and improved probability of mission success. Conduct mission technology assessments for manned vehicles and unmanned aerospace vehicles; determine design guides for effective mission management systems. Conduct aerospace vehicle technology simulations and identify controllability boundaries for safe aerospace vehicles flight.
- (U) $2,131 Continue to develop control technology for the autonomous maneuvering of unmanned aerospace vehicles in the terminal area to improve flight safety and combat effectiveness. Develop and integrate high integrity, four-dimensional precision trajectory generation and control algorithms.
- (U) $10,592 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics — PROJECT: 2403

(U) FY 2001 ($ in Thousands):

- (U) $3,541 Develop and demonstrate advanced flight control techniques for manned and unmanned aerospace vehicles to provide air combat advantage by increasing performance while decreasing vulnerability, cost, and supportability requirements. Continue development of advanced vehicle management system architecture concepts and perform laboratory demonstrations of key individual components. Initiate investigation into verification and validation techniques of flight critical systems that employ adaptive control techniques to reduce software development cost.
- (U) $3,163 Develop new flight control design methods and criteria that provide air combat advantage by increasing performance and decreasing vulnerability and cost. Continue development of unsteady aerodynamic modeling techniques for use in flight control system design.
- (U) $2,693 Develop capabilities to evaluate technologies for increased aerospace vehicle performance and decreased vulnerability and cost, and improved probability for mission success. Complete unmanned aerospace vehicle technology assessments and confirm mission effectiveness of strike packages with manned and unmanned aerospace vehicles. Complete aerospace vehicle simulations; and transition flight safety and mission effectiveness criteria for new aerospace vehicles.
- (U) $2,343 Continue to develop control technology for the autonomous maneuvering of manned and unmanned aerospace vehicles in the terminal area to improve flight safety and combat effectiveness. Conduct simulations to evaluate control integration strategies and iterate to an acceptable solution.
- (U) $11,740 Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602202F, Human Effectiveness Applied Research.
- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0603205F, Flight Vehicle Technology.
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics	PROJECT 2404

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2404 Aeromechanics and Integration	14,736	16,123	11,372	12,306	18,352	18,392	18,122	22,402	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $8,717 Developed affordable technologies that increased aerodynamic performance and decreased vulnerability with reduced drag, improved fuel fraction, enhanced maneuverability and control with high payoff aerodynamic concepts, and reduced signature through integrated compact inlet designs which resulted in improved aerospace aerodynamics.
- (U) $2,958 Developed numerical technologies which included mathematical models for aerodynamic and structural interactions that derived advanced aircraft designs such as tailless aerospace vehicle geometry for low cruise drag with increased performance and reduced signature for increased aerodynamic performance.
- (U) $3,061 Developed fixed wing aerospace vehicle advanced aerodynamic concepts, design, and analytical tools for the Air Force, Navy, and NASA.
- (U) $14,736 Total

(U) FY 1999 ($ in Thousands):

- (U) $4,580 Conduct aerodynamic design, analysis, test, and performance assessments of advanced manned and unmanned aerospace vehicles consistent with signature and cost constraints. Perform validation tests of innovative aerodynamic control concepts for low signature, manned and unmanned aerospace vehicles.
- (U) $3,944 Develop computational tools and techniques for predicting and optimizing aerodynamic and structural performance of advanced manned and unmanned aerospace vehicles. Continue development of computer design code addressing fluid/structural interactions. Initiate development of next generation, multi-disciplinary optimization computer design code integrating aerodynamic, structural, signature, and other scientific disciplines.
- (U) $4,644 Develop and demonstrate affordable fixed-wing vehicle aerodynamic technologies to increase aerospace vehicle performance and decreased vulnerability. Initiate development of aerodynamic and structural integration including flow control in payload bays.
- (U) $2,780 Develop conceptual designs and assess technologies to determine impacts of integrating directed energy systems such as high power microwaves, high energy lasers, and kinetic energy weapons into aerospace vehicles.
- (U) $ 175 Identified as a source for SBIR.
- (U) $16,123 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Flight Dynamics — PROJECT: 2404

(U) FY 2000 ($ in Thousands):

- (U) $3,879 Conduct aerodynamic design, analysis, test, and performance assessments of advanced tactical transport aircraft and aerospace vehicles consistent with signature and cost constraints. Design and perform sub-scale component test of a signature compatible, powered lift system for a transport aircraft.
- (U) $3,386 Develop computational tools and techniques for predicting and optimizing aerodynamic and structural performance of advanced manned and unmanned aerospace vehicles. Complete development of computer design code addressing fluid/structural interactions. Continue development of next generation, multi-disciplinary optimization computer design code integrating aerodynamic, structural, signature, and other scientific disciplines.
- (U) $4,107 Develop and demonstrate affordable fixed-wing vehicle aerodynamic technologies to increase aerospace performance and decrease vulnerability. Continue development of aerodynamic and structural integration including flow control in payload bays.
- (U) $11,372 Total

(U) FY 2001 ($ in Thousands):

- (U) $4,224 Conduct aerodynamic design, analysis, test, and performance assessments of advanced tactical transport aircraft and aerospace vehicles consistent with signature and cost constraints. Perform sub-scale wind tunnel tests of powered lift system. Initiate aerodynamic and test diagnostic studies.
- (U) $3,674 Develop computational tools and techniques for predicting and optimizing aerodynamic and structural performance of advanced manned and unmanned aerospace vehicles. Complete development of next generation, multi-disciplinary optimization computer design code integrating aerodynamic, structural, signature, and other scientific disciplines.
- (U) $4,408 Develop and demonstrate affordable fixed-wing vehicle aerodynamic technologies to increase aerospace vehicle performance and decrease vulnerability. Continue development of aerodynamic and structural integration including flow control in payload bays.
- (U) $12,306 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 2404

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics	PROJECT 4397

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4397 Air Base Technology	464	1,359	1,447	1,289	691	2,223	2,161	2,443	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):
- (U) $464 Developed aircraft and air base fire fighting technologies (e.g., clean, environmentally safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems).
- (U) $464 Total

(U) FY 1999 ($ in Thousands):
- (U) $598 Develop aircraft and air base fire fighting technologies (e.g., clean environmentally safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment technologies, and fire fighting training systems) and improve fire fighting rescue technology with infrared imaging.
- (U) $568 Develop utilities and shelters technologies that improve air mobility systems performance and reduce airlift requirements, with the development of waste management system, in support of Air Expeditionary Force (AEF) operations.
- (U) $178 Evaluate and develop air transportable shelters that are lightweight and suitable for AEF operations.
- (U) $ 15 Identified as a source for SBIR.
- (U) $1,359 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 4397

(U) FY 2000 ($ in Thousands):

- (U) $579 Develop aircraft and air base fire fighting technologies (e.g., clean environmentally safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment technologies, and fire fighting training systems) and improve fire fighting rescue technology with infrared imaging.
- (U) $550 Develop utilities and shelters technologies that improve air mobility systems performance and reduce airlift requirements, with the development of waste management system, in support of Air Expeditionary Force (AEF) operations.
- (U) $318 Evaluate and develop air transportable shelters that are lightweight and suitable for AEF operations.
- (U) $1,447 Total

(U) FY 2001 ($ in Thousands):

- (U) $526 Develop aircraft and air base fire fighting technologies (e.g., clean environmentally safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment technologies, and fire fighting training systems) and improve fire fighting rescue technology with infrared imaging.
- (U) $475 Develop utilities and shelters technologies that improve air mobility systems performance and reduce airlift requirements, with the development of waste management system, in support of AEF operations.
- (U) $288 Evaluate and develop air transportable shelters that are lightweight and suitable for AEF operations.
- (U) $1,289 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Flight Dynamics
	PROJECT 4397

(U) B. Project Change Summary - Description of Significant Change: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

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(U) C. Other Program Funding Summary:

(U) Related Activities:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	70,027	58,114	51,512	56,629	55,554	55,252	62,867	66,653	Continuing	Continuing
1123	Manpower, Personnel, and Training	18,633	13,805	9,041	10,287	14,156	14,690	15,052	15,561	Continuing	Continuing
1710	Deployment and Logistics Technologies	4,700	3,173	5,851	5,994	4,982	3,484	5,365	5,702	Continuing	Continuing
1900	Environmental Quality Technology	4,230	3,637	0	0	0	0	0	0	TBD	TBD
7184	Crew Technology	24,419	25,352	28,052	29,724	25,499	26,001	31,593	34,144	Continuing	Continuing
7755	Aircrew Physiology Technology	4,086	0	0	0	0	0	0	0	TBD	TBD
7757	Directed Energy Bioeffects	13,959	12,147	8,568	10,624	10,917	11,077	10,857	11,246	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

NOTE: The decrease between FY 1998 and FY 1999 is due to elimination of Aircrew Physiology Technology (Project 7755) and significant reductions to Deployment and Logistics Technologies (Project 1710) and Manpower, Personnel, and Training (Project 1123). The decrease between FY 1999 and FY 2000 is due to the elimination of Environmental Quality Technology (Project 1900) and reductions to Manpower, Personnel and Training (Project 1123) for intelligent computer adaptive instruction and knowledge-based technologies. Due to restructuring within the Air Force Research Laboratory, the environmental noise portion of Project 7757 moved to Project 7184 in FY 1999, studies in support of Distributed Mission Training will move from Project 7184 to Project 1123 in FY 2000, and the toxicology hazards research program will move from Project 7757 to Project 1710 in FY 2000.

(U) A. Mission Description: This Applied Research program establishes technology feasibility and develops the technology base for Air Force human interface needs required for weapon systems, operational readiness, and environmental quality. The program addresses crew systems; manpower, personnel, training, and logistics; aerospace physiology investigation; occupational and environmental safety; and environmental compliance, site remediation, and pollution prevention. Crew systems technologies increase the performance of humans in weapon systems operation by improving aircrew life support systems, man-machine integration (to include aircraft information display systems), and protection from dynamic forces (acceleration/escape/windblast). Manpower, personnel, training, and logistics technologies focus on reducing manpower required to operate and support weapon systems by: providing more effective methods to classify, train, and retain warfighters and their support force; modeling human cognitive functioning on complex tasks to enhance operational performance; increasing weapon systems supportability and affordability; and improving wartime logistics planning. Occupational and environmental health and safety technologies support deployment, operation, and maintenance of Air Force weapon systems

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research

by developing: occupational and operational exposure safety guidelines for militarily relevant electromagnetic radiation's and toxicants; detection, control, reduction, and disposal of pollutants from Air Force operations; and cleaning up contaminated Air Force sites. Payoff from these technology development efforts is to improve combat effectiveness by expanding all parameters defining operational performance limits.

(U) B. Budget Activity Justification: This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies. This Applied Research program establishes technology feasibility and develops the technology base for Air Force human interface needs required for weapon systems, operational readiness, and environmental quality.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	72,118	60,805	55,802	57,661	Cont
(U) Appropriated Value	76,102	60,805			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reduction	-2,641	-2,691			
b. SBIR	-1,164				
c. Omnibus/Other Above Threshold Reprogrammings	-2,117				
d. Below Threshold Reprogrammings	-153				
(U) Adjustments to Budget Year Since FY 1999 PB			-4,290	-1,032	
(U) Current Budget Submit/FY 2000 PB	70,027	58,114	51,512	56,629	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $937 identified as a source for SBIR.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research

PROJECT: 1123

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
1123 Manpower, Personnel, and Training	18,633	13,805	9,041	10,287	14,156	14,690	15,052	15,561	Continuing	Continuing

(U) A. Mission Description: This project develops and evaluates new methods and technologies in support of Air Force training and education requirements in a variety of specific areas, including: aircrew training; technical training; logistics training; mission rehearsal; training in support of complex decision making; space operations training; information warfare training; and warfare readiness training. It investigates the spectrum of new and advanced training and education technologies for optimal ways to determine needs and deficiencies, design and implement training, and to evaluate training effectiveness. It develops and evaluates specific training systems, desktop tutors, courseware development tools and technologies, assessment methodologies, and simulation-based systems to determine how to achieve maximum learning effectiveness for specific needs at minimum cost. This project will contribute to a more highly trained and flexible cadre of personnel and reduce the cost of maintaining crew, aircraft, and support personnel readiness. This Applied Research program develops technologies to increase operational readiness by providing more effective methods and approaches to classify, assign, train, assess, and retain personnel. This program focuses on reducing the manpower required to operate and support weapon systems and on improving the effectiveness of the operators, maintainers, and other support personnel for those systems. Note: Intelligent computer adaptive instruction and knowledge-based technologies will be eliminated in FY 2000.

(U) FY 1998 ($ in Thousands):

- (U) $ 9,717 Developed technologies required to create an integrated Distributed Mission Training environment by assessing concepts and trainers/simulators, evaluating simulation-based mission preparation and rehearsal effectiveness, and assessing alternative training strategies using eye tracking technology.
- (U) $ 4,725 Developed knowledge-based and adaptive training technologies including representation/student modeling schemes and associated instructional authoring technologies, intelligent/adaptive training and instructional design technologies, and student assessment and evaluation technologies.
- (U) $ 4,191 Developed and transitioned technologies to select, classify, and assess Air Force personnel and structure DoD jobs to maximize performance and mission accomplishment.
- (U) $18,633 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research
	PROJECT 1123

(U) FY 1999 ($ in Thousands):

- (U) $10,581 Develop technologies required to enhance the integrated Distributed Mission Training (DMT) environment by incorporating space and information operations systems and by developing mission rehearsal training technologies, a more representative electronic combat environment, and High Level Architecture (HLA) compliant systems.
- (U) $ 900 Develop Air Force training guidelines, instructional scenarios, and techniques for use in Air Force aircrew, space, and information operations mission training.
- (U) $ 700 Refine intelligent computer adaptive instruction authoring system based on knowledge representation/student modeling technologies and knowledge-based technologies for curriculum planning and media selection.
- (U) $ 1,400 Develop concept and technologies to enable a warfare operations center by creating performance specifications for a seamless, integrated information system consisting of mission planning, automated brief/debrief, simulation, academics, weapon systems, and Command, Control, and Information systems.
- (U) $ 224 Identified as a source for SBIR.
- (U) $13,805 Total

(U) FY 2000 ($ in Thousands):

- (U) $ 5,515 Develop technologies required to enhance the integrated DMT environment by developing space and information operations simulators/trainers, and representation, human systems, and interconnection technologies.
- (U) $ 2,600 Develop Air Force training guidelines, instructional scenarios, and techniques by transitioning combat aerial training technologies and performance measurement systems into aircrew, space, and information operations environments.
- (u) $ 926 Develop concept and technologies to enable a warfare operations center by integrating the command and control systems of the warfare operations center with the distributed mission training environment.
- (U) $ 9,041 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research
PROJECT 1123	

(U) FY 2001 ($ in Thousands):

– (U)	**$** 7,227	Develop technologies required to enhance the integrated Distributed Mission Training environment by developing space and information operations simulators/trainers, and representation, human system, and interconnection technologies.
– (u)	$ 1,200	Develop Air Force training guidelines, instructional scenarios, and techniques by transitioning combat aerial training technologies and performance measurement systems into aircrew, space, and information operations environments.
– (U)	$ 1,860	Develop concept and technologies to enable a warfare operations center by integrating the command and control systems of the warfare operations center with the distributed mission training environment.
– (U)	$ 10,287	Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT 1710

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
1710 Deployment and Logistics Technologies	4,700	3,173	5,851	5,994	4,982	3,484	5,365	5,702	Continuing	Continuing

(U) A. Mission Description: This project investigates and researches technologies to support the enhancement of the deployment and sustainment technologies critical to the goals and requirements of Agile Combat Support and Air Expeditionary Force operations. The research focuses on technologies with the potential to: reduce the time required for units to plan, pack up, and deploy; reduce airlift requirements while enhancing deployed capability; enhance sustainment of deployed forces in contingency environments; improve logistics support for both combat and peacetime operations; and develop toxicological tools and technology to minimize the health risks and mission impact to DoD personnel from exposure to hazardous chemicals while also reducing weapon system life cycle cost.

(U) FY 1998 ($ in Thousands):

- (U) $ 831 Explored and defined advanced logistics technology concepts in on-orbit servicing, remote diagnostics, and logistics models for improved support of space operations to increase the availability and flexibility of space assets.
- (U) $1,269 Explored technology options to improve agile combat support capabilities by conducting trade studies on advanced visualization presentation capabilities for use by maintenance technicians in advanced research projects, and evaluated speech intelligibility of synthetic voice software packages for use in depots and on flightlines.
- (U) $2,600 Adapted and refined information technologies to enhance logistics and deployment planning capabilities by including software tools and architectures that added high levels of intelligence to logistics information system interfaces and databases for more effective use in rapid response contingency and deployed operations.
- (U) $4,700 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research
	PROJECT: 1710

(U) FY 1999 ($ in Thousands):

- (U) $ 658 — Explore and define highly reliable, low footprint, multi-function, rapid on-load/off-load, and ground movement technology concepts which will increase deployment speed and decrease airlift requirements in support of agile combat support and rapid global mobility goals.
- (U) $1,062 — Explore and develop technology options to improve agile combat support capabilities by assessing alternative input devices, such as electro-oculographic and electromyographic capabilities, to be used in various maintenance environments which are loud (prohibiting voice control capability), and requiring free hands (prohibiting manual control). Investigate advanced user interfaces to support wing level logistics decision making to enhance response time and unit capability in Air Expeditionary Force operations.
- (U) $1,419 — Adapt and refine information technologies to enhance logistics and deployment planning capabilities by defining and evaluating advanced knowledge representation schemes and computational linguistics methods to automatically extract maintenance manual information for weapon systems design data.
- (U) $ 34 — Identified as a source for SBIR.
- (U) $3,173 — Total

(U) FY 2000 ($ in Thousands):

- (U) $ 500 — Develop interoperable and intermodal containerization and pallet optimization technologies that will significantly streamline cargo handling during on-load/off-load operations at aerial ports and deployed locations to directly support air expeditionary forces.
- (U) $3,051 — Explore and develop advanced logistics technology options and perform specialized technical research to support large-scale advanced technology development programs. Identify diagnostic strategies and develop initial algorithms to support the advanced prognostic/diagnostic program which will improve and reduce aircraft down time. Develop enabling technology for innovative software architectures for the representation of human behavior in synthetic environments to increase the fidelity of wargame simulations and decrease the number of required wargame-support personnel.
- (U) $2,300 — Develop and expand capabilities of robust bio-technology force protection tools to assess real-world mixed operational chemical exposures. Integrate biological assay results using novel mathematical models to provide Air Expeditionary Force commanders with near-real-time prediction of adverse human health and mission performance impact.
- (U) $5,851 — Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999	
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT 1710

(U) FY 2001 ($ in Thousands):

- (U) $ 500 Develop deployable, cargo-compartment-sized containers that will significantly decrease the time required to set up operations at deployed locations, thereby decreasing deployment times and increasing sortie generation rates. Develop point of use delivery and extraction technologies to decrease airlift vulnerability and increase delivery and retrograde pipeline speed during operational deployments.
- (U) $2,799 Explore and develop advanced logistics technology options to further enhance large-scale advanced development programs. Investigate technology concepts to extend the Distributed Mission Training capability into the maintenance and logistics areas to improve combat capability by enhancing technical performance. Develop innovative software architectures for automated transformation of weapon system engineering data into procedural maintenance instructions to drastically reduce technical order development costs.
- (U) $2,695 Demonstrate and continue to develop and evaluate force protection technologies in the form of biological assays and mathematical predictive models to assess operational chemical exposures and to provide Air Expeditionary Force commanders with near-real-time predictions of adverse human health mission performance impact. Initiate studies using deployment field samples to align and validate model predictions.
- (U) $5,994 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research / PROJECT: 1900

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
1900 Environmental Quality Technology	4,230	3,637	0	0	0	0	0	0	TBD	TBD

(U) A. Mission Description: This project develops technologies to characterize the chemistry of Air Force-generated pollutants and toxic materials, assesses their interaction with the environment, and develops reduction/destruction and control techniques with the objective to reduce the cost and increase the effectiveness of technologies that protect the environment; emphasis is placed on pollution prevention technologies. New Air Force fuels and chemicals are analyzed to identify and prevent possible environmental problems. Materials are investigated and new processes explored to assess and reduce environmental risks. Monitoring and control technologies are developed for Air Force operations by using novel instrumentation, characterization, and modeling techniques.

(U) FY 1998 ($ in Thousands):

- (U) $ 885 Developed technologies and design criteria for improved monitoring, characterization, and assessment of risks to the environment posed by Air Force activities by developing a database of the rates of photochemical reactions of Air Force solvent vapor and new fuels, and completed studies proving natural biodegradation of hydrocarbon contaminants is an acceptable method of treatment.
- (U) $1,796 Developed affordable technology capable of regenerating activated carbon filters in-place to control air polluting emissions from Air Force industrial processes and investigated gas phase by-products of cold, plasma-induced chemical reactions to determine how to produce an exhaust stream that when discharged, complies with Clean Air Act Amendments.
- (U) $1,549 Developed chemical reactors to convert liquid wastes and energetic materials from Air Force operations to non-hazardous products.
- (U) $4,230 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research
	PROJECT 1900

(U) FY 1999 ($ in Thousands):

- (U) $ 927 Investigate and develop environmentally acceptable replacement materials and processes to reduce the cost of weapon systems sustainment by developing new selection criteria for Air Force industrial solvents and fuels, and by characterizing the air quality effects of Air Force volatile materials.
- (U) $ 893 Develop environmental instrumentation for chemical detection and monitoring and process controls by: identifying and correcting unnecessary Air Transport and Dispersion (ATD) launch holds and reducing liability risks; developing techniques to accurately characterize Air Force-generated particulate matter (PM); and developing innovative instrumentation to detect chlorinated solvents, explosives, and other Air Force-monitored chemicals.
- (U) $1,759 Reduce weapon systems sustainment costs and enhance Air Force readiness by: developing engineering tools to isolate and synthesize enzymes for perchlorate chlorate and chlorite reduction; converting propellant from missiles and rockets to benign compounds; characterizing strategies for energy generation and water recovery from waste treatment systems; enhancing DoD capability to contain and control regulated emissions from depainting and other corrosion-control operations; and studying environmental interactions of advanced fuels and solvents.
- (U) $ 58 Identified as a source for SBIR.
- (U) $3,637 Total

(U) FY 2000: Not Applicable.

(U) FY 2001: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research — PROJECT: 1900

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0601102F, Defense Research Sciences.
- (U) PE 0602102F, Materials.
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603723F, Environmental Engineering Technology.
- (U) PE 0603716D, Strategic Environmental Research and Development Program.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research
	PROJECT 7184

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
7184 Crew Technology	24,419	25,352	28,052	29,724	25,499	26,001	31,593	34,144	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $ 1,710 Developed unobtrusive, reliable predictors of human system safety and effectiveness, including metrics for crew workload, situational awareness, and physical accommodation. Established workload and performance baselines in simulators. Demonstrated performance metrics in joint field exercises. Completed cockpit aircrew accommodation surveys for 50 percent of Air Force aircraft types and completed 50 percent U.S. data collection under a multi-national, whole-body three-dimensional size survey.
- (U) $ 4,454 Demonstrated system design technologies that integrate human factors data for workstations to accommodate an expanded crew population and demonstrated an effective crew workplace integration of DoD common surveillance automatic target recognition technology in operational field test.
- (U) $ 6,329 Developed visual display technology for improved human-machine interfaces, concentrating on sensor-augmented cockpit technology, including baseline human visual performance needed for future helmet displays and wide field-of-view night vision displays; standardized test methods for night vision devices and aircraft visual transparencies.
- (U) $ 2,775 Continued to develop improved audio technologies for enhanced human-system interfaces. Developed technologies to measure and predict the effects of human auditory responses, and provided voice communication criteria for selected Air Force weapon systems and base operations to improve situational awareness, enhance operator effectiveness, and reduce workload.
- (U) $ 5,228 Developed and evaluated aircrew life-support and performance technologies including oxygen generation, life support, and high-altitude protection technologies; developed in-flight spatial disorientation training technologies; developed strength conditioning regimens for improved acceleration tolerance; and determined effects of multi-axis accelerations on aircrew piloting performance.
- (U) $ 3,067 Developed technologies to assess aircrew safety during high-speed escape for use in designing and evaluating efficacy and safety of ejection seats, helmet systems, and other personal protection equipment.
- (U) $ 856 Developed fatigue models and demonstrated concept for integrating fatigue effects into campaign-level models for aircrew sustained operations.
- (U) $24,419 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research / PROJECT: 7184

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(U) FY 1999 ($ in Thousands):

– (U) $ 2,340	Continue to develop unobtrusive, reliable predictors of human system effectiveness based on crew workload and situational awareness. Finish international validation and select predictive workload model to advance technology for human performance design assessment and eliminate crew task overload. Validate model and metrics with simulation of Predator Unihabited Air Vehicle control station. Complete cockpit aircrew accommodation evaluations for Air Force inventory aircraft. Complete U.S. part of international whole-body three-dimensional size survey for new design tool.
– (U) $ 5,641	Continue to develop system design technologies that integrate human factors data for workstations by integrating an on-line data system and related computer-aided design templates, by developing network models to streamline the sharing of data among intelligence analysts and command centers, and by initiating development of multi-sensory adaptive control as a new design technology.
– (U) $ 7,590	Continue to develop visual display technology for improved human-machine interfaces and demonstrate adaptive interface technology, including integrated display and information processing standards; design alternatives for next generation helmet-mounted sight/displays, ejection-safe, panoramic night vision goggles with external sensor inputs to enhance night operations; and a pilot-vehicle interface that adapts to pilot physiological and behavioral state.
– (U) $ 1,775	Continue expansion of audio technologies to establish new information management methods to improve operator performance in high workload environments.
– (U) $ 1,580	Continue aircrew life support and performance research including the effect of high G on pilot color perception and the ability to discern color cues on head-up and head-down displays.
– (U) $ 3,606	Develop tolerance criteria for assessing effects of forces experienced during escape, sustained, and transient accelerations on crew safety and performance while using head/helmet mounted equipment.
– (U) $ 2,300	Improve integrated mission rehearsal training technologies for aircrew and battlestaff in simulated and field extended/continued operations.
– (U) $ 95	Support the joint Air Force/Defense Advanced Research Projects Agency Uninhabited Combat Air Vehicle (UCAV) program.
– (U) $ 425	Identified as a source for SBIR.
– (U) $25,352	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research
	PROJECT 7184

(U) FY 2000 ($ in Thousands):

- (U) $ 4,254 Continue to develop unobtrusive, reliable predictors of human performance by extending workload metric technology to include a near real-time classification of overload, and apply to next-generation multi-sensory fighter cockpit with high-fidelity immersive simulation under joint Air Force-France-United Kingdom agreements. Demonstrate performance metric technology in design evaluation of advanced Predator Unihabited Air Vehicle control station. Complete NATO part of multi-national whole-body three-dimensional survey, and begin to validate cockpit accommodation model.
- (U) $ 3,030 Continue to develop system design technologies that integrate human factors including network models to streamline the sharing and synchronization of operational performance data among intelligence analysts and command centers, and to overcome the data overload problem facing multi-place air battle staff operations.
- (U) $ 3,861 Advance crew system design technologies for airborne and ground control stations, and begin to develop a new human performance model technology to enable rapid affordable crew station design. Introduce the ability to define and visualize the human operator's cognitive, perceptual, and physical performance in the operational task environment.
- (U) $ 4,469 Continue to develop visual display technology concentrating on next generation helmet trackers, display visual performance criteria, on-board/off-axis weapon cueing, sensor display definitions, and monochrome active-matrix organic light-emitting-diode for helmet display; assess anti-reflection visors and ejection-safe, panoramic night vision goggles (PNVGs) with head-up display insert. Develop comprehensive transparency design guidelines.
- (U) $ 2,349 Develop and demonstrate integrated three-dimensional audio, active noise reduction, voice control, and voice activated switch technologies in a low-cost, high reliability, reconfigurable aircraft audio interface system to enhance performance and reduce workload. Continue to explore audio information management for improvement of operator performance in high-workload/high-noise environments and audio enhancements for improvements in remote threat detection. Demonstrate reduced cost noise monitoring systems for environmental compliance.
- (U) $ 5,489 Continue development of injury criteria and technologies for improved aircrew and support personnel protective equipment focusing on safe accommodation of the full aircrew population. Develop criteria for human performance in a high sustained acceleration environment.
- (U) $ 3,600 Continue to provide human systems technology support to the joint Air Force/Defense Advanced Research Projects Agency Uninhabited Combat Air Vehicle (UCAV) program.
- (U) $ 1,000 Conduct international cooperative effort with Australia for Virtual Air Commanders.
- (U) $28,052 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research / PROJECT: 7184

(U) FY 2001 ($ in Thousands):

- (U) $ 4,756 Continue to develop unobtrusive, reliable predictors of human performance by validating F-15E crew workload/operational weapon system and tactics data. Initiate development of on-line, intelligent physical accommodation information system for crew system and personal equipment design. Complete workload classification algorithm and incorporate into initial multi-sensory adaptive control interface for uninhabited air systems, for both improved crew effectiveness and mission success rate.
- (U) $ 3,418 Continue to develop system design technologies that integrate human factors including network models to streamline the sharing and synchronization of operational performance data among intelligence analysts and command centers, and to overcome the data overload problem facing multi-place air battle staff operations. Simulate command center operations using human-centered data interface and demonstrate ability to process and deploy critical information to maximize team performance.
- (U) $ 4,056 Continue to develop integrated human performance models and analysis tools to advance effective/rapid/affordable crew system design technologies for airborne and ground control stations; demonstrate with analytical experiments.
- (U) $ 5,000 Continue to develop visual display technology including integrated display and information processing standards for targeting helmet sight/display, design alternatives for lightweight helmet sight/display using eye line-of-sight cueing, and demonstrate monochrome active-matrix organic light-emitting-diode for helmet display. Perform ejection risk assessment for panoramic night vision goggles, and develop and verify visual performance models for windscreen optical parameters.
- (U) $ 2,648 Continue development and flight demonstration of reconfigurable aircraft audio interface system for enhanced performance and reduced workload. Explore active noise reduction and active vibration reduction concepts for mitigation of noise and vibration hazards for aircrews and Air Force personnel. Develop technology to assess and reduce adverse impacts of aircraft noise and sonic booms produced by Air Force operations.
- (U) $ 5,151 Develop advanced restraint system technologies using defined injury criteria to ensure safety of all aircrew during aircraft and other vehicle operations, crashes, and emergency escape. Develop criteria for human performance in a high sustained acceleration environment.
- (U) $ 3,195 Continue to provide human systems technology support to the joint Air Force/Defense Advanced Research Projects Agency Uninhabited Combat Air Vehicle (UCAV) program.
- (U) $ 1,500 Continue international cooperative effort with Australia for Virtual Air Commanders.
- (U) $29,724 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research — PROJECT: 7184

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0602702F, Command, Control, and Communications.
- (U) PE 0603205F, Aerospace Vehicle Technology.
- (U) PE 0603227F, Personnel, Training and Simulation Technology.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) PE 0604227F, Distributed Mission Training (DMT).
- (U) PE 0604703F, Aeromedical/Casualty Care Systems Development.
- (U) PE 0604706F, Life Support Systems.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research	PROJECT: 7755

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
7755 Aircrew Physiology Technology	4,086	0	0	0	0	0	0	0	TBD	TBD

(U) A. Mission Description: This project enhances aircrew effectiveness by developing an understanding of: (1) conditions affecting aircrew selection and retention; (2) methods of early disease detection; (3) impact of asymptomatic disease on aircrew performance; (4) therapeutic drug effects on flight safety; and (5) physiological factors affecting operational readiness and effectiveness.

(U) FY 1998 ($ in Thousands):
- (U) $ 883 Completed development of and evaluation for aircrew vision enhancement technologies for both day and night air combat.
- (U) $2,823 Completed development of methods to identify and remediate physiological impairments arising from flying high performance aircraft.
- (U) $ 380 Conducted and completed expanded physical fitness test battery and fire fighter physical fitness programs.
- (U) $4,086 Total

(U) FY 1999: Not Applicable.

(U) FY 2000: Not Applicable.

(U) FY 2001: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research / PROJECT: 7755

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research
	PROJECT 7757

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
7757 Directed Energy Bioeffects	13,959	12,147	8,568	10,624	10,917	11,077	10,857	11,246	Continuing	Continuing

(U) A. Mission Description: This project enables the safe operational use of Air Force directed energy weapon systems through technology development related to the biological effects of electromagnetic radiation used in, or resulting from, Air Force operations. The project identifies and mitigates the biological effects of exposure to radio frequency and microwave radiation, lasers, broad band munitions, and ultrawide band pulsed fields by addressing areas such as safety, risk assessment, mission planning and countermeasures in combat, and non-lethal applications for special operations, missions other than war, and peacekeeping operations. This project provides technical consultative support to other DoD programs to assess and counter optical and radio frequency hazards and threats.

(U) FY 1998 ($ in Thousands):

- (U) $ 3,533 Conducted laser optical bioeffects research to enable countermeasures for optical hazards/threats by initiating probabilistic risk approach to safety for high-energy laser systems and laser system safety standards.
- (U) $ 4,683 Conducted radio frequency radiation (RFR) bioeffects research to enable safe exploitation of lethal and non-lethal directed energy weapons, advanced communications systems, and radar by initiating RFR cancer promotion study and promulgating NATO RFR Standardization Agreement.
- (U) $ 4,996 Developed health-based risk management process for Air Force operational fuels and weapon system fire suppression agents. Demonstrated feasibility of rapid screening tool for toxic exposure hazard assessment applicable to a wide range of deployment locations.
- (U) $ 747 Developed technology to reduce adverse impacts of aircraft noise and sonic booms by demonstrating miniaturized affordable sonic boom monitor, conducting a joint study with the Navy to model noise propagation over water, and demonstrating radar tracking storage technology for noise analysis.
- (U) $13,959 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research / PROJECT: 7757

(U) FY 1999 ($ in Thousands):

- (U) $ 4,209 Conduct laser optical bioeffects research to enable countermeasures for optical hazards/threats by initiating development of guidelines for high energy laser safety and low energy systems for non-lethal use, and refining biological effects models to assess combat vulnerability to emerging optical threats.
- (U) $ 5,578 Conduct bioeffects research to enable safe exploitation of lethal and non-lethal directed energy weapons, advanced communications systems, and radar by transitioning tri-Service High-Power Microwave (HPM) Ocular Hazards Study results to DoD and developing/providing data for policy review of Active Denial Technology (ADT) non-lethal weapon.
- (U) $ 2,070 Develop and evaluate robust force protection bio-technology tools for Air Expeditionary Force commanders to assess chemical exposures and predict adverse human health and mission performance impacts.
- (U) $ 94 Evaluate Photorefractive Keratectomy (PRK) as surgical method to reduce need for glasses or contact lenses for aircrew.
- (U) $ 196 Identified as a source for SBIR.
- (U) $12,147 Total

(U) FY 2000 ($ in Thousands):

- (U) $ 3,245 Conduct laser optical bioeffects research to enable countermeasures for optical hazards/threats by evaluating and exploiting laser glare and flashblindness bioeffects with and without laser eye protection, conducting high-energy laser reflection hazard analysis, developing probability-based methods of laser hazard analysis, and proposing tri-Service recommendations for High-Energy Laser system use policy and requirements for test range certification.
- (U) $ 4,773 Conduct radio frequency bioeffects research to enable safe exploitation of lethal and non-lethal directed energy weapons and radar by providing updated DoD and exposure guidelines for ultra-wideband radiation and starting Air Expeditionary Force Agile Combat Support Initiative for portable High Energy Microwave Active Denial Technology.
- (U) $ 550 Continue to evaluate Photorefractive Keratectomy as surgical method to reduce need for glasses or contact lenses for aircrew. Collect and analyze first year post operative data.
- (U) $ 8,568 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602202F Human Effectiveness Applied Research — PROJECT: 7757

(U) FY 2001 ($ in Thousands):

- (U) $ 4,144 Conduct laser optical bioeffects research to enable countermeasures for optical hazards/threats by developing non-lethal laser use guidelines. Complete joint-Service personnel effects model to assess combat vulnerability to emerging optical threats and generate optical safety guidance for high energy laser test program.
- (U) $ 5,980 Conduct radio frequency bioeffects research to enable safe exploitation of lethal and non-lethal directed energy weapons and radar by continuing Air Expeditionary Force Agile Combat Support Initiative for portable High Energy Microwave Active Denial Technology and completing recommendation for DOD standard for High Power Microwave and ultra-wideband radiation weapons.
- (U) $ 500 Continue Photorefractive Keratectomy as surgical method to reduce need for glasses or contact lenses for aircrew. Collect and analyze second year post operative data.
- (U) $10,624 Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	58,054	68,329	62,012	66,607	70,453	74,783	71,197	72,225	Continuing	Continuing
3012	Advanced Propulsion Technology	1,683	1,941	0	0	0	0	0	0	0	0
3048	Fuels and Lubrication	10,629	11,569	8,415	9,036	9,392	14,181	14,629	15,037	Continuing	Continuing
3066	Turbine Engine Technology	31,682	36,078	41,421	42,055	39,867	36,710	32,179	32,396	Continuing	Continuing
3145	Aerospace Power Technology	14,060	18,741	12,176	15,516	21,194	23,892	24,389	24,792	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: As of FY 2000, all high-speed propulsion efforts under Project 3012, Advanced Propulsion Technology, are terminated. The decrease in Project 3048, Fuels and Lubrication, beginning in FY 2000 reflects deemphasis on high thermal stability fuels and engine technologies. The decrease in Project 3066, Turbine Engine Technology, beginning in FY 2002 reflects deemphasis on turbine engine technologies. The increase in Project 3145, Aerospace Power Technology, beginning in FY 2003 reflects increased emphasis on power components for space applications.

(U) A. Mission Description: This Applied Research program develops airbreathing propulsion and aerospace power technologies. The prime areas of focus are turbine engines, dual-mode ramjets, combined cycle engines, fuels, lubricants, and aerospace power technologies. Technology advances in turbine engine propulsion and lubrication systems are part of the Integrated High Performance Turbine Engine Technology (IHPTET) program and will increase engine performance, increase reliability, reduce specific fuel consumption, and lower cost of ownership. Dual-mode ramjet and combined cycle engines will increase weapon lethality and effectiveness against time-critical targets via high-speed propulsion systems. Fuels efforts will reduce system cost, maintenance, and the usage of hazardous cleaning materials while increasing aircraft performance and life through development of thermally stable and high heat sink fuels. High heat sink fuels from coal-derived resources will be investigated. Power system technologies are focused to eliminate troublesome, centralized hydraulic systems by replacement with highly reliable electric systems. Power conditioning, thermal management, and power source improvements will significantly enhance reliability, reduce weight, and lower life cycle costs.

(U) B. Budget Activity Justification: This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	57,261	69,061	70,539	73,303	Cont
(U) Appropriated Value	60,577	69,561			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-2,389	-1,232			
b. SBIR	-964				
c. Omnibus/Other Above Threshold Reprogrammings	-756				
d. Below Threshold Reprogrammings	1,586				
(U) Adjustments to Budget Year Since FY 1999 PB			-8,527	-6,696	
(U) Current Budget Submit/FY 2000 PB	58,054	68,329	62,012	66,607	Cont

(U) (U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program. As of FY 2000, all high-speed propulsion efforts under Project 3012, Advanced Propulsion Technology, are terminated.

FY 1999: $1,326 identified as a source for SBIR.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602203F Aerospace Propulsion

PROJECT: 3012

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3012 Advanced Propulsion Technology	1,683	1,941	0	0	0	0	0	0	0	0

(U) A. Mission Description: Establishes the technology base for advanced propulsion concepts including integral rocket ramjets for missile propulsion providing increased average velocity and lethality along with combined/advanced-cycle engines and hydrocarbon fueled dual-mode combustion ramjets for high-speed vehicles to support future missions such as rapid strike against time-critical targets. Note: This project is terminated in FY 2000.

(U) FY 1998 ($ in Thousands):

- (U) $632 Investigated unique concepts for combining advanced propulsion cycles which provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.
- (U) $343 Investigated, developed, and exploited Russian hypersonic technology. This effort supports technology transition for next generation hypersonic missiles and air vehicles to provide greater range and increased velocity which enhance weapon effectiveness.
- (U) $708 Investigated unique pulse detonation engine concepts to provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.
- (U) $1,683 Total

(U) FY 1999 ($ in Thousands):

- (U) $712 Investigate unique concepts for combining advanced propulsion cycles which provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.
- (U) $378 Investigate, develop, and exploit Russian hypersonic technology. This effort supports technology transition for next generation hypersonic missiles and air vehicles to provide greater range and increased velocity which enhance weapon effectiveness.
- (U) $814 Investigate unique pulse detonation engine concepts to provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.
- (U) $37 Identified as a source for SBIR.
- (U) $1,941 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion
	PROJECT 3012

(U) FY 2000: Not Applicable.

(U) FY 2001: Not Applicable.

(U) B. Project Change Summary - Description of Significant Changes: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion	PROJECT: 3048

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3048 Fuels and Lubrication	10,629	11,569	8,415	9,036	9,392	14,181	14,629	15,037	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $6,136 Developed high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.
- (U) $1,793 Developed high performance, low emissions, robust combustor concepts for advanced turbine engines to reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.
- (U) $2,700 Developed lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.
- (U) $10,629 Total

(U) FY 1999 ($ in Thousands):

- (U) $4,227 Develop high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.
- (U) $2,484 Develop high performance, low emissions, robust combustor concepts for advanced turbine engines to reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.
- (U) $4,633 Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.
- (U) $225 Identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion
	PROJECT 3048

– (U) $11,569 Total

(U) FY 2000 ($ in Thousands):

– (U) $2,993 Develop high thermal stability hydrocarbon fuels to provide higher heat capacity, higher operating temperatures, and reduced signatures for aerospace systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.

– (U) $2,000 Develop high performance, low emissions, robust combustor concepts for advanced airbreathing engines to reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.

– (U) $3,422 Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.

– (U) $8,415 Total

(U) FY 2001 ($ in Thousands):

– (U) $3,138 Develop high thermal stability hydrocarbon fuels to provide higher heat capacity, higher operating temperatures, and reduced signatures for aerospace systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.

– (U) $2,200 Develop high performance, low emissions, robust combustor concepts for advanced airbreathing engines to reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.

– (U) $3,698 Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.

– (U) $9,036 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion / PROJECT: 3048

(U) B. Project Change Summary - Description of Significant Changes: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3066

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3066 Turbine Engine Technology	31,682	36,078	41,421	42,055	39,867	36,710	32,179	32,396	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $28,632 Developed core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transport. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $3,050 Developed turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $31,682 Total

(U) FY 1999 ($ in Thousands):

- (U) $24,810 Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $5,875 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $2,415 Develop components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
- (U) $2,277 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
- (U) $701 Identified as a source for SBIR.
- (U) $36,078 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602203F Aerospace Propulsion — PROJECT: 3066

(U) FY 2000 ($ in Thousands):

- (U) $29,386 Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $6,958 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $2,861 Develop components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
- (U) $2,216 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
- (U) $41,421 Total

(U) FY 2001 ($ in Thousands):

- (U) $29,754 Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $7,045 Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) $2,897 Develop components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
- (U) $2,359 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
- (U) $42,055 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion
	PROJECT 3066

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

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

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT 3145

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3145 Aerospace Power Technology	14,060	18,741	12,176	15,516	21,194	23,892	24,389	24,792	Continuing	Continuing

(U) A. Mission Description: Develops technologies for aerospace power generation, conversion, and transmission systems including advanced electrical power component and subsystem technologies. Power components are developed for aircraft and flight line equipment to increase reliability, maintainability, commonality, and supportability. This project supports an initiative which uses electrical power to replace hydraulic and pneumatic power and their costly logistics support. These electrical power technologies are necessary to meet the 10-20 year long-term storage requirements of Air Force uninhabited combat aerial vehicles (UCAVs). Electrical power generation technologies developed are enabling technologies for all future military directed energy (DE) weapon systems. This project supports development of very high output power systems that are suitable for applications such as Space Based Laser. Essentially, all power electronics (conversion) technology being developed here has dual-use opportunities. Spin-off application areas include all military system conversion development from conventional to electrically-based on-board subsystems.

(U) FY 1998 ($ in Thousands):
- (U) $12,047 Developed power generation, conversion, and transmission components for aircraft systems. These components provide aircraft with a high degree of self-sufficiency, improved reliability, maintainability, and supportability, all yielding a quicker aircraft turn-around time. In addition, ground support equipment requirements will be dramatically reduced.
- (U) $1,505 Developed power sources for guidance, navigation, and control functions for missile systems, and for use in navigational aids, radios, and sensors for special operations forces. Power sources with higher power density, longer life, and increased reliability will provide missiles systems and special operations forces with greater reliability and reduced maintenance costs.
- (U) $508 Developed special purpose power components for advanced surveillance and communications systems, as well as ground power applications.
- (U) $14,060 Total

(U) FY 1999 ($ in Thousands):
- (U) $16,153 Develop power generation components for aircraft systems. These components improve aircraft self-sufficiency, reliability, maintainability, and supportability.
- (U) $1,738 Develop power source components for use in navigational aids, radios, and sensors for special operations forces. Power sources with higher power density, longer life, and increased reliability will provide special operations forces with greater reliability and reduced maintenance costs.
- (U) $487 Develop special purpose power components for advanced directed energy weapon systems, as well as ground power applications.
- (U) $363 Identified as a source for SBIR.
- (U) $18,741 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion
PROJECT 3145	

(U) FY 2000 ($ in Thousands):
- (U) $4,501 Develop power generation components for aircraft and space systems. These components improve aircraft and space systems self-sufficiency, reliability, maintainability, and supportability.
- (U) $6,275 Develop advanced power electronics and energy storage components for aircraft, space, and directed energy power systems.
- (U) $1,400 Develop power and thermal management system components to increase performance and reliability and reduce weight in space power applications.
- (U) $12,176 Total

(U) FY 2001 ($ in Thousands):
- (U) $5736 Develop power generation components for aircraft and space systems. These components improve aircraft and space systems self-sufficiency, reliability, maintainability, and supportability.
- (U) $7996 Develop advanced power electronics and energy storage components for aircraft, space, and directed energy power systems.
- (U) $1,784 Develop power and thermal management system components to increase performance and reliability and reduce weight in space power applications.
- (U) $15,516 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

	COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	57,766	63,719	64,988	69,245	71,392	75,438	80,236	82,263	Continuing	Continuing
2000	Electronic Countermeasures Technology	14,448	15,440	15,969	16,426	17,936	19,932	20,958	22,262	Continuing	Continuing
2001	Electro-Optical Technology	6,011	463	495	597	997	1,698	2,598	2,005	Continuing	Continuing
2002	Microwave Technology	9,167	9,039	9,387	10,505	9,976	10,194	10,465	10,754	Continuing	Continuing
2003	Avionics System Design Technology	5,410	9,282	9,362	9,728	10,314	11,010	11,302	11,616	Continuing	Continuing
6095	Sensor Fusion Technology	6,539	11,345	12,395	13,333	14,367	14,943	16,046	16,324	Continuing	Continuing
6096	Microelectronics Technology	8,600	9,180	7,703	8,548	7,409	6,978	6,898	7,032	Continuing	Continuing
7622	Radio Frequency Sensor Technology	7,591	8,970	9,677	10,108	10,393	10,683	11,969	12,270	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Applied Research program develops the technology base for Air Force aerospace sensors. Advances in aerospace sensors are required to increase combat effectiveness by providing "anytime, anywhere" surveillance, reconnaissance, precision targeting, and electronic warfare capabilities for ground, air, and space platforms. Advances in aerospace sensor technology will also reduce life cycle costs, facilitate affordable modernization of aging and future aerospace platforms, and provide protection against emerging hostile threat systems. Meeting these needs necessitates simultaneous advances in multiple, interrelated disciplines including: airborne and spaceborne sensors (e.g., infrared, radar, etc.); multi-function high-power electronic devices; target detection, classification, and recognition techniques; fire control; sensor fusion methods; communication and navigation subsystems; and electronic warfare technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors

(U) B. Budget Activity Justification: This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary sensor, electronics, and electronic combat technologies.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	61,025	65,549	67,461	72,064	Cont
(U) Appropriated Value	64,144	65,549			
(U) Adjustments to Appropriated Value					Cont
a. Congressional/General Reductions	-2,464	-1,830			
b. SBIR	-739				
c. Omnibus/Other Above Threshold Reprogrammings	-1,671				
d. Below Threshold Reprogrammings	-1,504				
(U) Adjustments to Budget Year Since FY 1999 PB			-2,473	-2,819	
(U) Current Budget Submit/FY 2000 PB	57,766	63,719	64,988	69,245	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $719 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT 2000

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2000 Electronic Countermeasures Technology	14,448	15,440	15,969	16,426	17,936	19,932	20,958	22,262	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $3,255 Developed technologies for on-board and off-board (active IR decoys) countermeasures to counter IR-guided missiles and electro-optical threats, including evaluating techniques against imaging missile seekers, developing a shielded narrow band IR source, downselecting laser beamrider missile concepts, and developing cooperative on-board and off-board countermeasure concepts.
- (U) $4,126 Developed affordable RF jamming technology and concepts to degrade enemy radar, missile, and command and control systems, including testing countermeasures to monopulse tracking radars, evaluating digital RF memory architectures for defeating coherent doppler radars, developing digital jamming metrics, and examining countermeasures to covert featureless waveform communication links.
- (U) $771 Developed off-board (expendable) RF countermeasure concepts, including designing active decoys to counter microwave and millimeter wave radars, developing methods to predict the effectiveness of advanced chaff, and developing and testing environmentally degradable and electromagnetically tailorable chaff designs.
- (U) $1,542 Developed technology for generic software modules to enable low-cost block upgrades to electronic warfare receivers, including ground testing combined de-interleaving, correlation, and threat identification software and completing a preliminary design of advanced threat parameter normalization software.
- (U) $3,854 Developed affordable RF receiver and antenna technology for use in operational and future aircraft, including testing a wideband digital receiver brassboard, developing wideband receiver specialized software, developing narrowband digital receiver technology, completing design of six-to-eight gigahertz conformal array, and transitioning software for design and evaluation of flush-mounted conformal arrays.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 2000

- (U) $900 Developed missile and laser warning technology to accurately cue countermeasures, including developing laser warning discrimination techniques, evaluating infrared (IR) clutter rejection techniques, developing and evaluating multifrequency, non-mechanical filters, and developing a laser warning breadboard.
- (U) $14,448 Total

(U) FY 1999 ($ in Thousands):

- (U) $4,150 Develop countermeasure technologies for on-board and off-board (active IR decoys) to counter IR-guided missiles and electro-optic threats, including continuing to evaluate techniques against imaging missile seekers, developing cooperative jammer and decoy concepts, and demonstrating night vision device countermeasure concepts.
- (U) $2,677 Develop affordable radio frequency (RF) jamming technology and concepts to degrade enemy radar, missile, and command and control (C2) systems, including completing covert featureless waveform study, developing advanced deception countermeasures techniques, developing techniques for degrading enemy modern communication networks, and evaluating RF countermeasure techniques in the laboratory.
- (U) $305 Develop off-board (expendable) RF and combined IR/RF countermeasure concepts, including design tools and analytic methods to predict effectiveness of advanced decoys.
- (U) $2,095 Develop technology for generic software modules to enable low-cost block upgrades to electronic warfare receivers, including testing of combined de-interleaving, correlation, and threat identification software modules.
- (U) $4,689 Develop affordable antenna technology for use in operational and future aircraft, including demonstrating first wideband digital receiver, developing new techniques for wideband to narrowband cueing, and investigating the electromagnetic characterization of and demonstrating dual-use conformal array technology.
- (U) $1,305 Develop missile and laser warning technology to accurately cue countermeasures and improve survivability. This includes continued development of laser warning techniques and evaluation of IR clutter rejection techniques.
- (U) $219 Identified as a source for SBIR.
- (U) $15,440 Total

(U) FY 2000 ($ in Thousands):

- (U) $3,524 Develop countermeasure technologies against IR-guided missiles and electro-optic threats, including continuing to evaluate techniques against imaging missile seekers and demonstrating cooperative jammer and decoy concepts.
- (U) $3,007 Develop affordable RF jamming technology and concepts that enhance aircraft survivability by degrading enemy radar, missile, and C2 systems, including completing covert evaluation of featureless waveform detection, optimizing advanced deceptive countermeasure techniques, and continuing to develop techniques for degrading enemy modern communication networks.
- (U) $491 Develop off-board (expendable) radio frequency (RF) and combined infrared/RF countermeasure concepts for affordable survivability, including demonstrating countermeasure effectiveness of advanced decoys against dual-mode missile seekers.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors
	PROJECT: 2000

- (U) $2,341 Develop technology for generic software modules to enable low-cost block upgrades to electronic warfare (EW) receivers, including completing tests of combined de-interleaving correlation and threat identification software modules for aerospace EW receivers.
- (U) $3,045 Develop affordable RF receiver technology for use in operational and future EW receivers, including continuing to demonstrate a wideband digital receiver brassboard, evaluating narrowband receiver technology, and developing wideband analog-to-digital circuits (ADCs).
- (U) $2,058 Develop affordable antenna technology for use in operational and future aerospace platform electronic receivers and apertures, including developing low-frequency direction-finding antennas, demonstrating advanced pattern control of multimode/multifunction antennas, and demonstrating wideband phase shifters and transmit/receive module technology.
- (U) $1,503 Develop aerospace missile and laser warning technologies to accurately cue countermeasures, including devising laser warning discrimination methods, assessing hyperspectral imaging technology for missile warning, and demonstrating infrared clutter rejection techniques.
- (U) $15,969 Total

(U) FY 2001 ($ in Thousands):

- (U) $2,999 Develop countermeasure technologies against infrared-guided missiles and electro-optic threats, including continuing to evaluate techniques against imaging missile seekers and demonstrating cooperative jammer and decoy concepts.
- (U) $3,776 Develop affordable RF jamming technology and concepts that enhance aircraft survivability by degrading enemy radar, missile, and command and control systems, including developing a wide bandwidth microwave tube for EW transmitters, testing optimized deception countermeasure techniques, and testing techniques to degrade modern communication networks.
- (U) $1,145 Develop technology for generic software modules to enable low-cost block upgrades to EW receivers, including designing threat identification software modules for next-generation space-based threat warning receivers.
- (U) $3,258 Develop affordable RF receiver technology for use in operational and future aerospace platform EW receivers. This includes demonstrating a wideband all-digital receiver brassboard for space-based applications that incorporates new hardware and software elements, evaluating the utility of narrowband receivers technology for affordable space-based receivers, and demonstrating high-speed, wideband ADCs.
- (U) $2,886 Develop affordable antenna technology for use in operational and future aerospace platform electronic receivers and apertures, including continuing to demonstrate advanced pattern control of multimode/multifunction antennas.
- (U) $2,362 Develop aerospace missile and laser warning technologies to accurately cue countermeasures, including developing advanced temporal and spectral tracking algorithms, refining hyperspectral imaging techniques, and demonstrating laser warning discrimination methods.
- (U) $16,426 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 2000

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT: 2001

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2001 Electro-Optical Technology	6,011	463	495	597	997	1,698	2,598	2,005	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):
- (U) $1,162 Developed ultraviolet technology for applications such as missile threat warning, communications, and jet engine analysis.
- (U) $311 Developed high-speed opto-electronics technology for faster interfaces between electronic components for high-speed analog-to-digital converters, digital radar, and real-time image/target recognition.
- (U) $747 Developed affordable, supportable, manufacturable high definition/resolution displays with all digital interface and sunlight readability.
- (U) $1,369 Developed advanced electro-optical sensor technologies, including non-mechanical beam steering techniques, for a single compact, affordable navigation and targeting sensor.
- (U) $2,422 Developed and demonstrated frequency agile electro-optical technologies to enhance air-to-ground and to air-to-air sensor performance, increase target detection and identification ranges, and defeat heat-seeking missiles.
- (U) $6,011 Total

(U) FY 1999 ($ in Thousands):
- (U) $457 Develop advanced electro-optical sensor technologies, including non-mechanical beam steering techniques, for a single compact, affordable navigation and targeting sensor.
- (U) $6 Identified as a source for SBIR.
- (U) $463 Total

(U) FY 2000 ($ in Thousands):
- (U) $495 Develop optical transmitter technology capable of sensing multiple target characteristics to provide robust non-cooperative combat identification, including performing proof-of-concept demonstrations and critical design of single imaging and non-imaging transmitters.
- (U) $495 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 2001

(U) FY 2001 ($ in Thousands):

- (U) $597 Develop optical transmitter technology capable of sensing multiple target characteristics to provide robust non-cooperative target identification, to include fabricating a single imaging and non-imaging transmitter.
- (U) $597 Total

(U) B. Project Change Summary - Description of Changes: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0603270F, Electronic Combat Technology.
- (U) PE 0602712E, Materials and Electronics Technology.
- (U) PE 0603739E, Advanced Electronics Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT 2002

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2002 Microwave Technology	9,167	9,039	9,387	10,505	9,976	10,194	10,465	10,754	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $1,450 Developed military essential mixed-mode (e.g., high-power/low-noise, microwave/digital, electronic/electro-optical, etc.) multi-function components for radar and EW receivers and for digital phased array radars. Application of this compact and more flexible sensor technology will improve warfighter situational awareness, enhance defense suppression, and improve precision weapon delivery.
- (U) $3,015 Developed high-power (1 to 100 watts), military unique, solid state transmitters for radar and communications applications. This technology will enable the warfighter to detect and track low radar cross-section targets at greater ranges, improve situational awareness, and enable development of compact affordable transmitters for smaller platforms such as advanced unmanned air vehicles.
- (U) $1,780 Developed high-operating-temperature, military essential, solid state microwave transmitters used in ground-based and airborne radar applications. This technology allows compact transmitters to be located in remote areas of the platform for increased sensor coverage.
- (U) $1,417 Developed military unique, very high-power (100 to 1,000 watts) vacuum electronics devices and components for EW, radar, and communications applications which will result in modular, very compact and affordable microwave and millimeter wave transmitters.
- (U) $1,505 Developed military unique millimeter wave integrated circuits for terminal guidance and communications systems with reduced size and weight, thereby, enabling the inclusion of these sensors on very small platforms.
- (U) $9,167 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,316 Develop compact, affordable, mixed-mode, multi-function receiver and phased array components for radar and EW, including designing miniature digital receiver components and refining advanced component evaluation methods to reduce non-recurring engineering costs.
- (U) $2,506 Develop high-power (1 to 100 watts), military unique, solid state transmitters for radar and communications applications, including transmit amplifiers to improve range and kill probability of precision guided munitions and advanced microwave amplifiers for improved power dissipation and reliability.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 2002

- (U) $2,833 Develop high yield process technologies to enable high-operating-temperature, military essential, solid state microwave transmitters used in ground-based and airborne radar applications, including evaluating candidate materials for improved transistor reliability and demonstrating integrated circuits and high power internally matched transistors.
- (U) $1,256 Develop military unique, very high-power (100 to 1,000 watts) vacuum electronics devices and components for affordable microwave and millimeter wave transmitters, including designing advanced microwave tube components.
- (U) $128 Identified as a source for SBIR.
- (U) $9,039 Total

(U) FY 2000 ($ in Thousands):

- (U) $4,510 Develop compact, affordable, mixed-mode, multi-function receiver and phased array components for radar and electronic warfare (EW), including fabricating miniature digital receiver components, direct digital waveform transmitters, and very low power (<0.5W) analog-to-digital converters for space-based sensors and refining advanced component evaluation methods.
- (U) $2,437 Develop high-efficiency radio frequency power amplifiers for military space-based sensors, including designing a 10 GHz power amplifier for space-based radar and compact, affordable, reliable transistors and devising fabrication techniques for microwave amplifiers that have improved power dissipation.
- (U) $332 Develop microwave technologies to enable high operating temperature, solid state microwave transmitters used in military ground-based and airborne radar applications, including robust high-speed, high-power III-nitride transistors.
- (U) $318 Demonstrate high-power, internally matched transistors that will allow replacement of S-band vacuum tube transmitters to increase the reliability and lower the life cycle cost of high-power, ground-based radars.
- (U) $903 Develop aerospace surface protective coatings and packaging technologies for high-performance, mixed analog/digital microwave circuits to improve reliability and lower the cost of components that operate in harsh military environments, including developing advanced packaging and interconnect processes for phased array antennas and EW transmitters. (In FY 2000, this work moved from PE 0602204F, Project 6096.)
- (U) $887 Develop military unique, very high-power (100 to 1,000 watts) vacuum electronics devices and components for compact, affordable microwave and millimeter wave transmitters used in EW, radar, and communications applications, including fabricating of advanced microwave tube components.
- (U) $9,387 Total

(U) FY 2001 ($ in Thousands):

- (U) $4,119 Develop compact, affordable mixed-mode multi-function receiver and phased array components for radar and electronic warfare, including demonstrating miniature airborne digital receiver components, fabricating direct digital waveform transmitters and very low power (<0.5W) analog-to-digital converters for space-based sensors, and demonstrating and refining advanced component evaluation methods.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 2002

- (U) $2,783 Develop high-efficiency radio frequency power amplifiers for military space-based sensors, including fabricating a 10 GHz power amplifier for space-based radar and demonstrating compact, affordable, reliable transistors and fabrication techniques for microwave amplifiers that have improved power dissipation.
- (U) $756 Develop microwave technologies to enable high operating temperature, solid state microwave transmitters used in military ground-based and airborne radar applications, including robust high-speed, high-power III-nitride transistors and high temperature silicon-carbide amplifiers.
- (U) $645 Develop and laboratory test aerospace surface protective coatings and packaging technologies for high performance mixed analog/digital microwave circuits to improve reliability and lower the cost of components that operate in harsh military environments, including testing advanced packaging and interconnect processes for phased array antennas and electronic warfare transmitters.
- (U) $736 Demonstrate military-unique, very high-power (100 to 1,000W) vacuum electronics devices and components for compact, affordable microwave and millimeter wave transmitters used in electronic warfare, radar, and communications applications, including demonstrating advanced microwave tube components.
- (U) $1,466 Develop space sensor component technology, including direct digital synthesis for waveform generation and miniaturized receiver technology.
- (U) $10,505 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT: 2003

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2003 Avionics System Design Technology	5,410	9,282	9,362	9,728	10,314	11,010	11,302	11,616	Continuing	Continuing

(U) A. Mission Description: Develops advanced aerospace sensor and avionics technology for electro-optical (EO) dectection, track, and identification of difficult targets, digital processing, software tools and techniques, and systems architectures. Develops new concepts, demonstrates feasibility, and advances technology for avionics system needs. Develops new concepts and demonstrates the feasibility of passive and active hyperspectral imaging sensors and algorithms for detection of airborne and ground-based targets in the presence of severe weather. These sensors are critical to future air and space-based surveillance and targeting capabilities. Additional technology development is being conducted in digital processing hardware, sensor integration, and real-time distributed software to improve weapon system performance, reduce life cycle costs, and increase avionics mission readiness.

(U) FY 1998 ($ in Thousands):

- (U) $1,066 Developed avionics software engineering technologies to improve reliability, quality, and supportability of both existing and next-generation weapon systems software. Successful re-engineering of existing software will dramatically improve the cost of modernizing aging avionics.
- (U) $1,632 Developed advanced machine intelligence technologies to provide a capability for enhanced management of critical on-board sensors and detection/recognition of targets.
- (U) $2,712 Developed advanced integration technology and evaluate the feasibility of integrating commercial-off-the-shelf components for affordable avionics modernization.
- (U) $5,410 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,547 Develop software engineering technologies to promote assured performance and affordability of complex existing and next-generation air and space platform software, including demonstrating automated means to ensure correctness of cockpit display and console software, developing capability for performing in-flight self-checking of mission critical weapons and information systems software, and continuing to develop new techniques for rapidly incorporating new functions and hardware into scaleable systems.
- (U) $3,829 Develop advanced machine intelligence technologies to provide a capability for enhanced management of critical on-board sensors and detection/recognition of targets, including demonstrating enhanced, real-time embedded avionics database management system, demonstrating advanced multi-target, multi-source identification capability, demonstrating an advanced tactical surveillance sensor manager, and developing and applying efficient target recognition and combat information fusion techniques.
- (U) $2,775 Develop and demonstrate avionics integration technologies that allow rapid re-allocation of avionics hardware to meet changing operational requirements. These technologies dramatically reduce warfighter timelines for interoperability and adaptability in changing threat environments.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors
	PROJECT: 2003

- (U) $131 Identified as a source for SBIR.
- (U) $9,282 Total

(U) FY 2000 ($ in Thousands):

- (U) $2,298 Develop software engineering technologies to promote assured performance and affordability of complex existing and next-generation air and space platform software, including continuing to demonstrate automated means to ensure correctness of cockpit display and console software, developing and applying capability for performing in-flight self-checking of mission critical weapons and information systems software, and continuing to develop new techniques for rapidly incorporating new hardware/software functions into scaleable, plug-and-play systems.
- (U) $2,566 Develop technologies to find and fix deep hide targets in day and night from high altitude and/or space in time to support precision targeting, including developing aerospace infrared hyperspectral sensor components and fusion algorithms, and continue validating sensor target models.
- (U) $1,119 Develop technology for non-cooperative identification of airborne and ground-based platforms, including investigating target background and atmospheric phenomenology effects on sensor performance, generating multi-dimensional/multi-functional sensor platform concepts, and developing coherent image processing/extraction algorithms.
- (U) $1,839 Develop electro-optical technology to enable passive or active targeting of difficult targets, including investigating ways of mitigating atmospheric phenomenology effects on extreme range aerospace sensors, developing turbulence compensation techniques for precision targeting, target signatures and phenomenology models, and selecting multifunction sensor target characteristics. (Prior to FY 2000, this work was performed under PE 0602702F, Project 4600.)
- (U) $451 Develop military-unique optical transmission components to enable information dominance, including fabricating laboratory high-speed optical communication subsystem.
- (U) $1,089 Develop innovative techniques and components to target difficult objects in degraded atmospheric conditions, including fabricating components for active multispectral imaging, assessing active imaging systems for their ability to penetrate weather and obscurants, and designing improved capabilities into existing systems.
- (U) $9,362 Total

(U) FY 2001 ($ in Thousands):

- (U) $1,979 Develop software engineering technologies to promote assured performance and affordability of complex existing and next-generation air and space platform software, including continuing to develop and apply capability for performing in-flight self-checking of mission critical weapons and information systems software, and continuing to develop new techniques for rapidly incorporating new hardware/software functions into scaleable, plug-and-play systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 2003

- (U) $2,308 Develop technologies to find and fix deep hide targets in day and night from high altitude and/or space in time to support precision targeting, including fabricating aerospace infrared hyperspectral sensor components, developing data extraction algorithms, and analyzing performance.
- (U) $1,005 Develop technology for non-cooperative identification of airborne and ground-based platforms, including designing long-range sensors, testing coherent image processing/extraction algorithms, and flight-demonstrating a multifunction ladar.
- (U) $2,800 Develop electro-optical technology to enable passive or active targeting of difficult targets, including examining mitigating atmospheric phenomenology effects on extreme range aerospace sensors, generating turbulence compensation techniques for precision targeting, target signatures and phenomenology models, and validating multifunction sensor target characteristics.
- (U) $419 Develop military-unique optical transmission components to enable information dominance, including demonstrating useful commercial-off-the-shelf technologies integrated with military-unique components.
- (U) $1,217 Develop innovative techniques and components to target difficult objects in degraded atmospheric conditions, including analyzing and demonstrating concepts based on high precision range gating and image processing.
- (U) $9,728 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors / PROJECT: 6095

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
6095 Sensor Fusion Technology	6,539	11,345	12,395	13,333	14,367	14,943	16,046	16,324	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $1,351 Developed and evaluated multi-sensor management technologies to optimize search techniques, increase air combat situational awareness, increase detection ranges, allow high-confidence target identification, and enhance surface strike applications.
- (U) $2,416 Demonstrated rapid evaluation of multi-sensor system concepts to support all-aspect fire control, target tracking, and situation awareness.
- (U) $554 Applied emerging open software architecture standards and practices to the development and evaluation of real-time, on-board, adaptive information fusion systems for reduced targeting errors and enhanced situation awareness.
- (U) $1,220 Developed low-cost techniques using on-board sensors for cooperative air-to-ground identification of friendly forces to reduce fratricide and increase mission effectiveness.
- (U) $998 Developed advanced ATR techniques, including extracting radar "signature fingerprints" and evaluating thermal invariance features.
- (U) $6,539 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,335 Develop, evaluate, and demonstrate air-to-air single and multisensor tracking, sensor management, fire control, situation awareness, and identification algorithms to dramatically improve air combat capability.
- (U) $5,062 Develop, evaluate, and demonstrate air-to-ground single and multi-sensor tracking, sensor management, fire control, situation awareness, and identification algorithms to dramatically improve reconnaissance, surveillance, and strike operations.
- (U) $2,772 Develop, evaluate, and demonstrate feasibility of single and multi-sensor ATR algorithms to dramatically improve capability to recognize hostile ground forces.
- (U) $1,216 Develop and demonstrate ATR enabling technologies for long-range, high-altitude air and space vehicles.
- (U) $800 Develop precision time, position, and velocity sensors to generate a common precision reference and enable platforms to share sensor data.
- (U) $160 Identified as a source for SBIR.
- (U) $11,345 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 6095

(U) FY 2000 ($ in Thousands):

- (U) $3,773 Develop, evaluate, and demonstrate single and multisensor lethality algorithms to dramatically improve air combat capability, including performing a ground station emulation, simulating real-time information into the cockpit (RTIC) targeting, and developing adaptive resource allocation.
- (U) $3,573 Develop, evaluate, and demonstrate air-to-ground single and multi-sensor radar target signature models to support automatic target recognition (ATR) in strike operations, including investigating computational electromagnetics (CEM) techniques, generating geometric target models, and characterizing clutter.
- (U) $1,712 Develop, evaluate, and demonstrate feasibility of multi-sensor ATR algorithms for on- and off-board sensor-to-shooter image and data fusion to rapidly attack time-critical targets, including completing the evaluation of a sensor-to-shooter algorithm, devising multi-sensor performance metrics, and evaluating multisensor ATR algorithms.
- (U) $2,281 Develop and demonstrate enabling ATR technologies for long-range, high-altitude air and space vehicles, including investigating physics-based and adaptive learning techniques.
- (U) $1,056 Develop precision time, position, and velocity sensors, leveraging on the Global Positioning System (GPS), and to enable multiple platforms to share sensor data with reduced jamming vulnerability and increased precision targeting accuracy, including conducting trade studies to determine optimal mix and density of digital devices, and developing detailed designs for advanced direct signal acquisition techniques for increased jam resistance of GPS user equipment.
- (U) $12,395 Total

(U) FY 2001 ($ in Thousands):

- (U) $4,142 Develop, evaluate, and demonstrate single and multi-sensor lethality algorithms to dramatically improve air combat capability, including performing a live-feed to ground station emulation, evaluating RTIC targeting schemes, and optimizing adaptive resource allocation methods.
- (U) $3,893 Develop, evaluate, and demonstrate air-to-ground single and multi-sensor radar target signature models to support ATR in strike operations, including generating geometric target models and incorporating clutter effects on target recognition.
- (U) $1,748 Develop, evaluate, and demonstrate feasibility of multi-sensor ATR algorithms for on- and off-board sensor-to-shooter image and data fusion to rapidly attack time-critical targets, including completing multi-sensor performance metrics and evaluating multi-sensor ATR algorithms.
- (U) $2,912 Develop and demonstrate enabling ATR technologies for long-range, high-altitude air and space vehicles, including continuing to investigate physics-based and adaptive learning techniques.
- (U) $638 Develop technologies for reduced jamming vulnerability and increased precision targeting and strike accuracy of GPS, including completing detailed designs of advanced direct signal acquisition techniques for increased jam resistance of GPS user equipment and testing signal acquisition techniques.
- (U) $13,333 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 6095

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

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

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT: 6096

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
6096 Microelectronics Technology	8,600	9,180	7,703	8,548	7,409	6,978	6,898	7,032	Continuing	Continuing

(U) A. Mission Description: This project focuses on military unique, sensor aspects of microelectronics and radio frequency (RF) photonics such as photonic sub-systems and components for the control and distribution of RF signals; high-speed devices and circuits; packaging and power distribution; design tools; and hardware design languages. The warfighter requirements for technology developments are based on Air Force and other DoD weapon systems needs in the areas of radar, communications, electronic warfare (EW), navigation, and smart weapons applications. Future surveillance and sensor information processing systems will require very small, environmentally robust, high-speed, low power, lightweight components and sub-systems using both microelectronics and photonics in the following areas: electronic and photonic analog-to-digital converter circuits, fiber optic signal control and distribution sub-systems, high-temperature electronics, multi-function monolithic integrated circuits, high density photonic interconnects, and RF distributions and radar beamforming. Computer-aided engineering technology is key to addressing the low-cost, very high performance, low power, tough environmental, multi-organization development, and high complexity challenges of our warfighting electronics. The developed technology is unavailable through commercial sources.

(U) FY 1998 ($ in Thousands):

- (U) $2,486 Developed advanced high-speed devices and fabrication processes for digital integrated circuits to allow high-speed military sensors to interface with slower commercial processing components, thereby eliminating bulky, costly, and temperature-sensitive down-conversion electronics. These technologies include very high-speed analog-to-digital converter circuits, digital RF memory chips, etc.
- (U) $2,316 Developed surface protective coatings, distributed power management, and packaging technologies for high performance digital integrated circuits to improve reliability and lower the cost of components that are required to operate in harsh military aerospace environments.
- (U) $1,744 Developed and integrated advanced design tools into a commercial software environment for affordable model year upgrades.
- (U) $2,054 Developed next generation hardware design languages to enable more effective interchange of replacement part design information, better control of obsolete parts, and reduced logistics support costs.
- (U) $8,600 Total

(U) FY 1999 ($ in Thousands):

- (U) $3,107 Develop advanced high-speed devices and fabrication processes for digital integrated circuits (e.g., very high-speed, analog-to-digital converters and digital RF memory chips) to allow high-speed military sensors to interface with slower commercial processors, thereby eliminating bulky, costly, and temperature-sensitive down-conversion electronics. This includes demonstrating fabrication processes and devices for a transceiver chip set and augmenting analog-to-digital conversion circuits to enable use of commercial-of-the-shelf components in radar, EW, and other sensors.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 6096

– (U) $2,609 Develop surface protective coatings and packaging technologies for high performance, mixed analog/digital microwave circuits to improve reliability and lower component cost for space sensor components, including developing advanced packaging and interconnect processes for phased array antennas and electronic warfare transmitters and receivers. (In FY 2000 this work moves to PE 0602204F, Project 2002.)

– (U) $2,528 Develop advanced design tools to reduce the cost and time required to create complex Air Force electronic systems, including assessing and refining tools for next-generation "systems-on-a-chip" and reconfigurable computer design.

– (U) $805 Develop next generation design representations and system-level modeling and simulation capability to support the complexity in implementing the Air Force's "system of systems" vision, including developing extensions to industry standard hardware description and design language tools for developing complex military information systems.

– (U) $131 Identified as a source for SBIR.

– (U) $9,180 Total

(U) FY 2000 ($ in Thousands):

– (U) $2,487 Develop advanced high-speed device technologies to enable affordable, compact space-based sensors, including designing radio frequency (RF) components and analog-to-digital converters for high dynamic range, high sensitivity micro-receivers.

– (U) $1,771 Develop advanced design tools to reduce the cost and time required to create complex Air Force electronic systems, for example mixed analog and digital systems, including demonstrating tools for reconfigurable computers and for describing hardware behavior.

– (U) $775 Develop next-generation design representations and system-level modeling and collaborative engineering capability to support the complexity in implementing the Air Force's "system of systems" vision, including specifying required representations and developing advanced techniques for analyzing life cycle cost/performance trade offs.

– (U) $2,270 Develop RF photonics technologies to demonstrate compact, affordable, wide bandwidth, high data rate sensors, to include designing photonic interconnect architectures for high performance digital receivers and processors. (In FY 1999, this work was performed in PE 0602702F, Project 4600.)

– (U) $400 Develop, as part of an international cooperative effort, the three-dimensional multilayer microwave packaging and interconnect multichip assembly technologies needed for next-generation aircraft and space-based radars.

– (U) $7,703 Total

(U) FY 2001 ($ in Thousands):

– (U) $3,397 Develop high-speed device technologies to enable affordable, compact space-based sensors, including designing and fabricating low power, radiation tolerant analog-to-digital converters for high dynamic range, high sensitivity micro-receivers.

– (U) $1,812 Develop advanced design tools to reduce the cost and time required to create complex Air Force electronic systems, for example mixed analog and digital systems, including continuing to demonstrate tools for reconfigurable computing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 6096

- (U) $760 Develop next-generation design representations and system-level modeling and collaborative engineering capability to support the complexity in implementing the Air Force's "system of systems" vision, including implementing required representations and demonstrating advanced techniques for analyzing life cycle cost/performance trade offs.
- (U) $2,579 Develop radio frequency photonics technologies to demonstrate compact, affordable, wide bandwidth, high data rate sensors, including fabricating photonic interconnect components for high performance digital receivers and processors.
- (U) $8,548 Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) PE 0602702F, Command, Control and Communications.
- (U) PE 0602705A, Electronics and Electronic Devices.
- (U) PE 0602234N, Materials, Electronics and Computers.
- (U) PE 0602712E, Materials and Electronics.
- (U) PE 0603739E, Manufacturing Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT 7622

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
7622 Radio Frequency Sensor Technology	7,591	8,970	9,677	10,108	10,393	10,683	11,969	12,270	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $2,995 Developed advanced microwave sensor technology for air-to-air radar and target detection, including electronic protection, multi-dimensional image processing, and adaptive algorithms, to improve performance and reduce life cycle costs.
- (U) $2,802 Developed advanced airborne sensors for air-to-ground targeting and attack with robust performance in adverse weather, severe jamming, natural clutter, or concealment by foliage or camouflage.
- (U) $1,794 Developed technology for information transmission between airborne vehicles and cooperating assets with high fidelity, low probability of detection, and high jam resistance to improve strike effectiveness.
- (U) $7,591 Total

(U) FY 1999 ($ in Thousands):

- (U) $3,742 Develop advanced microwave sensor technologies, such as electronic protection, multi-dimensional image processing, and adaptive algorithms, for high-performance, lower life cycle cost air-to-air radar and target detection, including testing integrated RF techniques, developing adaptive algorithms for interference and lobe cancellation, and continuing to develop radar engineering tools to evaluate targeting errors.
- (U) $3,666 Develop advanced airborne sensors for air-to-ground targeting and attack with robust performance in adverse weather, severe jamming, natural clutter, or concealment by foliage or camouflage, including developing improved targeting scenes for synthetic aperture radars (SAR) and continuing to develop analytical tools to predict SAR performance.
- (U) $1,435 Develop technology for information transmission between airborne vehicles and cooperating assets with high fidelity, low probability of detection, and high jam resistance to improve strike effectiveness, including integrating a communication asset management system and completing a preliminary design for a non-linear adaptive interference limiter to reduce interference.
- (U) $127 Identified as a source for SBIR.
- (U) $8,970 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 7622

(U) FY 2000 ($ in Thousands):

- (U) $568 Develop aerospace microwave sensor technologies for air-to-air radar and target detection that supports surveillance, reconnaissance, protection, targeting, attack, and electronic warfare, including designing electromagnetic interference mitigation techniques and validating advanced radar performance/cost analysis tools.
- (U) $1,759 Develop adaptive microwave processing algorithms for detecting and locating advanced cruise missiles and slow airborne and ground targets, including designing techniques to mitigate clutter and jamming on airborne monostatic and bistatic radars.
- (U) $1,577 Develop advanced aerospace sensors for air-to-ground targeting and attack, providing synthetic aperture radar (SAR) targeting solutions for maneuvering tactical aircraft under hostile environment, including performing an independent assessment of various current and future airborne and space surveillance sensors.
- (U) $743 Develop technology for detecting and attacking concealed targets, including developing innovative foliage- and ground-penetrating radar waveforms and targeting algorithms.
- (U) $1,199 Develop technology for information transmission between airborne vehicles and cooperating assets with high fidelity, low probability of detection, and high jam resistance to improve strike effectiveness, including completing a dual-use, integrated communication/navigation system demonstrator, developing a design for a non-linear adaptive interference limiter, and continuing propagation characterization studies and experiments.
- (U) $491 Develop technology to accurately determine algorithm and sensor performance from airborne and space-based platforms in realistic airborne surveillance and combat scenarios, including testing bistatic adjuncts on unmanned aerial vehicles. (Prior to FY 2000, this effort was conducted under PE 0602702F, Project 4506.)
- (U) $2,139 Develop advanced electromagnetic aperture technology, including demonstrating the feasibility of a space-based radar subarray; completing an antenna element/aperture design for a digital beam-formed bistatic radar multibeam antenna, evaluating advanced antenna concepts for sparse distributed satellite arrays, and demonstrating a three-dimensional optically excited antenna array. (Prior to FY 2000, this effort was conducted under PE 0602702F, Project 4600.)
- (U) $1,201 Develop electromagnetic technologies for advanced surveillance systems applications for the detection of low-observable airborne targets within severe clutter from airborne or space-based surveillance platforms. (Prior to FY 2000, this effort was conducted under PE 0602702F, Project 4600.)
- (U) $9,677 Total

(U) FY 2001 ($ in Thousands):

- (U) $1,377 Develop aerospace microwave sensor technologies for air-to-air radar and target detection that supports surveillance, reconnaissance, protection, targeting, attack, and electronic warfare, including developing electromagnetic interference mitigation components.
- (U) $1,142 Develop adaptive microwave processing algorithms for detecting and locating advanced cruise missiles and slow airborne and ground targets, including laboratory testing techniques to mitigate clutter and jamming in airborne monostatic and bistatic radars.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 7622

- (U) $1,129 Develop advanced aerospace sensors for targeting and attack, including developing a high fidelity space-based radar evaluation tool for performing an independent assessment of surveillance and reconnaissance sensors.
- (U) $1,325 Develop technology for detecting and attacking concealed targets, including evaluating innovative foliage- and ground-penetrating radar waveforms and targeting algorithms, devising techniques to prevent discovery by the enemy, and assessing potential for embedded communications.
- (U) $1,379 Develop technology for information transmission between airborne vehicles and cooperating assets with high fidelity, low probability of detection, and high jam resistance to improve strike effectiveness, including completing the design of a non-linear adaptive interference limiter and continuing wide-band propagation characterization experiments.
- (U) $893 Develop technology to accurately determine algorithm and sensor performance from airborne and space-based platforms in realistic airborne surveillance and combat scenarios, including demonstrating performance on airborne surveillance and fighter platforms such as bistatic adjunct unmanned aerial vehicles (UAV), airborne foliage penetration assets, and space-based radar platforms.
- (U) $2,058 Develop advanced electromagnetic aperture technology, including demonstrating algorithms for a digital beam-formed bistatic radar multibeam antenna, demonstrating switched multi-function phased array employing micro-machined electromechanical system technology, and demonstrating a broadband antenna horn array for a UAV foliage penetration radar.
- (U) $805 Develop electromagnetic technologies for advanced surveillance systems applications for the detection of low-observable airborne targets within severe clutter from airborne or space-based surveillance platforms, including continuing to build a laboratory bistatic radar cross section measurement capability.
- (U) $10,108 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors
	PROJECT 7622

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) PE 0603253F, Advanced Avionics Integration.
- (U) PE 0602782A, Command, Control and Communications (C3) Technology.
- (U) PE 0602232N, Navy C3 Technology.
- (U) PE 0603792N, Advanced Technology Transition.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602269F Hypersonic Technology Program

PROJECT: 1025

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
1025 Hypersonic Technology	9,115	16,586	0	0	0	0	0	0	0	0
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2000, this program is terminated.

(U) A. Mission Description: This Applied Research program develops advanced hypersonic technologies and will provide revolutionary technology options to satisfy future Air Force needs such as future hypersonic weapons and space launch concepts. This program will focus on hydrocarbon fueled hypersonic vehicle technologies and demonstrate their feasibility. Technologies developed under this program will be dual-use and applicable to both DoD and National Aeronautics and Space Administration (NASA) requirements. Planned efforts include analyses, hypersonic materials/structures, airbreathing propulsion, hydrocarbon fuels, and integrated technology test demonstrations.

(U) FY 1998 ($ in Thousands):

- (U) $7,908 Designed, developed, and tested propulsion components, structures, and integrated propulsion designs to demonstrate performance and durability of advanced hypersonic propulsion concepts.
- (U) $471 Designed, developed, and tested advanced high-temperature, high-strength materials and structures for durability and affordability in hypersonic applications.
- (U) $284 Developed technologies for instrumentation and test in realistic hypersonic conditions to enable appropriate system testing.
- (U) $310 Developed and extended computational technologies for supersonic combustion flow paths, validated these technologies, and applied them to predict internal flows and performance of scramjet engines for accurate prediction of system performance.
- (U) $142 Conducted feasibility studies, design trades, and simulations to integrate hypersonic technologies into advanced vehicle designs for hypersonic applications that will improve warfighting capability and satisfy the requirements of Global Reach/Global Power.
- (U) $9,115 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602269F Hypersonic Technology Program — PROJECT: 1025

(U) FY 1999 ($ in Thousands):

- (U) $14,127 Design, develop, and test propulsion components, structures, and integrated propulsion designs to demonstrate performance and durability of advanced hypersonic propulsion concepts.
- (U) $1,063 Design, develop, and test advanced high-temperature, high-strength materials and structures for durability in hypersonic applications.
- (U) $392 Develop technologies for instrumentation and test in realistic hypersonic conditions to enable appropriate system testing.
- (U) $392 Develop and extend computational technologies for supersonic combustion flow paths, validate these technologies, and apply them to predict internal flows and performance of scramjet engines for accurate prediction of system performance.
- (U) $147 Conduct feasibility studies, design trades, and simulations to integrate hypersonic technologies into advanced vehicle designs for hypersonic applications that will improve warfighting capability and satisfy the requirements of Global Reach/Global Power.
- (U) $465 Identified as a source for SBIR
- (U) $16,586 Total

(U) FY 2000: Not Applicable

(U) FY 2001: Not Applicable

(U) B. Budget Activity Justification: This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602269F Hypersonic Technology Program / PROJECT: 1025

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	9,305	16,649	16,577	16,396	Cont
(U) Appropriated Value	9,840	16,649			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-326	-63			
b. SBIR	-216				
c. Omnibus/Other Above Threshold Reprogrammings	-519				
d. Below Threshold Reprogrammings	336				
e. Rescissions					
(U) Adjustments to Budget Years Since FY 1999 PB			-16,577	-16,396	
(U) Current Budget Submit/FY 2000 PB	9,115	16,586	0	0	

(U) (U) Significant Program Changes: In FY 2000, this program is terminated due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $465 indentified as a source for SBIR.

(U) D. Other Program Funding Summary:

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

(U) E. Acquisition Strategy: Not Applicable.

(U) F. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: **2 - Applied Research**

PE NUMBER AND TITLE: **0602601F Phillips Laboratory Exploratory Development**

	COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	113,000	125,585	115,313	110,811	116,109	131,858	144,557	149,674	Continuing	Continuing
1010	Geophysics and Weather Technology	19,848	23,885	8,120	9,133	7,960	8,641	15,437	17,028	Continuing	Continuing
1011	Rocket Propulsion Technology	28,199	34,824	31,835	20,817	24,820	36,105	41,916	40,541	Continuing	Continuing
3326	Lasers and Imaging Technology	16,873	18,662	17,193	17,211	16,177	19,161	19,600	19,561	Continuing	Continuing
5797	Advanced Weapons and Survivability Technology	13,602	14,239	16,183	16,752	17,304	17,723	17,375	17,870	Continuing	Continuing
8809	Space and Missile Technology	34,478	33,975	41,982	46,898	49,848	50,228	50,229	54,674	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2000, spectral sensing (intelligent satellite systems and hyperspectral technology) efforts currently in Project 3326 move into Project 8809.

(U) A. Mission Statement: This is the Applied Research program for space technology, rocket propulsion, and directed energy for the Air Force Research Laboratory. In geophysics, this PE develops technologies to understand, mitigate, and exploit effects of weather and geophysics environments on the design and operation of Air Force systems. This includes defining, modeling, and developing techniques to predict the phenomena of solar and space environments. In rocket propulsion, this PE develops technologies to demonstrate the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) goals for boost and orbit transfer, satellite maneuvering, and tactical/ballistic missile rocket propulsion. In lasers, this PE examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. Technologies researched include high power laser devices, mid-infrared semiconductor laser devices, semiconductor diode laser arrays, optical components, advanced beam control and atmospheric compensation technologies, techniques for laser target vulnerability assessments, and nonlinear optics processes and techniques. Advanced weapons examines high power microwave and other unconventional weapon concepts using innovative technologies such as compact toroids. This also provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets. In space and missiles, this PE develops the following technologies: spacecraft platform (e.g., structures, controls, power, and thermal management); space-based payload (e.g., sensors, satellite communications, and survivable electronics); satellite control (e.g., spacecraft software); ballistic missile/launch vehicle-specific (e.g., astrodynamics and guidance, navigation, and control avionics); and integrated experiments of advanced technologies for transition to planned systems (e.g., payload/platform/launch vehicle

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**

merging). Note: In FY 1999, Congress added $9.0 million for the High-frequency Active Auroral Research Program and $4.0 million for the Terabit fiber optic technology program.

(U) B. Budget Activity Justification: This program in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	118,266	116,139	131,078	138,457	Cont
(U) Appropriated Value	127,259	129,139			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-7,390	-3,554			
b. SBIR	-1,765				
c. Omnibus/Other Above Threshold Reprogrammings	-3,811				
d. Below Threshold Reprogrammings	-1,293				
(U) Adjustments to Budget Year Since FY 1999 PB			-15,765	-27,646	
(U) Current Budget Submit/FY 2000 PB	113,000	125,585	115,313	110,811	Cont

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

FY 1999: $2,632 identified for a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**
	PROJECT **1010**

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
1010 Geophysics and Weather Technology	19,848	23,885	8,120	9,133	7,960	8,641	15,437	17,028	Continuing	Continuing

(U) A. Mission Statement: This project develops the technologies to exploit the aerospace environment to the warfighter's benefit. The project focuses on characterizing the battlespace environment for realistic space system design, modeling, and simulation. It includes technologies to specify and forecast the environment " mud to sun" for planning operations and ensuring uninterrupted system performance. Finally, it includes technologies that allow the opportunity to mitigate or exploit the aerospace environment for both offensive and defensive operations.

(U) FY 1998 ($ in Thousands):

- (U) $3,863 Developed hardware, software, and decision aids to specify the impact of space radiation on the design and operation of DoD space systems. Fabricated a space experiment to track solar eruptions, which disrupt communications and cause satellite anomalies and tracking errors.
- (U) $5,600 Developed infrared background clutter codes and missile and aircraft target identification codes to improve the detection of theater ballistic missiles and other targets from space. Conducted atmospheric turbulence measurements and performance analysis required by operational laser systems.
- (U) $10,385 Developed techniques and systems, both ground-based and space-based, to measure, specify, and predict the effects of ionospheric disturbances on the operation of communications, surveillance, navigation, and other space systems. Increased the capability of the High-frequency Active Auroral Research Program (HAARP) facility in Alaska and initiated development of techniques for imaging underground structures.
- (U) $19,848 Total

(U) FY 1999 ($ in Thousands):

- (U) $4,099 Complete and validate hardware, software, and decision aids, including the Improved Solar Optical Observation Network (ISOON) system, and transition to Air Force Space Command and other users for improved specification of space environmental hazards.
- (U) $4,939 Develop techniques for detecting and tracking low-signature ballistic and cruise missiles and optimizing new surveillance sensor design, including hyperspectral sensors. Develop instruments and techniques to detect theater ballistic missiles through clouds, haze, smoke, and dust and to optimize the performance of operational laser weapon systems.
- (U) $5,557 Develop systems such as the space-based Communications/Navigation Outage Forecasting System (C/NOFS), sensors, and decision aids to measure, specify, and predict the effects of ionospheric disturbances on the operation of DoD space systems.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 1010

– (U) $8,791 Expand the infrastructure at the High Frequency Active Auroral Research Program's (HAARP) Alaska facility through construction of a control center and installation of radio and optical diagnostic instruments. Use the HAARP facility to assess new concepts for imaging underground structures.
– (U) $499 Identified as a source for SBIR.
– (U) $23,885 Total

(U) FY 2000 ($ in Thousands):
– (U) $2,960 Develop techniques and systems to monitor and predict environmental conditions hazardous to DoD operational space systems. Complete analysis and initial design of a space experiment to demonstrate control of radiation belt particle levels.
– (U) $2,515 Design real-time predictive background clutter code and develop data-based models to support design and operation of global surveillance systems. Validate atmospheric turbulence effects on operational laser systems and conduct experiment to detect theater ballistic missiles at earliest boost phase to enhance counterforce operations and force protection.
– (U) $2,645 Fabricate and test instrumentation for the Communications/Navigation Outage Forecasting System (C/NOFS).
– (U) $8,120 Total

(U) FY 2001 ($ in Thousands):
– (U) $3,672 Develop systems to predict space environmental hazards, including solar disturbances and the earth's radiation belts, and the resultant disruptions of operational space systems.
– (U) $2,772 Develop real-time infrared background clutter code, target detection techniques, and decision aids for application to space surveillance, laser weapons, and countermeasures systems, including detection of low-observable targets. Confirm utility of hyperspectral imaging sensors for earliest boost-phase detection of theater ballistic missiles.
– (U) $2,689 Develop artificial intelligence techniques, forecasting tools, and sensors for improved ionospheric specification and forecasting support, including communications/navigation outage forecasting and space-based radar demonstrations.
– (U) $9,133 Total

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BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**
	PROJECT **1010**

(U) B. Project Change Summary - Description of Significant Changes: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0601102F, Defense Research Sciences.
- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0603410F, Space Systems Environmental Interactions Technology.
- (U) PE 0305111F,.Weather Systems
- (U) PE 0603707F, Weather Systems Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**
	PROJECT **1011**

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
1011 Rocket Propulsion Technology	28,199	34,824	31,835	20,817	24,820	36,105	41,916	40,541	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):
- (U) $3,442 Developed propellants with a high-energy density for increased payload capability and lower cost space launch systems.
- (U) $13,790 Developed propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems.
- (U) $3,601 Developed advanced boost and orbit transfer propellants which are environmentally safe during manufacture, storage, use, and disposal.
- (U) $6,000 Initiated technologies for long-term sustainment of strategic systems which also apply to the development of the next generation booster.
- (U) $1,366 Developed solar electric and solar thermal propulsion technologies for stationkeeping, repositioning, and orbit transfer appropriate for large communication satellites and satellite constellations.
- (U) $28,199 Total

(U) FY 1999 ($ in Thousands):
- (U) $3,756 Develop propellants with a high-energy density for increased payload capability and lower cost space launch systems. Develop advanced chemical propellant formulation and perform propellant testing. This propellant will be used in heavylift vehicles.
- (U) $2,928 Develop advanced combustion technology for improved performance and reliability of engines used in heavylift vehicles.
- (U) $3,629 Develop advanced material technology for lightweight components and material property enhancement.
- (U) $13,509 Develop propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems. Develop solid and hybrid rocket propulsion technologies for upperstage and air launched missiles, part of international agreements.
- (U) $7,000 Develop technologies for long-term sustainment of strategic systems which also apply to the development of the next generation booster.

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

- (U) $3,278 Develop solar electric and solar thermal propulsion technologies for stationkeeping, repositioning, and orbit transfer appropriate for large communication satellites and satellite constellations.
- (U) $724 Identified as a source for SBIR.
- (U) $34,824 Total

(U) FY 2000 ($ in Thousands):

- (U $4,269 Develop propellants with a high-energy density for increased payload capability and lower cost space launch systems. Develop advanced chemical propellant formulation and perform propellant testing.
- (U) $14,347 Develop propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems.
- (U) $3,260 Develop advanced combustion technology for improved performance and reliability of liquid engines used in heavylift vehicles.
- (U) $4,114 Develop advanced material technology for lightweight components and material property enhancement.
- (U) $2,000 Complete development of insulation and case materials for high combustion temperature propellants, plus complete analytical tools for prediction of propellant life.
- (U) $3,845 Develop solar electric and solar thermal propulsion technologies for stationkeeping, repositioning, and orbit transfer appropriate for large communication satellites and satellite constellations.
- (U) $31,835 Total

(U) FY 2001 ($ in Thousands):

- (U) $3,926 Develop propellants with a high-energy density for increased payload capability and lower cost space launch systems.
- (U) $14,001 Develop propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems.
- (U) $1,093 Continue to develop advanced combustion technology for improved performance and reliability.
- (U) $1,797 Develop advanced ablative components using hybrid polymers for use in current and future launch systems.
- (U) $20,817 Total

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

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

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

(U) D. Acquisition Strategy: Not Applicable.

U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602601F Phillips Laboratory Exploratory Development

PROJECT: 3326

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3326 Lasers and Imaging Technology	16,873	18,662	17,193	17,211	16,177	19,161	19,600	19,561	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):

- (U) $898 Developed generic, high energy laser technologies for applications such as illuminators and use in wavelength-specific military missions.
- (U) $1,666 Developed long-range optical imaging and non-imaging technologies for increased resolution and data fusion to support missions such as space object identification.
- (U) $1,485 Investigated and developed advanced laser radar for space surveillance and remote sensing using transceiver systems, and advanced data collection and processing algorithms for laser radar (LADAR) remote sensing of atmospheric properties, chemical agents, and target effluents, and intelligence preparation of the battlefield.
- (U) $4,600 Developed laser source and targeted coupling technology for next generation high-payoff applications such as damage/destroy countermeasures against infrared imaging seekers.
- (U) $1,610 Investigated and developed nonlinear optics (NLO) technologies to support imaging and other applications.
- (U) $3,801 Developed high power semiconductor lasers/arrays at alternate wavelengths for applications such as forward looking infrared (FLIR) systems and infrared (IR) missile jamming, chemical agent detection, illuminators, efficient semiconductor laser array pumping modules, and disrupt/jam countermeasures against near-term threats.
- (U) $2,813 Developed coherent laser diode arrays for improved performance/higher power in applications requiring high power levels.
- (U) $16,873 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**
	PROJECT **3326**

(U) FY 1999 ($ in Thousands):

– (U)	$1,025	Develop generic, high energy laser technologies for applications such as illuminators and use in wavelength-specific military missions.
– (U)	$3,606	Develop long-range optical technologies for increased resolution, characterization, and data fusion to support missions such as space object identification and ground target identification from space.
– (U)	$1,486	Investigate and develop advanced laser transceiver systems, and advanced data collection and processing algorithms for light detection and ranging (LIDAR) remote sensing of atmospheric properties, chemical agents, and target effluents, and intelligence preparation of the battlefield.
– (U)	$2,854	Develop laser source and target coupling technology for next-generation high-payoff applications such as damage/destroy countermeasures against infrared imaging seekers.
– (U)	$588	Investigate and develop nonlinear optics (NLO) technologies to support imaging and beam projection technologies.
– (U)	$4,558	Develop high power semiconductor lasers/arrays at alternate wavelengths for applications such as forward looking infrared (FLIR) systems and infrared (IR) missile jamming, chemical agent detection, illuminators, efficient semiconductor laser array pumping modules, and disrupt/jam countermeasures against near-term threats.
– (U)	$4,150	Develop spatially coherent lasers for tactical/unmanned air vehicle and space applications such as designation/illumination and remote sensing which require higher power sources.
– (U)	$395	Identified as a source for SBIR.
– (U)	$18,662	Total

(U) FY 2000 ($ in Thousands):

– (U)	$1,892	Develop long-range optical technologies (e.g., speckle holography) for increased resolution, characterization, and data fusion for applications such as space object identification and status.
– (U)	$645	Continue development of NLO technologies to support imaging and beam projection applications. NLO allows non-mechanical beam clean-up and modification for decreased complexity.
– (U)	$3,514	Develop high power chemical gas/solid state laser technologies for applications such as directed energy weapons, illuminators, and wavelength specific applications such as infrared countermeasures.
– (U)	$1,806	Develop laser source beam control and target coupling technology for next generation high payoff applications such as damage/destroy countermeasures against surface-to-air missiles (SAM) and air-to-air missiles (AAM) threats.
– (U)	$2,614	Develop high power semiconductor lasers at alternate (e.g., longer) wavelengths for applications such as forward looking infrared (FLIR) systems and IR missile warning/sensor jamming, chemical agent detection, and illuminators.
– (U)	$6,722	Develop higher power, more efficient monolithic, solid state/semiconductor lasers for tactical/unmanned air vehicle and space applications such as jamming near-term infrared guided missile threats.

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

– (U) $17,193 Total

(U) FY 2001 ($ in Thousands):

– (U) $1,925 Continue development of long-range imaging and non-imaging optical technologies for increased resolution, characterization, and data fusion for identifying satellites.

– (U) $645 Continue development and begin large-scale field test of nonlinear optics (NLO) technologies to support beam projection and imaging applications associated with large aperture lightweight optics.

– (U) $3,655 Develop high power chemical gas/solid-state laser technologies for applications such as directed energy weapons, illuminators, and wavelength specific applications such as infrared countermeasures.

– (U) $1,893 Develop laser source beam control and target coupling technology for next generation high payoff applications such as damage/destroy countermeasures against surface-to-air missiles (SAM) and air-to-air missiles (AAM) threats.

– (U) $2,286 Develop high power semiconductor lasers at alternate (e.g., higher) wavelengths for applications such as forward looking infrared (FLIR) systems and infrared (IR) missile warning/sensor jamming, chemical agent detection, and illuminators.

– (U) $6,807 Develop higher power, more efficient monolithic, solid state/semiconductor lasers for tactical/unmanned air vehicle and space applications such as jamming near-term infrared guided missile threats.

– (U) $17,211 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602101N, Directed Energy Weapons.
- (U) PE 0602307A, Laser Weapon Technology.
- (U) PE 0603314A, High Energy Laser and Directed Energy Components.
- (U) PE 0603319F, Airborne Laser Demonstrator.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

	DATE **February 1999**
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602601F Phillips Laboratory Exploratory Development

PROJECT: 5797

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
5797 Advanced Weapons and Survivability Technology	13,602	14,239	16,183	16,752	17,304	17,723	17,375	17,870	Continuing	Continuing

(U) A. Mission Statement: High power microwave (HPM) and other unconventional weapon concepts using innovative technologies are explored in this project. Technologies that support a wide range of Air Force missions such as suppression of enemy air defenses, command and control warfare, and vehicle self-protection are developed. This project provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets. In addition to directed energy weapon threats, this project conducts assessments of specific space environmental (natural and man-made) effects on space systems and develops hardening technologies and methodologies.

(U) FY 1998 ($ in Thousands):

- (U) $4,723 Developed generic advanced weapon technologies that support multiple Air Force applications such as command and control warfare and suppression of enemy air defenses.
- (U) $1,884 Assessed effects/lethality of directed energy weapon technologies against representative air and ground military systems.
- (U) $978 Developed HPM technologies that will support applications such as command and control warfare.
- (U) $2,217 Developed HPM technologies that will support applications such as suppression of enemy air defenses and aircraft self-protection.
- (U) $1,909 Developed HPM technologies, including susceptibility and effects experiments and modeling and database development, to support space control applications.
- (U) $1,891 Assessed the vulnerability of various space assets to threats such as solar radiation and directed energy weapons.
- (U) $13,602 Total

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BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**
	PROJECT **5797**

(U) FY 1999 ($ in Thousands):

- (U) $5,799 Developed generic advanced weapon technologies that support multiple Air Force applications such as command and control warfare and suppression of enemy air defenses.
- (U) $3,439 Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.
- (U) $1,397 Develop high power microwave (HPM) technologies that will support applications such as command and control warfare.
- (U) $1,583 Develop HPM technologies that will support applications such as suppression of enemy air defenses.
- (U) $1,723 Assess the vulnerability of various space assets to threats such as solar radiation, space debris, and directed energy weapons.
- (U) $298 Identified as a source for SBIR.
- (U) $14,239 Total

(U) FY 2000 ($ in Thousands):

- (U) $1,498 Investigate technologies for developing innovative HPM sources to support multiple Air Force applications such as command and control warfare and suppression of enemy air defenses.
- (U) $1,977 Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.
- (U) $1,787 Develop HPM technologies that will support applications such as command and control warfare.
- (U) $2,646 Investigate HPM technologies best suited to support applications such as suppression of enemy air defenses.
- (U) $5,727 Investigate HPM technologies best suited to support offensive and defensive advanced tactical applications made possible based on increased power available on future aircraft.
- (U) $571 Investigate best means for Active Denial Technology to support Agile Combat Support applications.
- (U) $1,977 Assess the vulnerability of various space assets to radiation threats such as solar radiation and directed energy weapons.
- (U) $16,183 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**
	PROJECT **5797**

(U) FY 2001 ($ in Thousands):

- (U) $1,574 Investigate technologies for developing innovative high power microwave (HPM) sources to support multiple Air Force applications such as command and control warfare and suppression of enemy air defenses.
- (U) $1,868 Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.
- (U) $1,957 Develop HPM technologies that will support applications such as command and control warfare.
- (U) $2,899 Investigate HPM technologies best suited to support applications such as suppression of enemy air defenses.
- (U) $6,498 Investigate HPM technologies best suited to support offensive and defensive advanced tactical applications made possible based on increased power available on future aircraft.
- (U) $1,956 Assess the vulnerability of various space assets to radiation threats such as solar radiation and directed energy weapons.
- (U) $16,752 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602120A, Electronic Survivability and Fuzing Technology.
- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602601F Phillips Laboratory Exploratory Development

PROJECT: 8809

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
8809 Space and Missile Technology	34,478	33,975	41,982	46,898	49,848	50,228	50,229	54,674	Continuing	Continuing

(U) A. Mission Statement: This project focuses on seven major space and missile technology areas: spacecraft platforms (e.g., structures, controls, power, and thermal management); space-based payload (e.g., sensors and survivable electronics); satellite control (e.g., software for satellite control and autonomous operations); modeling and simulation of space-based systems; satellite protection technologies (e.g., space environment effects, debris prediction, and threat warning/attack reporting); microsatellite technologies; and integrated experiments of advanced technologies for transition to planned systems (e.g., payload/platform/launch vehicle merging).

(U) FY 1998 ($ in Thousands):

- (U) $4,656 Developed technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact, high efficiency solar power cells, lightweight batteries, and innovative power generation and storage concepts.
- (U) $3,522 Developed technologies for space platform structures such as spacecraft structural controls for vibration suppression, multifunctional structures, and lightweight composite satellite and launch vehicle structures.
- (U) $2,155 Developed technologies for space-based payload subsystems such as advanced infrared sensors, advanced hardened focal plane detector arrays, and antenna architectures for Space-based Radar.
- (U) $3,808 Developed technologies for space-based payload components such as low power, high performance, radiation hardened electronic devices, micro-electo-mechanical systems (MEMS) devices, and advanced electronics packaging.
- (U) $2,719 Developed technologies for satellite control, autonomous satellite operations, astrodynamics, and modeling and simulation for space-based surveillance systems.
- (U) $10,726 Developed ground and small satellite integration technologies for space and near-space experiments such as MightySat and the Integrated Ground Demonstration Program.
- (U) $1,113 Developed technologies such as guidance, navigation, and control avionics to support launch vehicles and ballistic missile flights.
- (U) $5,779 Conducted Phase III of the Terabit fiber optic technology program.
- (U) $34,478 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A EXHIBIT)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**
	PROJECT **8809**

(U) FY 1999 ($ in Thousands):

- (U) $4,669 Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact, high efficiency solar power cells, lightweight batteries, and innovative power generation and storage concepts.
- (U) $4,589 Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression, multifunctional structures, and lightweight composite satellite and launch vehicle structures.
- (U) $1,889 Develop technologies for space-based payload subsystems such as advanced infrared sensors, advanced hardened focal plane detector arrays, and antenna architectures for Space-based Radar.
- (U) $3,661 Develop technologies for space-based payload components such as low power, high performance, radiation hardened electronic devices, micro-electo-mechanical systems (MEMS) devices, and advanced electronics packaging.
- (U) $1,831 Develop technologies for satellite control, autonomous satellite operations, and modeling and simulation for space-based surveillance systems.
- (U) $1,402 Develop satellite protection technologies such as space environmental effects mitigation and space debris prediction.
- (U) $9,548 Develop ground and small satellite integration technologies for space and near-space experiments.
- (U) $1,763 Develop microsatellite technologies and integrated microsatellite technology concepts for applications such as near-earth object inspection and collaborative microsatellite constellations.
- (U) $3,907 Conduct Phase III of the Terabit fiber optic technology program.
- (U) $716 Identified as a source for SBIR.
- (U) $33,975 Total

(U) FY 2000 ($ in Thousands):

- (U) $5,581 Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact, high efficiency solar power cells, lightweight batteries, and innovative power generation and storage concepts.
- (U) $5,787 Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression, multifunctional structures, and lightweight composite satellite and launch vehicle structures.
- (U) $2,395 Develop technologies for space-based payload subsystems such as advanced infrared sensors, advanced hardened focal plane detector arrays, and antenna architectures for Space-Based Radar.
- (U) $1,904 Develop hyperspectral imaging data exploitation methodologies for military remote sensing applications.
- (U) $4,426 Develop technologies for space-based payload components such as low power, high performance, radiation hardened electronic devices, MEMS devices, and advanced electronics packaging.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A EXHIBIT)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601F Phillips Laboratory Exploratory Development**
	PROJECT **8809**

– (U) $1,831 Develop technologies for satellite control, autonomous satellite operations, and modeling and simulation for space-based surveillance systems.
– (U) $3,275 Develop satellite protection technologies such as space debris prediction and threat warning/attack reporting.
– (U) $12,961 Develop ground and small satellite integration technologies for space and near-space experiments.
– (U) $3,822 Develop microsatellite technologies and integrated microsatellite technology concepts for applications such as near-earth object inspection and collaborative microsatellite constellations.
– (U) $41,982 Total

(U) FY 2001 ($ in Thousands):
– (U) $5,919 Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact, high efficiency solar power cells, lightweight batteries, and innovative power generation and storage concepts.
– (U) $5,562 Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression, multifunctional structures, and lightweight composite satellite and launch vehicle structures.
– (U) $3,434 Develop technologies for space-based payload subsystems such as advanced infrared sensors, advanced hardened focal plane detector arrays, and antenna architectures for Space-Based Radar.
– (U) $1,938 Develop hyperspectral imaging data exploitation methodologies for military remote sensing applications.
– (U) $5,815 Develop technologies for space-based payload components such as low power, high performance, radiation hardened electronic devices, micro-electo-mechanical systems (MEMS) devices, and advanced electronics packaging.
– (U) $1,713 Develop technologies for satellite control, autonomous satellite operations, and modeling and simulation for space-based surveillance systems.
– (U) $2,331 Develop satellite protection technologies such as threat warning/attack reporting.
– (U) $10,218 Develop ground and small satellite integration technologies for space and near-space experiments.
– (U) $9,968 Develop microsatellite technologies and integrated microsatellite technology concepts for applications such as near-earth object inspection and collaborative microsatellite constellations.
– (U) $46,898 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A EXHIBIT)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
	PROJECT 8809

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0602102F, Materials.
- (U) PE 0603302F, Space and Missile Rocket Propulsion.
- (U) PE 0603311F, Ballistic Missile Technology.
- (U) PE 0603401F, Advanced Spacecraft Technology.
- (U) PE 0603410F, Space Systems Environmental Interactions.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602602F Conventional Munitions

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	36,687	40,386	42,205	46,840	47,804	50,030	51,662	53,247	Continuing	Continuing
2068	Advanced Guidance Technology	15,173	16,465	14,403	18,089	18,718	20,245	20,562	19,314	Continuing	Continuing
2502	Ordnance Technology	21,514	23,921	27,802	28,751	29,086	29,785	31,100	33,933	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Applied Research program investigates, develops and establishes the technical feasibility and military utility of advanced guidance and ordnance technologies for conventional munitions. The program includes development of: (1) advanced guidance technologies, including seekers, navigation and control, signal and image processing/algorithms, and simulation assessments for low-cost precision adverse-weather autonomous seekers; and (2) conventional ordnance technologies, including warheads, fuzes, explosives, munition integration, and lethality and vulnerability assessments. Payoff from this program is increased warhead penetration effectiveness, enhanced blast and fragmentation weapons, precision fuze control for increased probability of target kill, and precision terminal guidance for improved weapon effectiveness, and the capability to increase weapon standoff range while operating in adverse weather conditions.

(U) B. Budget Activity Justification: This Program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	38,505	41,529	42,826	45,556	Cont
(U) Appropriated Value	40,772	41,529			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-1,780	-1,143			
b. SBIR	-517				
c. Omnibus/Other Above Threshold Reprogrammings	-1,356				
d. Below Threshold Reprogrammings	-432				
(U) Adjustments to Budget Year Since FY 1999 PB			-621	1,284	
(U) Current Budget Submit/FY 2000 PB	36,687	40,386	42,205	46,840	Cont

(U) Significant Program Changes: Not Applicable.

FY 1999: $658 identified as a source for SBIR.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602602F Conventional Munitions

PROJECT: 2068

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2068 Advanced Guidance Technology	15,173	16,465	14,403	18,089	18,718	20,245	20,562	19,314	Continuing	Continuing

(U) A. Mission Description: This Applied Research project investigates, develops, and evaluates conventional munition advanced guidance technologies to establish technical feasibility and military utility. This project includes development of advanced guidance, including terminal seekers, navigation and control, signal and image processing/algorithms, and assessments for digital six degree-of-freedom simulations. Project payoffs include: adverse-weather and "launch and leave" precision guidance capability; increased number of kills per sortie; increased aerospace vehicle survivability; improved reliability and affordability; reduced test costs; shorter development programs; and improved survivability and effectiveness of conventional weapons.

(U) FY 1998 ($ in Thousands):

- (U) $4,236 Investigated and developed advanced component technology for low-cost precision adverse-weather autonomous seekers that will allow increased standoff launch ranges, reduced pilot workload, and improved aerospace vehicle survivability.
- (U) $6,322 Investigated and developed advanced navigation and control technologies for current and future munitions that will decrease pilot workload and increase survivability.
- (U) $2,339 Investigated and developed advanced optical and digital processors and advanced target detection/classification/identification algorithms for autonomous seekers that will provide the basis for smart autonomous weapons that will decrease pilot workload and increase survivability.
- (U) $2,276 Investigated and developed detailed six degree of freedom and hardware-in-the-loop simulations and models for the analysis of guided munitions and their components to enable requirement studies, design iteration/evaluation, and experiment risk reduction. These advanced simulations will shorten development time, reduce development cost, and provide more effective munitions that will reduce cost per kill.
- (U) $15,173 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602602F Conventional Munitions / PROJECT: 2068

(U) FY 1999 ($ in Thousands):

- (U) $3,988 Investigate and develop advanced component technology for low-cost precision adverse-weather autonomous seekers that will allow increased standoff launch ranges, reduced pilot workload, and improved aerospace vehicle survivability.
- (U) $8,338 Investigate and develop advanced navigation and control technologies for current and future munitions that will decrease pilot workload and increase survivability.
- (U) $1,786 Investigate and develop advanced optical and digital processors and advanced target detection/classification/identification algorithms for autonomous seekers that will provide the basis for smart autonomous weapons that will decrease pilot workload and increase survivability.
- (U) $2,085 Investigate and develop detailed six degree of freedom and hardware-in-the-loop simulations and models for the analysis of guided munitions and their components to enable requirement studies, design iteration/evaluation, and experiment risk reduction. These advanced simulations will shorten development time, reduce development cost, and provide more effective munitions that will reduce cost per kill.
- (U) $268 Identified as a source for SBIR.
- (U) $16,465 Total

(U) FY 2000 ($ in Thousands):

- (U) $4,467 Investigate and develop advanced component technology for low-cost precision adverse-weather autonomous seekers that will allow increased standoff launch ranges, reduced pilot workload, and improved aerospace vehicle survivability.
- (U) $5,611 Investigate and develop advanced navigation and control technologies for current and future munitions that will decrease pilot workload and increase survivability.
- (U) $2,586 Investigate and develop advanced optical and digital processors and advanced target detection/classification/identification algorithms for autonomous seekers that will provide the basis for smart autonomous weapons that will decrease pilot workload and increase survivability.
- (U) $1,739 Investigate and develop detailed six degree of freedom and hardware-in-the-loop simulations and models for the analysis of guided munitions and their components to enable requirement studies, design iteration/evaluation, and experiment risk reduction. These advanced simulations will shorten development time, reduce development cost, and provide more effective munitions that will reduce cost per kill.
- (U) $14,403 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602602F Conventional Munitions
	PROJECT: 2068

(U) FY 2001 ($ in Thousands):

- (U) $5,099 Investigate and develop advanced component technology for low-cost precision adverse-weather autonomous seekers that will allow increased standoff launch ranges, reduced pilot workload, and improved aerospace vehicle survivability.
- (U) $7,586 Investigate and develop advanced navigation and control technologies for current and future munitions that will decrease pilot workload and increase survivability.
- (U) $2,578 Investigate and develop advanced optical and digital processors and advanced target detection/classification/identification algorithms for autonomous seekers that will provide the basis for smart autonomous weapons that will decrease pilot workload and increase survivability.
- (U) $2,826 Investigate and develop detailed six degree of freedom and hardware-in-the-loop simulations and models for the analysis of guided munitions and their components to enable requirement studies, design iteration/evaluation, and experiment risk reduction. These advanced simulations will shorten development time, reduce development cost, and provide more effective munitions that will reduce cost per kill.
- (U) $18,089 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603601F, Conventional Weapons Technology.
- (U) PE 0604314F, Advanced Medium Range Air-to-Air Missile.
- (U) PE 0604940D, Central Test and Evaluation Improvement Program.
- (U) PE 0604604F, Submunitions Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602602F Conventional Munitions	PROJECT: 2502

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2502 Ordnance Technology	21,514	23,921	27,802	28,751	29,086	29,785	31,100	33,933	Continuing	Continuing

(U) A. Mission Description: This Applied Research project investigates, develops, and evaluates technologies for advanced weapon dispensers, submunitions, safe and arm devices, fuzes, explosives, warheads for conventional weapons, and weapon airframe and carriage technology. It also assesses the lethality and effectiveness of current and planned conventional weapons technology programs and assesses the vulnerability of targets against which conventional weapons are designed. The payoffs include: improved storage capability and transportation safety of fully assembled weapons; improved non-nuclear warhead and fuze effectiveness; improved submunition dispensing; selectable multimode kill capability; low-cost airframe/subsystem components and structures; reduced aerospace vehicle/weapons drag and radar signature; and more thoroughly tested weapon systems and improved weapon lethality.

(U) FY 1998 ($ in Thousands):

- (U) $5,607 Investigated and developed high fidelity analytical tools including computational mechanics model for calculating weapons effects and assessing lethality and vulnerability. Quantified and characterized the coupling of destructive energy into the target, and the means to translate that information into advanced analytical methods for predicting weapon effectiveness. These tools will reduce development time and cost while providing more effective munitions to the Air Force.
- (U) $3,060 Investigated and developed new affordable explosives that provide higher performance and lower sensitivity for development of advanced munitions that will provide more effective munitions to the Air Force and reduce cost per kill.
- (U) $3,820 Investigated and developed advanced fuze, including safe and arm, technologies for current and future munitions that will reduce cost and provide increased weapons supportability, safety, and performance for the Air Force.
- (U) $3,467 Investigated and developed advanced weapon control and carriage technologies for integrated ordnance packages with enhanced lethality for current and future air-to-ground and agile air-to-air missiles that will provide increased accuracy, lethality, and loadout while improving aircrew survivability and decreasing pilot workload.
- (U) $5,560 Investigated and developed advanced warhead development technologies and advanced kill mechanisms to enhance munitions lethality that will allow reduced sortie rates and lower cost per kill.
- (U) $21,514 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602602F Conventional Munitions
	PROJECT: 2502

(U) FY 1999 ($ in Thousands):

- (U) $6,698 Investigate and develop high fidelity analytical tools including computational mechanics model for calculating weapons effects and assessing lethality and vulnerability. Quantify and characterize the coupling of destructive energy into the target, and the means to translate that information into advanced analytical methods for predicting weapon effectiveness. These tools will reduce development time and cost while providing more effective munitions to the Air Force.
- (U) $2,178 Investigate and develop new affordable explosives that provide higher performance and lower sensitivity for development of advanced munitions that will provide more effective munitions to the Air Force and reduce cost per kill.
- (U) $3,282 Investigate and develop fuze, and safe and arm technology for advanced munitions that will reduce cost and provide increased weapons supportability, safety, and performance for the Air Force.
- (U) $4,695 Investigate and develop advanced control and carriage technologies for integrated ordnance packages with enhanced lethality for current and future air-to-ground and agile air-to-air missiles that will provide increased accuracy, lethality, and loadout while improving aircrew survivability and decreasing pilot workload.
- (U) $6,678 Investigate and develop advanced warhead development technologies and advanced kill mechanisms to enhance munitions lethality that will allow reduced sortie rates and lower cost per kill.
- (U) $390 Identified as a source for SBIR.
- (U) $23,921 Total

(U) FY 2000 ($ in Thousands):

- (U) $6,625 Investigate and develop high fidelity analytical tools including computational mechanics model for calculating weapons effects and assessing lethality and vulnerability. Quantify and characterize the coupling of destructive energy into the target, and the means to translate that information into advanced analytical methods for predicting weapon effectiveness. These tools will reduce development time and cost while providing more effective munitions to the Air Force.
- (U) $2,452 Investigate and develop new affordable explosives that provide higher performance and lower sensitivity for development of advanced munitions that will provide more effective munitions to the Air Force and reduce cost per kill.
- (U) $4,125 Investigate and developed fuze, and safe and arm technology for advanced munitions that will reduce cost and provide increased weapons supportability, safety, and performance for the Air Force.
- (U) $8,603 Investigate and develop advanced control and carriage technologies for integrated ordnance packages with enhanced lethality for current and future air-to-ground and agile air-to-air missiles that will provide increased accuracy, lethality, and loadout while improving aircrew survivability and decreasing pilot workload.
- (U) $5,997 Investigate and develop advanced warhead development technologies and advanced kill mechanisms to enhance munitions lethality that will allow reduced sortie rates and lower cost per kill.
- (U) $27,802 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602602F Conventional Munitions — PROJECT: 2502

(U) FY 2001 ($ in Thousands):

- (U) $6,755 Investigate and develop high fidelity analytical tools including computational mechanics model for calculating weapons effects and assessing lethality and vulnerability. Quantify and characterize the coupling of destructive energy into the target, and the means to translate that information into advanced analytical methods for predicting weapon effectiveness. These tools will reduce development time and cost while providing more effective munitions to the Air Force.
- (U) $2,611 Investigate and develop new affordable explosives that provide higher performance and lower sensitivity for development of advanced munitions that will provide more effective munitions to the Air Force and reduce cost per kill.
- (U) $4,757 Investigate and develop fuze, and safe and arm technology for advanced munitions that will reduce cost and provide increased weapons supportability, safety, and performance for the Air Force.
- (U) $7,469 Investigate and develop advanced control and carriage technologies for integrated ordnance packages with enhanced lethality for current and future air-to-ground and agile air-to-air missiles that will provide increased accuracy, lethality, and loadout while improving aircrew survivability and decreasing pilot workload.
- (U) $7,159 Investigate and develop advanced warhead development technologies and advanced kill mechanisms to enhance munitions lethality that will allow reduced sortie rates and lower cost per kill.
- (U) $28,751 Total

B. Project Change Summary - Description of Significant Changes: Not Applicable

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603601F, Conventional Weapons Technology.
- (U) PE 0604314F, Advanced Medium Range Air-to-Air Missile.
- (U) PE 0604602F, Armament Ordnance Development.
- (U) PE 0604604F, Submunitions Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602702F Command,Control, and Communication (C3)

	COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	80,686	71,661	46,448	52,283	52,769	63,285	65,615	68,076	Continuing	Continuing
2338	Reliability Sciences Technology	8,191	0	0	0	0	0	0	0	0	Continuing
4506	Surveillance Technology	14,578	11,688	9,224	9,826	10,058	10,485	10,918	11,331	Continuing	Continuing
4519	Communications Technology	10,207	17,259	10,817	13,208	13,300	13,990	14,577	16,026	Continuing	Continuing
4594	Information Technology	14,302	9,549	14,235	14,699	15,331	15,568	15,827	15,941	Continuing	Continuing
4600	Electromagnetic Technology	18,866	13,518	0	0	0	0	0	0	Continuing	Continuing
5581	Command and Control (C2) Technology	14,542	19,647	12,172	14,550	14,080	23,242	24,293	24,778	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Project 2338, Reliability Sciences Technology,was eliminated beginning in FY 1999 due to higher Air Force priorities. Project 4600, Electromagnetic Technology, will be eliminated beginning in FY 2000 due to higher Air Force priorities.

(U) A. Mission Description: This Applied Research program is the primary source of new concepts, feasibility demonstrations, and advanced technology for Air Force Command, Control, and Communications (C3). Current developments include: improving effectiveness and survivability through secure communications; improving surveillance range and detection capabilities against low-observable threats and enemy electronic countermeasures; and improving the timeliness and quality of data acquisition for decision making. The program addresses five technology areas: surveillance; communications; information; electromagnetics; and command and control. Note: In FY 1999, Congress added $2.0 million for Protein-Based Memory and $5.0 million for a Cyber Security program.

(U) B. Budget Activity Justification: This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602702F Command,Control, and Communication (C3)**

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	84,545	65,175	54,146	52,826	Cont
(U) Appropriated Value	88,567	72,175			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-2,978	-514			
b. SBIR	-1,172				
c. Omnibus/Other Above Threshold Reprogrammings	-1,705				
d. Below Threshold Reprogrammings	-2,026				
(U) Adjustments to Budget Years Since FY 1999 PB			-7,698	-543	
(U) Current Budget Submit/FY 2000 PB	80,686	71,661	46,448	52,283	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $847 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 2338

COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2338 Reliability Sciences Technology	8,191	0	0	0	0	0	0	0	0	Continuing

(U) A. Mission Description: The Air Force requires technology which increases reliability and diagnostic capability for electronic devices and systems while assessing electromagnetic environmental performance. Payoffs are increased system availability and lower life cycle costs. This effort focuses on technology to identify and eliminate design and fabrication characteristics that result in poor reliability. It develops equipment and system reliability and diagnostic techniques to be applied in development of military systems with improved operational readiness and supportability. Areas of emphasis include electronic technology reliability assessment, diagnostic development and integration, design for reliability, and system design and operational assurance.

(U) FY 1998 ($ in Thousands):
- (U) $2,710 Developed electronic reliability techniques to evaluate new devices in an operational environment and recommend corrective action.
- (U) $2,600 Developed diagnostics technologies and integrated them into existing tools and techniques to address high-priority user requirements.
- (U) $2,881 Developed reliability system design process enhancements for improved Command, Control, and Communications (C3) devices.
- (U) $8,191 Total

(U) FY 1999: Not Applicable.

(U) FY 2000: Not Applicable.

(U) FY 2001: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 2338

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603617F, C3 Applications.
- (U) PE 0603726F, C3 Subsystem Integration.
- (U) PE 0603728F, Advanced Computing Technology.
- (U) PE 0603789F, C3 Advanced Development.
- (U) PE 0604609F, Reliability and Maintainability Technology Insertion Program.
- (U) PE 0708026F, Producibility, Reliability, Availability, and Maintainability.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602702F Command,Control, and Communication (C3)**
	PROJECT **4506**

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4506 Surveillance Technology	14,578	11,688	9,224	9,826	10,058	10,485	10,918	11,331	Continuing	Continuing

(U) A. Mission Description: The Air Force requires advanced surveillance technologies to improve the performance and reduce the cost of Air Force surveillance systems. Major Applied Research areas of interest include: low-observable surveillance; passive surveillance; information fusion; and advanced processing technologies. Technologies being developed include: advanced passive bistatic radar; spatial coordinate and time processing techniques; sensor and data fusion; and advanced signal processors.

(U) FY 1998 ($ in Thousands):

- (U) $6,110 Developed, tested, and demonstrated new high-speed signal processor processing technologies and algorithms (space and time) to enhance small target detection in a complex electromagnetic background.
- (U) $5,120 Developed and tested technologies and concepts for passive surveillance with emphasis on airborne unmanned aerial vehicle (UAV) platforms.
- (U) $2,753 Developed, tested, demonstrated, and assessed advanced multispectral/multisensor knowledge-based fusion techniques and artificial intelligence machines for enhanced target detection and tracking.
- (U) $595 Designed, developed, and tested ultrahigh frequency microwave electronics and optically controlled antenna array for radar applications.
- (U) $14,578 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,467 Develop and demonstrate sensor performance analysis and software for synthetic aperture radar and moving target indicator from airborne and space-based platforms in hostile (jamming) scenarios.
- (U) $2,880 Develop technologies and concepts for passive surveillance with emphasis on electronic support measures and airborne wideband bistatics for UAV platform applications.
- (U) $4,040 Develop, test, and demonstrate improved real-time multispectral and multisensor fusion techniques for enhanced air and space situational awareness. Implement measures of merit for advanced distributed fusion system evaluation.
- (U) $3,163 Design architecture for an affordable, scaleable, teraflop information processor and augment it to support rapid fusion processing.
- (U) $138 Identified as a source for SBIR.
- (U) $11,688 Total

	DATE **February 1999**
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602702F Command,Control, and Communication (C3)**

(U) FY 2000 ($ in Thousands):

- (U) $2,647 Continue to develop technologies and concepts for passive surveillance with emphasis on electronic support measures and advanced bistatic waveform and antenna designs for operation in severe clutter and jamming environments. Develop and evaluate space-based radar subsystem technologies and concepts.
- (U) $3,905 Demonstrate and assess operational algorithms processing massive global databases to produce improved real-time multispectral and multisensor data fusion, delivering an enhanced air and space situational picture. Complete development and demonstrate fusion quality measures validating enhanced performance.
- (U) $2,672 Complete design and implementation technologies for fully programmable, scaleable, affordable teraflop processors for real-time fusion and processing.
- (U) $9,224 Total

(U) FY 2001 ($ in Thousands):

- (U) $2,888 Continue to develop technologies and concepts for passive surveillance with emphasis on electronic support measures and bistatics for enhanced detection, tracking, and classification in severe clutter and jamming environments. Evaluate space-based radar subsystem concepts.
- (U) $4,214 Develop, test, and demonstrate fused and unfused data information sharing strategies enhancing common interfaces to a consistent battlespace knowledge.
- (U) $2,724 Demonstrate fully programmable, scaleable, affordable teraflop processors and algorithms for real-time fusion and processing.
- (U) $9,826 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603726F, C3 Subsystems Integration.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4506

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602702F Command,Control, and Communication (C3)**
	PROJECT **4519**

COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4519 Communications Technology	10,207	17,259	10,817	13,208	13,300	13,990	14,577	16,026	Continuing	Continuing

(U) A. Mission Description: The Air Force requires technologies that enable worldwide communications. The rapid build-up of U.S presence abroad, via rapid application of air power, requires assured connectivity providing reliable, responsive, affordable transfer of information using all available communications media. This program provides the technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques such as spread spectrum and adaptive null steering; lightweight antennas and phased array antennas; modular, programmable, low-cost radios; and Command, Control, and Communications (C3) across the electromagnetic and optical spectrums. It includes technologies for advanced processors and devices, advanced network protocols, artificial intelligent communications management and control, advanced algorithms, and enabling processing techniques.

(U) FY 1998 ($ in Thousands):

- (U) $3,340 Developed critical high frequency (HF) to super-high frequency (SHF) communications technologies employing on-board programmable devices, processing technologies, nulling algorithms, and monolithic microwave integrated circuits to provide survivable radios and transceivers.
- (U) $4,645 Developed technologies for improved security, survivability, timeliness, and reconstruction of communications networks between airborne and fiber optic networks that are commercially compatible.
- (U) $2,222 Developed advanced adaptive electronic and photonic processors and controllers, advanced network protocols, advanced artificial intelligence algorithms, and enabling adaptive signal processing technologies essential for robust, survivable, spread spectrum communications.
- (U) $10,207 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4519

(U) FY 1999 ($ in Thousands):

- (U) $3,414 Develop critical communications technologies (for imagery and video) employing programmable devices, processing technologies, and monolithic microwave integrated circuits to provide global connectivity to aerospace forces in the ultra-high frequency (UHF) and super-high frequency (SHF) spectrums. Analyze weight, cost, and drag for unmanned aerial vehicle (UAV) applications.
- (U) $4,576 Develop assurance of service and universal transaction service technologies for improved security, survivability, timeliness, and reconstruction of communications networks.
- (U) $3,188 Develop advanced communications signal processors, an advanced Smart Network protocol, advanced algorithms, and enabling processing technologies essential for survivable radio communications.
- (U) $5,877 Develop Defensive Information Warfare (DIW) tools and technologies (i.e., pathology and forensics to detect and countermeasure break-ins) to ensure information protection and security of sensitive and encrypted Air Force information systems.
- (U) $204 Identified as a source for SBIR.
- (U) $17,259 Total

(U) FY 2000 ($ in Thousands):

- (U) $3,700 Develop assurance of services and universal transaction services technologies for improved security, survivability, and timeliness in a global, seamless, distributed communications network employing wireless and wired links.
- (U) $5,078 Develop critical communications and signal processing technologies to provide adaptive, covert, anti-jam, and global connectivity to aerospace forces. Continue millimeter component development and the Smart Network Radio program.
- (U) $2,039 Develop DIW tools (Net Visualization) and technologies (attack indicators) to ensure information and database protection and security for Air Force communication and information systems.
- (U) $10,817 Total

(U) FY 2001 ($ in Thousands):

- (U) $4,400 Continue to develop assurance of service and universal transaction service technologies for improved security, survivability, and timeliness in a global, seamless, distributed communications network and global distributed information system.
- (U) $6,112 Continue to develop critical communications technologies to provide adaptive, covert, anti-jam, and global seamless military and commercial connectivity to aerospace forces. Develop stealth antennas and subsystems and continue efforts on Smart Network Radio.
- (U) $2,696 Develop DIW tools and technologies to ensure information protection using preemptive indicators, damage assessment, recovery, and security for Air Force information systems (normal and encrypted).
- (U) $13,208 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4519

(U)B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603726F, C3 Subsystem Integration.
- (U) PE 0603728F, Advanced Computing Technology.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602702F Command,Control, and Communication (C3)**
PROJECT **4594**	

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4594 Information Technology	14,302	9,549	14,235	14,699	15,331	15,568	15,827	15,941	Continuing	Continuing

(U) A. Mission Description: The Air Force requires technologies which improve and automate capabilities to process, manage, generate, fuse, exploit, interpret, and disseminate timely information. This project improves Global Awareness at all levels enabling warfighters to understand relevant military situations on a consistent basis with the precision needed to accomplish their missions. Global Awareness is achieved by exploiting information provided by other government agencies. The information is fused to support Dynamic Planning and Execution via the Global Information Exchange distribution system. Knowledge, information, and data are archived in the Global Information Base for continued use and historical analysis. The information technologies required to achieve this capability are developed under this project in an affordable manner and include appropriate access mechanisms for our coalition partners.

(U) FY 1998 ($ in Thousands):
- (U) $7,470 Developed processing technologies (including memories, sorting algorithms, and fusion and correlation displays) that improve information timeliness, reliability, and accessibility for applications such as non-cooperative combat target identification.
- (U) $2,231 Developed information data handling techniques to automatically and expertly extract event data from multimedia databases for prediction and awareness purposes.
- (U) $2,291 Developed sensor exploitation techniques for faster and more efficient imaging to support planning, targeting, damage assessment, and mission execution.
- (U) $2,310 Developed protein-based optical memories for high-density, high-throughput mass storage systems of the future.
- (U) $14,302 Total

(U) FY 1999 ($ in Thousands):
- (U) $1,867 Develop information exploitation capabilities for imagery and electromagnetic signals. Develop technology to transition the capability to tag targets in space and sort large volumes of communications in direct support of information superiority for global engagement.
- (U) $3,824 Develop information warehousing and protein storage and retrieval technologies to provide timely warfighter access to a complete multimedia, multidimensional suite of Command, Control, Communications, Computers, and Intelligence information.
- (U) $1,920 Develop technologies for real-time and stored data fusion to support target identification, dynamic planning, and weapons engagement.
- (U) $1,825 Develop advanced technologies and approaches for the acquisition, analysis, and timely dissemination of intelligence information.
- (U) $113 Identified as a source for SBIR.
- (U) $9,549 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4594

(U) FY 2000 ($ in Thousands):

- (U) $4,552 Automate multisensor and multimedia technologies to automatically detect and track targets using radiated signals across the entire spectrum for precision location and identification.
- (U) $4,500 Develop innovative multisensor collaboration system to fuse events in time and space, to locate and identify objects, and to project future behavior for spaceborne systems in a fully distributed fusion environment.
- (U) $5,183 Develop Global Information Base technologies for global, theater, and local situation awareness providing timely and accurate input to dynamic planning and execution operations.
- (U)$14,235 Total

(U) FY 2001 ($ in Thousands):

- (U) $4,800 Continue to develop multisensor, multimedia analytical techniques to automatically detect and track the presence and location of targets, and demonstrate improvements in decision-making execution resulting from the integration of these capabilities. Evaluate advanced information extraction capabilities for seamless integration into the Global Information Base.
- (U) $4,818 Develop and evaluate innovative multisensor collaborative fusion technologies addressing surface, airborne, and spaceborne systems in a fully distributed environment.
- (U) $5,081 Develop, evaluate, and demonstrate Global Information Base technology concepts that employ multiple levels of abstraction, providing timely and accurate input to dynamic planning and execution operations in response to dynamically changing requirements and guidance.
- (U)$14,699 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603726F, C3 Subsystem Integration.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

	DATE **February 1999**
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602702F Command,Control, and Communication (C3)**

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602702F Command,Control, and Communication (C3)**
	PROJECT **4600**

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4600 Electromagnetic Technology	18,866	13,518	0	0	0	0	0	0	Continuing	Continuing

(U) A. Mission Description: This project consists of three subset technologies: electromagnetics; solid state sciences; and photonics. Future surveillance, communications, and imagery/information processing systems will require improved technology for the generation, control, processing, and radiation of electromagnetic and optical energy to reduce system cost, improve system sensitivity, and increase processing rates. Promising technologies for improving Command, Control, and Communications (C3) systems are electromagnetic propagation and scattering (from targets and clutter), and monolithic microwave and millimeter-wave integrated components and antennas. This project develops: a technology base for electronic and photonic devices and device materials for C3 systems; optical technology for electronic data processing and storage; real-time target recognition and high-speed fiber optic interconnects; and control techniques for large phased array antennas. It also characterizes phenomena for low-observable surveillance.

(U) FY 1998 ($ in Thousands):
- (U) $6,010 Developed electromagnetic technologies, such as digital beamforming and phased array correction algorithms, for advanced surveillance and communications systems applications.
- (U) $4,016 Developed advanced materials and components capable of higher processing speeds at reduced power levels for telecommunications and survivable server applications.
- (U) $8,840 Developed photonic components and related materials for insertion into core Command, Control, and Communications (C3) programs to increase efficiencies and reduce costs.
- (U) $18,866 Total

(U) FY 1999 ($ in Thousands):
- (U) $4,616 Demonstrate digital beam nulling techniques and new computer codes for advanced surveillance and communications systems applications. (In FY 2000, this effort will be conducted under Project 7622, PE 0602204F.)
- (U) $1,177 Develop advanced electromagnetic materials and components capable of higher processing speeds for sensing and communications applications.
- (U) $5,748 Develop photonic sub-systems and components for control and processing of both data and radio frequency signals.
- (U) $1,817 Develop advanced concepts for electromagnetic apertures. (In FY 2000, this effort will be conducted under Project 7622, PE 0602204F.)
- (U) $160 Identified as a source for SBIR.
- (U) $13,518 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 4600

(U) FY 2000 ($ in Thousands): Not Applicable.

(U) FY 2001 ($ in Thousands): Not Applicable.

(U) B. Project Change Summary - Description of Significant Changes: : Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603617F, C3 Applications.
- (U) PE 0603726F, C3 Subsystem Integration.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602702F Command,Control, and Communication (C3)**
	PROJECT **5581**

COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
[5581] Command and Control (C2) Technology	14,542	19,647	12,172	14,550	14,080	23,242	24,293	24,778	Continuing	Continuing

(U) A. Mission Description: The Air Force requires Command and Control (C2) technologies which provide the next generation of weapon systems with improved processing and presentation of information for real-time battle management. Technologies being developed in this project will increase capability, quality, and reliability while reducing the cost of computer resources in C2 systems. Work in this project focuses on developing advanced C2 computer software systems capable of providing vast improvements in military decision making. These include collaborative intelligent agent, planning, and scheduling technologies. The project develops technology for distributed systems, data bases, and fault tolerance mechanisms; and knowledge-based technologies, systems, and data bases.

(U) FY 1998 ($ in Thousands):

- (U) $4,862 Developed intelligent information technologies for real-time battle management and command and control including full-dialog man-machine interface.
- (U) $4,760 Developed software technologies to support modeling and analysis of evolvable software and parallel processing systems.
- (U) $4,920 Developed enabling technology for distributed computing and database technology using cluster techniques.
-
- (U) $14,542 Total

(U) FY 1999 ($ in Thousands):

- (U) $7,128 Develop intelligent information technologies including preplan-to-react planning technology for noncontinuous planning and tools and techniques for collaborative intelligent systems.
- (U) $6,139 Develop architecture-centered technology that provides easier-to-design and easier-to-maintain software for increased capability, quality, and reliability with reduced support cost.
- (U) $6,148 Develop distributed computing and database technology including collaborative workspaces shared across a distributed computing environment and optical storage multimedia database management systems.
- (U) $232 Identified as a source for SBIR.
- (U) $19,647 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602702F Command,Control, and Communication (C3)
	PROJECT 5581

(U) FY 2000 ($ in Thousands):

- (U) $5,816 Develop intelligent information technologies including planning technology for coalition Command and Control (C2).
- (U) $1,046 Develop high performance knowledge base technology for coordination and cooperative use of aerospace C2 resources.
- (U) $5,310 Investigate, analyze, and develop intelligent information management and user interface systems that tailor visualization strategies, information, access, and assurance mechanisms based on C2 application parameters.
- (U) $12,172 Total

(U) FY 2001 ($ in Thousands):

- (U) $6,263 Demonstrate intelligent information technologies for real-time battle management and C2 for time-critical air operations, including collaborative systems and agents.
- (U) $1,963 Continue to develop high performance knowledge base technology for coordination and cooperative use of aerospace C2 resources.
- (U) $6,324 Investigate, analyze, and develop reconfiguration mechanisms to adapt an intelligent information system to varying crisis levels based on quality of service parameters.
- (U) $14,550 Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603617F, C3 Applications.
- (U) PE 0603728F, Advanced Computing Technology.
- (U) PE 0603789F, C3 Advanced Development.
- (U) PE 0303401F, Communications-Computer Systems (C-CS) Security RDT&E.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602805F Dual Use Science & Technology

PROJECT: 4770

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4770 Dual Use Science and Technology (S&T)	0	9,961	17,927	17,841	17,735	17,726	18,095	18,472	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Applied Research program allows the Air Force to leverage industry investments in advanced technologies that are mutually advantageous to both the Air Force and industry. One of the program's goals is to incorporate dual use technology as part of the standard Air Force Science and Technology (S&T) way of doing business. A key component of the program is the cost sharing requirement from both industry and laboratory which affirms commitment to the development effort. Specific projects are determined through annual competitive solicitation(s). Another goal is to utilize FY 1997 Defense Authorization Act Section 804, Other Transactions Authority, as part of the Dual Use S&T program in order to educate the Air Force S&T workforce in non-traditional or commercial contracting practices. Dual use technology was previously funded by the Defense Advanced Research Projects Agency (DARPA), first under the Technology Reinvestment Program (TRP) (FY 1993-96) and then under the Dual Use Application Program (DUAP) (FY 1997-98). In FY 1997, the decision was made to begin transferring responsibility for DUAP from DARPA to the Services Dual Use programs. The two existing DUAP efforts, Dual Use S&T (DU S&T) and Commercial Operations and Support Savings Initiative (COSSI), were split and transferred into Service 6.2 and 6.4 PEs, respectively. This PE is the DU S&T effort for the Air Force. Note: In FY 1999, Congress reduced this program by $9.6 million which explains the perceived increase in FY 2000 and out.

(U) FY 1998: Not Applicable.

(U) FY 1999 ($ in Thousands):

- (U) $2,000 Develop air vehicle technologies that extend the life and improve the performance of both Air Force and commercial fixed wing air vehicles. Areas of research include improving flight control, lightweight structures, common electronics, and vehicle subsystems.
- (U) $2,556 Develop information technologies that improve the capability of both aerospace command and control, and commercial communications and awareness. Areas of research include intelligent information systems, communication systems, information fusion, and collaborative environment development.
- (U) $5,069 Develop space technologies that will reduce the cost and improve the capability of both Air Force and commercial space vehicles and launch systems. Areas of research include improved space vehicle survivability, space vehicle control, and space-based sensing.
- (U) $336 Identified as a source for SBIR.
- (U) $9,961 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602805F Dual Use Science & Technology / PROJECT: 4770

(U) FY 2000 ($ in Thousands):

- (U) $8,000 Develop air vehicle technologies that extend the life and improve the performance of both Air Force and commercial fixed wing air vehicles. Areas of research include improving flight control, lightweight structures, common electronics, and vehicle subsystems.
- (U) $5,000 Develop information technologies that improve the capability of both aerospace command and control, and commercial communications and awareness. Areas of research include intelligent information systems, communication systems, information fusion, and collaborative environment development.
- (U) $4,927 Develop space technologies that will reduce the cost and improve the capability of both Air Force and commercial space vehicles and launch systems. Areas of research include improved space vehicle survivability, space vehicle control, and space-based sensing.
- (U) $17,927 Total

(U) FY 2001 ($ in Thousands):

- (U) $8,500 Develop air vehicle technologies that extend the life and improve the performance of both Air Force and commercial fixed wing air vehicles. Areas of research include improving flight control, lightweight structures, common electronics, and vehicle subsystems.
- (U) $4,500 Develop information technologies that improve the capability of both aerospace command and control, and commercial communications and awareness. Areas of research include intelligent information systems, communication systems, information fusion, and collaborative environment development.
- (U) $4,841 Develop space technologies that will reduce the cost and improve the capability of both Air Force and commercial space vehicles and launch systems. Areas of research include improved space vehicle survivability, space vehicle control, and space-based sensing.
- (U) $17,841 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602805F Dual Use Science & Technology	PROJECT: 4770

(U) B. Budget Activity Justification: This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revoultionary technologies.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	0	19,606	18,253	18,180	Cont
(U) Appropriated Value	0	10,000			0
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions		-39			
b. SBIR					
c. Omnibus/Other Above Threshold Reprogrammings					
d. Below Threshold Reprogrammings					
(U) Adjustments to Budget Year Since FY 1999 PB			-326	-339	
(U) Current Budget Submit/FY 2000 PB	0	9,961	17,927	17,841	Cont

FY 1999: $336 identified as a source for SBIR.

(U) D. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) E. Other Program Funding Summary:

(U) Related Activities:

- (U) This project will be coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) F. Aquisition Strategy: Not Applicable.

(U) G. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603106F Logistics Systems Technology

PROJECT: 2745

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2745 Logistics Performance and Support Technology	14,115	9,069	10,786	14,015	15,603	15,566	16,270	12,876	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

NOTE: Beginning in FY 1999, three projects (Project 2745, Logistics for Contingency Operations and Weapons Systems Support; Project 2940, Technology for Design and Maintenance; and Project 2950, Improved Logistics and Maintenance Performance) were combined into a single project (Project 2745, Logistics Performance and Support Technology). The total project costs for Project 2745 reflect this consolidation.

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates cost-effective technologies to improve the design, performance, and support of current and future weapon systems. This effort also develops technology to incorporate human operator, maintenance, and support considerations into the weapon systems design process and to make engineering, product support, and maintenance data electronically available throughout weapon systems' life cycles. The program provides more realistic logistics planning and combat capability assessment tools, provides technologies to reduce deployment airlift and footprint requirements, improves logistics information command and control and asset visibility, provides critical logistics risk reduction technology, and helps control total weapon systems' life cycle costs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology
	PROJECT 2745

(U) FY 1998 ($ in Thousands):

- (U) $ 2,612 Developed and demonstrated technologies to enable/streamline aircraft maintenance processes. Field tested, documented, and transitioned technologies to repair composite and low-observable materials in battle and accident damaged aircraft. Continued development of electronic technical data, software, and algorithms to support the automated assessment of aircraft battle damage. Gathered baseline assessment performance data, and completed initial field test of damage assessment using paper technical orders.
- (U) $ 4,462 Developed and demonstrated tools and technologies to maximize efficiency and effectiveness of Air Force operational deployments. Developed, tested, documented, and transitioned technologies to enhance rapid logistics contingency planning, deployments, and operations. Transitioned specific planning tools to support deployment planning and airlift reduction, and to support beddown planning and operations. Began development of deployable capability to process waste materials generated in deployed operation to environmentally safe state and minimize requirements to return hazardous waste to continental U.S. Fully defined system concept for next generation highly reliable, reconfigurable, and easily deployable multi-function, modular support equipment.
- (U) $ 5,443 Developed and demonstrated analytical tools to improve efficiency of Air Force depot maintenance operations and logistics information systems. Transitioned analytical tool suites to improve the efficiency and affordability of organic depot maintenance processes and the interaction between depots and their customers at the operational wings.
- (U) $ 1,598 Completed, demonstrated, and transitioned analysis tools to ensure tight correlation between specific operational user requirements and systems acquisition, repair, and modification. Completed and transitioned advanced computer-based air vehicle maintainability assessment tools using high fidelity human models and maintenance task simulations to ensure designed-in supportability of fielded weapon systems.
- (U) $14,115 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology
	PROJECT 2745

(U) FY 1999 ($ in Thousands):

- (U) $2,196 Develop, demonstrate, and transition technologies to enable/streamline aircraft maintenance processes by continuing development of electronic technical data, algorithms, and software to support automated assessment of battle damaged aircraft. Field test with trained aircraft damage assessors.
- (U) $4,668 Develop and demonstrate tools and technologies to maximize efficiency and effectiveness of Air Force operational deployments by continuing to develop technologies for next generation, multi-function, modular support equipment that are highly reliable, reconfigurable, and easily deployable. Continue to develop and field test technologies to enhance rapid contingency planning, deployments, and operations. Begin development of technology to provide wing commanders/senior logisticians with advanced information and management capabilities.
- (U) $1,453 Develop and demonstrate analytical tools by defining artificial intelligence requirements to improve efficiency of Air Force depot maintenance operations and logistics information systems.
- (U) $ 504 Investigate technologies to demonstrate the feasibility of downloading aircraft status information anytime during a flight (Passive Aircraft Status System).
- (U) $ 248 Identified as a source for SBIR.
- (U) $9,069 Total

(U) FY 2000 ($ in Thousands):

- (U) $ 1,036 Develop and demonstrate technologies to enable/streamline aircraft maintenance processes by beginning development of diagnostics capability to provide technicians with more effective tools for isolating faults on the software intensive, reconfigurable systems found on modern aircraft and advanced aircraft systems currently in development.
- (U) $ 6,568 Develop and demonstrate tools and technologies to maximize efficiency and effectiveness of Air Force operational deployments by continuing development of technology to provide wing commanders/senior logisticians with advanced information and management capabilities, including rapid access to real-time resources status information, proactive problem identification, decision support, and process tracking. Begin development of technology to provide enhanced capability for units to manage logistics resources for deployed operations including identification of deployment support requirements, management of waste, medical and non-medical equipment, and deployment processes. Demonstrate agile/lean deployment capability, reduced airlift requirements, and reduced on-site footprint using highly-reliable, modular, multi-function support equipment for flightline maintenance.
- (U) $ 3,182 Develop and demonstrate analytical tools by using intelligent software agents and realistic human behavior models to improve the logistics aspects and operational fidelity of large-scale synthetic environments and wargames.
- (U) $10,786 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology PROJECT 2745

(U) FY 2001 ($ in Thousands):

- (U) $ 1,210 Develop and demonstrate technologies to enable/streamline aircraft maintenance processes by continuing development of diagnostics capability to provide technicians with more effective tools for isolating faults on the software intensive, reconfigurable systems found on modern aircraft and advanced aircraft systems currently in development.
- (U) $ 7,438 Develop and demonstrate tools and technologies to maximize efficiency and effectiveness of Air Force operational deployments by continuing development of technology to provide enhanced capability for units to manage logistics resources for deployed operations including identification of deployment support requirements, management of waste, medical and non-medical equipment, and deployment processes. Continue development of technology to provide wing commanders/senior logisticians with advanced information and management capabilities, including rapid access to real-time resources status information, proactive problem identification, decision support, and process tracking. Define requirements for advanced material handling equipment and software tools which will significantly streamline cargo handling and on-load/off-load operations at aerial ports and at deployed locations.
- (U) $ 3,763 Continue development of advanced modeling and simulation technologies to improve the operational fidelity and logistics representation in large-scale synthetic environments and wargames. Research and develop high leverage, high-payoff technology concepts to improve the supportability of space-based assets and ground support segments of space operations.
- (U) $ 1,604 Develop tools and methods that automatically generate maintenance information and the associated maintenance/repair manuals directly from design, engineering, and supportability analysis data.
- (U) $14,015 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology
	PROJECT 2745

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates cost-effective technologies to improve the design, performance, and support of current and future weapon systems.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	14,502	8,677	7,883	10,381	Cont
(U) Appropriated Value	15,338	9,177			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-502	-108			
b. SBIR	-345				
c. Omnibus/Other Above Threshold Reprogrammings	-99				
d. Below Threshold Reprogrammings	-277				
(U) Adjustments to Budget Year Since FY 1999 PB			2,903	3,634	
(U) Current Budget Submit/FY 2000 PB	14,115	9,069	10,786	14,015	Cont

(U) Significant Program Changes: The adjustments in FY 2000 and FY 2001 are due to increased Air Force emphasis on cognitive and logistics modeling and for agile support for the Expeditionary Aerospace Forces initiative.

FY 1999: $248 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603106F Logistics Systems Technology
	PROJECT 2745

(U) D. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0207219F, Advanced Tactical Fighter.
- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602202F, Human Effectiveness Applied Research.
- (U) PE 0603721N, Integrated Diagnostic System.
- (U) PE 0604708F, Generic Integrated Maintenance Diagnostics Systems.
- (U) PE 0604740F, Computer Resource Management Technology.
- (U) PE 0605801A, Pollution Prevention Research and Development.
- (U) PE 0708011F, Manufacturing Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) E. Acquisition Strategy: Not Applicable.

(U) F. Schedule Profile: Not Applicable.

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

DATE: **February 1999**

BUDGET ACTIVITY: **3 - Advanced Technology Development**

PE NUMBER AND TITLE: **0603108F Integrated Data Systems (IDS)**

PROJECT: **4427**

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4427 Integrated Maintenance Data Systems (IMDS)	19,660	0*	0*	0*	0*	0*	0*	0*	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

* FY 99 and outyear funding resides within PE 0708611F, Project 4654. Following FY 98, all funds for IMDS reside within PE 0708611F. All backup and justification material associated with this program is located within that PE.

(U) A. Mission Description :

The IMDS program is an evolutionary acquisition program that is developing an Air Force standard maintenance information system. This program element integrates information systems supporting Air Force maintenance activities into a single open architecture, modern decision support system. This enhanced decision support system increases operational production capability and support system efficiency, while decreasing mobility infrastructure requirements and cost of operations. The IMDS System will be integrated with the Global Combat Support System-Air Force (GCSS-AF) Program. IMDS provides a single virtual data repository for access by all Air Force command levels. Full IMDS capability is reached through multiple increments of the application software, each increment building on the previous one. The first increment entered test at Eglin AFB July 97 after one year of development. The second increment was delevered in July 98. Operatioanl Test wholesale-level functionality as well as continued expansion of retail capabilities.

(U) FY 1998 ($ in Thousands):

- (U) $ 16,947 IMDS system contract Increment 2 - Base level system interfaces and Beta site support.
- (U) $ 1,275 IMDS system contract Increment 3 - Requirements definition activities.
- (U) $ 1,226 Support Contractors (MITRE, TELCOLOTE, TEMS).
- (U) $ 212 SPO Operations
- (U) $ 19,660 Total

(U) FY 1999 ($ in Thousands):

- (U) $ 0 Funding resides within PE 0708611F. See description for PE 0708611F, Project 4654

(U) FY 2000 ($ in Thousands):

- (U) $ 0 Funding resides within PE 0708611F. See description for PE 0708611F, Project 4654

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603108F Integrated Data Systems (IDS)
	PROJECT 4427

(U) FY 2001 ($ in Thousands):

– (U) $ 0 Funding resides within PE 0708611F. See description for PE 0708611F, Project 4654

(U) B. Budget Activity Justification

This program is Budget Activity 3, Advanced Technology Development.

(U) C. Program Change Summary ($ in Thousands)

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget FY 1999 PB	18,541	0	0	0	Continuing
(U) Appropriated Value	19,753				
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-760				
b. SBIR	-461				
c. Omnibus or Other Above Threshold Reprogramming	-148				
d. Below Threshold Reprogramming	1,276				
(U) Adjustments to Budget Years Since FY 1999 PB					
(U) Current Budget Submit/FY 2000 PB	19,660	0	0	0	Continuing

(U) Significant Program Changes:

$1.276 million in FY 98 funds were added to cover additional beta development costs resulting from the Base Realignment and Closure (BRAC) activity. FY 99 and outyear funding resides within PE 0708611F, Project 4654. Following FY 98, all funds for IMDS reside within PE 0708611F. All backup and justification material associated with this program is located within that PE.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603108F Integrated Data Systems (IDS) / PROJECT: 4427

(U) D. Other Program Funding Summary ($ in Thousands)

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	To Compl	Total Cost
(U) Other Procurement AF, BA 7, P-1:55, IMDS (PE 0708611F)	1,299	956	2,681	2,646	2,646	2,605	2,660	2,720	Cont	Cont
Related RDT&E:										
(U) PE 0708611F, Project 4654, Integrated Maintenance Data System (IMDS)	0	18,645	18,632	24,806	25,607	24,514	25,025	25,546	Cont	Cont

(U) E. Acquisition Strategy:

All major contracts within this Program Element were awarded after full and open competition.

(U) F. Schedule Profile

See description for PE 0708611F, Project 4654.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems

	COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	25,826	32,900	25,890	25,702	23,971	25,219	25,928	27,144	Continuing	Continuing
2100	Laser Hardened Materials	9,205	10,959	11,242	11,260	11,675	11,947	12,197	12,451	Continuing	Continuing
3153	Non-Destructive Inspection Development	6,383	4,492	4,352	3,890	4,038	4,412	4,759	5,108	Continuing	Continuing
3946	Materials Transition	10,238	17,449	10,296	10,552	8,258	8,860	8,972	9,585	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program demonstrates materials technology options for application into Air Force weapon systems. Developing materials technologies for the broadband laser protection of aircrews and sensors from a variety of threats is a high priority of the Air Force. The Non-Destructive Inspection/Evaluation (NDI/E) techniques for fighter, bomber, and transport aircraft are critical to the logistics centers as well as the operational fleet as the service lives of these systems increase. This program provides critical data for prospective users to make engineering decisions on both structural and non-structural materials for air and space. Reducing risk in materials technology improves the affordability, supportability, reliability, survivability, and operational performance of current and future warfighting systems. Note: In FY 1999, Congress added $3.0 million for the Aerospace Metals Program, $5.0 million for the National Center for Industrial Competitiveness, and $4.0 million for advanced low-observable coatings which explains the perceived decrease in FY 2000 and out.

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603112F Advanced Materials for Weapon Systems**

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	26,503	21,006	22,629	22,792	Cont
(U) Appropriated Value	28,096	33,006			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-952	-106			
b. SBIR	-565				
c. Omnibus/Other Above Threshold Reprogrammings	-181				
d. Below Threshold Reprogrammings	-572				
(U) Adjustments to Budget Year Since FY 1999 PB			3,261	2,910	
(U) Current Budget Submit/FY 2000 PB	25,826	32,900	25,890	25,702	Cont

(U) Significant Program Changes: The adjustments in FY 2000 and FY 2001 reflect increased emphasis on implementation of Integrated Product Process Development (IPPD) and support of Air Expeditionary Force (AEF) operations.

FY1999: $977 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603112F Advanced Materials for Weapon Systems**
	PROJECT **2100**

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2100 Laser Hardened Materials	9,205	10,959	11,242	11,260	11,675	11,947	12,197	12,451	Continuing	Continuing

(U) A. Mission Description: This project develops new materials and concepts for protecting Air Force assets such as aircrews, munitions, sensors, and structures against laser radiation. The goal is to ensure mission capability before, during, and after laser exposure. The world laser market is rapidly expanding with easy export to any nation. Survivability solutions must account for a variety of lasers facing a mission. Current protection schemes are activated by intensity or color and are only capable of countering a specific portion of the laser threat. To harden systems against all potential lasers, a combination of approaches is required. Concepts are demonstrated to provide hardening options for transition to Air Force systems.

(U) FY 1998 ($ in Thousands):
- (U) $1,360 Developed and demonstrated advanced materials technologies that enhance laser hardening of Air Force aircraft and spacecraft structures to ensure safety, survivability, and operability in a laser threat environment.
- (U) $3,914 Developed and demonstrated advanced materials technologies that enhance laser hardening for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in a laser threat environment.
- (U) $3,931 Developed and demonstrated advanced materials technologies that enhance laser hardening for sensors, avionics, and components to increase survivability and mission effectiveness of electronic systems.
- (U) $9,205 Total

(U) FY 1999 ($ in Thousands):
- (U) $1,563 Develop and demonstrate advanced materials technologies that enhance laser hardening of Air Force aircraft and spacecraft structures to ensure safety, survivability, and operability in a laser threat environment.
- (U) $4,563 Develop and demonstrate advanced materials technologies that enhance laser hardening for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in a laser threat environment.
- (U) $4,507 Develop and demonstrate advanced materials technologies that enhance laser hardening for sensors, avionics, and components to increase survivability and mission effectiveness of electronic systems.
- (U) $326 Identified as a source for SBIR.
- (U) $10,959 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603112F Advanced Materials for Weapon Systems**
	PROJECT **2100**

(U) FY 2000 ($ in Thousands):

- (U) $1,654 Develop and demonstrate advanced materials technologies that enhance laser hardening of Air Force aircraft and spacecraft structures to ensure safety, survivability, and operability in a laser threat environment.
- (U) $4,823 Develop and demonstrate advanced materials technologies that enhance laser hardening for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in a laser threat environment.
- (U) $4,765 Develop and demonstrate advanced materials technologies that enhance laser hardening for sensors, avionics, and components to increase survivability and mission effectiveness of electronic systems.
- (U) $11,242 Total

(U) FY 2001 ($ in Thousands):

- (U) $1,656 Develop and demonstrate advanced materials technologies that enhance laser hardening of Air Force aircraft and spacecraft structures to ensure safety, survivability, and operability in a laser threat environment.
- (U) $4,832 Develop and demonstrate advanced materials technologies that enhance laser hardening for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in a laser threat environment.
- (U) $4,772 Develop and demonstrate advanced materials technologies that enhance laser hardening for sensors, avionics, and components to increase survivability and mission effectiveness of electronic systems.
- (U) $11,260 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems
	PROJECT 2100

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602102F, Materials.
- (U) PE 0602202F, Human Effectiveness Applied Research.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0604706F, Life Support System.
- (U) Coordinated through the Tri-Service Laser Hardening Materials and Structures Working Group and the Joint Service Agile Laser Eye Protection Program.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems

PROJECT: 3153

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3153 Non-Destructive Inspection Development	6,383	4,492	4,352	3,890	4,038	4,412	4,759	5,108	Continuing	Continuing

(U) A. Mission Description: Develops and demonstrates advanced Non-Destructive Inspection/Evaluation (NDI/E) methods and procedures to monitor performance integrity and to detect failure causing conditions in weapon systems components and materials. NDI/E capabilities greatly influence and/or limit many designs, manufacturing, and maintenance practices. Reduction in the number of fighter wings and the need for rapid sortie generation demand an ability to perform real-time NDI/Es faster than current capability. This project provides technology to satisfy critical Air Force requirements to extend lifetimes of current systems through increased reliability and cost-effectiveness at field and depot maintenance levels, as well as assuring manufacturing quality, integrity, and safety requirements.

(U) FY 1998 ($ in Thousands):

- (U) $5,385 Developed advanced technologies for improved capabilities in materials corrosion and fatigue monitoring and testing of aging aircraft to reduce operation and maintenance costs and to guarantee full operability and safety of the aircraft fleet.
- (U) $320 Developed advanced inspection technologies supporting low-observable and space systems to enhance affordability and ensure full performance and survivability of low-observable systems and rapid turnaround of space systems.
- (U) $678 Developed advanced technologies for improved NDI/E capabilities in materials and process testing, monitoring, inspection, and maintenance to reduce cost and increase reliability of advanced materials.
- (U) $6,383 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,939 Develop advanced technologies for improved capabilities in materials corrosion and fatigue monitoring and testing of aging aircraft to reduce operation and maintenance costs and to guarantee full operability and safety of the aircraft fleet.
- (U) $592 Develop advanced inspection technologies supporting low-observable and space systems to enhance affordability and ensure full performance and survivability of low-observable systems and rapid turnaround of space systems.
- (U) $828 Develop advanced technologies for improved NDI/E capabilities in materials and process testing, monitoring, inspection, and maintenance to reduce cost and increase reliability of advanced materials.
- (U) $133 Identified as a source for SBIR.
- (U) $4,492 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems PROJECT 3153

(U) FY 2000 ($ in Thousands):

- (U) $1,560 Develop advanced technologies for improved capabilities in materials corrosion and fatigue monitoring and testing of aging aircraft to reduce operation and maintenance costs and to guarantee full operability and safety of the aircraft fleet.
- (U) $2,170 Develop advanced inspection technologies supporting low-observable and space systems to enhance affordability and ensure full performance and survivability of low-observable systems and rapid turnaround of space systems.
- (U) $622 Develop advanced technologies for improved Non-Destructive Inspection/Evaluation (NDI/E) capabilities in materials and process testing, monitoring, inspection, and maintenance to reduce cost and increase reliability of advanced materials.
- (U) $4,352 Total

(U) FY 2001 ($ in Thousands):

- (U) $1,439 Develop advanced technologies for improved capabilities in materials corrosion and fatigue monitoring and testing of aging aircraft to reduce operation and maintenance costs and to guarantee full operability and safety of the aircraft fleet.
- (U) $1,849 Develop advanced inspection technologies supporting low-observable and space systems to enhance affordability and ensure full performance and survivability of low-observable systems and rapid turnaround of space systems.
- (U) $602 Develop advanced technologies for improved NDI/E capabilities in materials and process testing, monitoring, inspection, and maintenance to reduce cost and increase reliability of advanced materials.
- (U) $3,890 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems

PROJECT: 3946

COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3946 Materials Transition	10,238	17,449	10,296	10,552	8,258	8,860	8,972	9,585	Continuing	Continuing

(U) A. Mission Description: Develops data to accelerate the time to scale-up new defense-related materials and achieve their acceptance by designers. The goal is to reduce risk, improve confidence, and reduce cost of the incorporation of new materials into weapons, airframes, engines, and space applications. Advanced materials and related processes that have matured beyond applied research are characterized and critical data is developed to reduce the risk of demonstrating these technologies in Air Force applications. Critical evaluations of materials in the proposed design environment are performed. This design and scale-up data provides confidence to transition new materials to upgrades and future Air Force systems as well as provide the initial incentive for their industrial development.

(U) FY 1998 ($ in Thousands):
- (U) $6,897 Developed technologies and databases to facilitate timely transition of advanced structures, propulsion, and subsystems materials to warfighters, industry, and academia.
- (U) $2,924 Developed technologies and databases to facilitate timely transition of advanced materials for high power radars, space-based sensors, and infrared countermeasure materials to warfighters, industry, and academia.
- (U) $417 Developed technologies and databases to facilitate timely transition of advanced materials for improved systems support and operational support to warfighters, industry, and academia.
- (U) $10,238 Total

(U) FY 1999 ($ in Thousands):
- (U) $13,634 Develop technologies and databases to facilitate timely transition of advanced structures, propulsion, and subsystems materials to warfighters, industry, and academia.
- (U) $2,879 Develop technologies and databases to facilitate timely transition of advanced materials for high power radars, space-based sensors, and infrared countermeasures to warfighters, industry, and academia.
- (U) $418 Develop technologies and databases to facilitate timely transition of advanced materials for improved systems support and operational support to warfighters, industry, and academia.
- (U) $518 Identified as a source for SBIR.
- (U) $17,449 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems
	PROJECT 3946

(U) FY 2000 ($ in Thousands):

- (U) $1,356 Develop advanced materials technologies for air vehicles and subsystems to enhance lift, propulsion, and low-observable performance and affordability of manned and unmanned air vehicles.
- (U) $3,486 Develop advanced materials technologies for space vehicles and subsystems to provide enhanced surveillance and sensing capabilities and improved access to space.
- (U) $1,408 Develop advanced materials technologies that enhance sustainability of Air Force air and space systems to lower operations and maintenance costs and to ensure full operability and safety of aircraft and personnel.
- (U) $1,156 Develop methods, processes, and technologies that support the continued implementation of Integrated Product Process Development (IPPD) concepts into the Science and Technology (S&T) environment by expanding education and training across a large Air Force scientist and engineer population.
- (U) $2,890 Develop technologies (i.e., utilities and shelters) that improve air mobile systems performance and reduce airlift requirements in support of Air Expeditionary Force (AEF) operations.
- (U) $10,296 Total

(U) FY 2001 ($ in Thousands):

- (U) $1,376 Develop advanced materials technologies for air vehicles and subsystems to enhance lift, propulsion, and low-observable performance and affordability of manned and unmanned air vehicles.
- (U) $3,656 Develop advanced materials technologies for space vehicles and subsystems to provide enhanced surveillance and sensing capabilities and improved access to space.
- (U) $1,494 Develop advanced materials technologies that enhance sustainability of Air Force air and space systems to lower operations and maintenance costs and to ensure full operability and safety of aircraft and personnel.
- (U) $1,156 Develop methods, processes, and technologies that support the continued implementation of IPPD concepts into the S&T environment by expanding education and training across a large Air Force scientist and engineer population.
- (U) $2,870 Develop technologies (i.e., utilities and shelters) that improve air mobile systems performance and reduce airlift requirements in support of AEF operations.
- (U) $10,552 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems
	PROJECT 3946

(U) (U) B. Project Change Summary - Description of Significant Changes: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603202F, Aerospace Propulsion Subsystem Integration.
- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems
	PROJECT 3946

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603202F Aerospace Propulsion Subsystem Integration

PROJECT: 668A

COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
668A Aircraft Propulsion Subsystem Integration	22,253	27,722	29,825	31,022	25,495	20,027	13,766	14,197	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates gas turbine propulsion system technologies applicable to a broad range of aircraft. The Aircraft Propulsion Subsystem Integration (APSI) program includes demonstrator engines such as the Joint Technology Demonstrator Engine (JTDE) for manned systems and the Joint Expendable Turbine Engine Concept (JETEC) for uninhabited air vehicle and cruise missile applications. These demonstrator engines apply the core technology developed under the Advanced Turbine Engine Gas Generator (ATEGG) program coupled with affordable and durable system component technology such as low pressure fans and low pressure turbines (LPT), engine controls, and nozzles developed as part of APSI. This program also focuses on system integration aspects of inlets, nozzles, engine/airframe compatibility, and low-observable technologies. APSI will provide aircraft with potential for longer range and higher cruise speed with lower specific fuel consumption; surge power for successful engagements; high sortie rates with reduced maintenance; reduced life cycle cost; and improved survivability resulting in increased mission effectiveness. The APSI program supports the demonstration of performance, cost, and durability goals of the Integrated High Performance Turbine Engine Technology (IHPTET) program. IHPTET is a three phase, totally integrated DOD, Defense Advanced Research Projects Agency (DARPA), National Aeronautics and Space Administration (NASA), and industry initiative focused on doubling turbine engine propulsion capabilities while reducing cost of ownership. The IHPTET program structure provides continuous technology transition for military turbine engine upgrades and derivatives and has the added benefit of enhancing the U.S. turbine engine industry's international competitiveness.

(U) FY 1998 ($ in Thousands):

- (U) $4,733 Designed, fabricated, and demonstrated durability and integration technology for turbofan/turbojet engines for improved supportability and affordability of current and future Air Force aircraft.
- (U) $13,606 Designed, fabricated, and tested technology demonstration engines for improved performance and fuel consumption of turbofan/turbojet engines for fighters, aircraft, bombers, and transports.
- (U) $3,914 Designed, fabricated, and tested technology demonstration engines for improved performance, durability, and affordability of engines for missile and uninhabited air vehicle applications.
- (U) $22,253 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603202F Aerospace Propulsion Subsystem Integration
	PROJECT 668A

(U) FY 1999 ($ in Thousands):

- (U) $3,613 Design, fabricate, and demonstrate controls technology for turbofan/turbojet engines for improved performance and reduced maintenance of current and future Air Force aircraft.
- (U) $8,830 Design, fabricate, and demonstrate durability and integration technology for turbofan/turbojet engines for improved supportability and affordability of current and future Air Force aircraft.
- (U) $9,848 Design, fabricate, and test technology demonstration engines for improved performance and fuel consumption of turbofan/turbojet engines for fighters, aircraft, bombers, and transports.
- (U) $4,551 Design, fabricate, and test technology demonstration engines for improved performance, durability, and affordability of engines for missile and uninhabited air vehicle applications.
- (U) $880 Indentified as a source for SBIR.
- (U) $27,722 Total

(U) FY 2000 ($ in Thousands):

- (U) $4,350 Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines for improved supportability and affordability of current and future Air Force aircraft.
- (U) $20,864 Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines for fighters, aircraft, bombers, and transports.
- (U) $4,611 Design, fabricate, and test advanced component technologies for improved performance, durability, and affordability of engines for missile and uninhabited air vehicle applications.
- (U) $29,825 Total

(U) FY 2001 ($ in Thousands):

- (U) $5,522 Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines for improved supportability and affordability of current and future Air Force aircraft.
- (U) $19,896 Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines for fighters, aircraft, bombers, and transports.
- (U) $5,604 Design, fabricate, and test advanced component technologies for improved performance, durability, and affordability of engines for missile and uninhabited air vehicle applications.
- (U) $31,022 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603202F Aerospace Propulsion Subsystem Integration
	PROJECT 668A

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	23,378	30,814	31,616	32,620	Cont
(U) Appropriated Value	24,785	27,814			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-810	-92			
b. SBIR	-611				
c. Omnibus/Other Above Threshold Reprogrammings	-159				
d. Below Threshold Reprogrammings	-952				
(U) Adjustments to Budget Years Since FY 1999 PB			-1,791	-1,598	
(U) Current Budget Submit/FY 2000 PB	22,253	27,722	29,825	31,022	Cont

(U) (U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $880 indentified as a source for SBIR.

(U) D. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) PE 0602122N, Aircraft Technology.
- (U) PE 0603217N, Air Systems Advanced Technology Demonstration.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603202F Aerospace Propulsion Subsystem Integration
	PROJECT 668A

(U) E. Acquisition Strategy: Not Applicable.

(U) F. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	23,944	28,534	29,405	32,330	33,587	31,561	30,209	31,749	Continuing	Continuing
665A	Advanced Aerospace Sensors Technology	11,316	13,481	15,070	17,249	18,033	15,012	13,286	14,495	Continuing	Continuing
69CK	Advanced Electronics	1,114	1,562	815	952	1,430	2,080	2,084	2,088	Continuing	Continuing
69DF	Target Attack and Recognition Technology	11,514	13,491	13,520	14,129	14,124	14,469	14,839	15,166	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program develops technology to enable continued sensors superiority from space and aerial platforms. Combat aircraft must defeat increasingly sophisticated active and passive countermeasures, destroy a wide variety of targets with precision under a myriad of environmental conditions, and reliably perform complex missions with less logistics support in a world of proliferating threats. This program responds to these needs by developing and demonstrating the means to find, fix, target track and engage air and ground targets, anytime, anywhere, and in any weather. Specifically, this program develops the aerospace radio frequency sensors (i.e., radar) and electro-optical sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets, whether those targets are obscured by natural or man-made means, while providing the capability to adapt to changes in target signatures and background environments. These advanced sensor capabilities will provide for flexible, multi-function/multi-mission combat aircraft that can: safely penetrate threat areas; destroy multiple ground targets per pass; accurately detect and identify targets beyond-visual-range within a complex mix of look-alike friendly, neutral, and enemy aircraft; win aerial engagements; and return to fight again. Note: In FY 1999, Congress added $2.2 million for the Enhanced Recognition and Sensing Ladar (ERASER) program.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	25,077	26,442	25,148	26,269	Cont
(U) Appropriated Value	26,507	28,642			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-879	-108			
b. SBIR	-571				
c. Omnibus/Other Above Threshold Reprogrammings	-170				
d. Below Threshold Reprogrammings	-943				
(U) Adjustments to Budget Year Since FY1999 PB			4,257	6,061	
(U) Current Budget Submit/FY 2000 PB	23,944	28,534	29,405	32,330	Cont

(U) Significant Program Changes: Outyears reflect program redirection to increase development of space-based sensor technology.

FY 1999: $780 identified as a source for SBIR.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors

PROJECT: 665A

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
665A Advanced Aerospace Sensors Technology	11,316	13,481	15,070	17,249	18,033	15,012	13,286	14,495	Continuing	Continuing

(U) A. Mission Description: Develops and demonstrates aerospace sensor technologies for manned and umanned platforms, including electro-optical (EO) sensors, radars, and electronic counter-countermeasures (ECCM) for radars. This project will provide warfighters with the capability to precisely detect and target both airborne targets (conventional and low radar cross section) and ground-based, high-value, time-critical targets from air and space-based platforms. Work includes developing both complete sensor capabilities as well as advanced component technologies. The desired warfighting capability includes the ability to detect and target in difficult background conditions, with emphasis on countering improvements in camouflage, concealment, and deception techniques that limit current detection and tracking capability for threats obscured by these means. Note: In FY 1999, Congress added $2.2 million for Enhanced Recognition and Sensing Ladar (ERASER) technologies.

(U) FY 1998 ($ in Thousands):

- (U) $2,194 Developed integrated air-to-air and air-to-ground EO sensor technologies to detect, locate, and identify targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. This included design of a day/night multispectral sensor and initiation of a multinational program for affordable precision targeting at standoff ranges.
- (U) $2,326 Developed airborne, air-to-ground wind profiling technologies to enhance accuracy of bomb drops and cargo delivery, including demonstration of a modular wind profiler and designing a wind sensor.
- (U) $1,241 Developed and demonstrated radar ECCM techniques to negate air intercept and synthetic aperture radar electronic countermeasures, including development of concepts for using neural nets to counter jamming.
- (U) $2,945 Developed processing techniques to negate clutter and electromagnetic interference, both intentional and unintentional, for uninterrupted sensor performance and increased detection and targeting performance against sophisticated and low radar cross section targets, including refinement and demonstration of adaptive processing techniques for improving radar performance under severe jamming.
- (U) $1,117 Developed and demonstrated the radio frequency sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques, including a joint Air Force/Army/Defense Advanced Projects Research Agency demonstration of real-time automated detection algorithms for unmanned aerial vehicle-sized radars.
- (U) $1,493 Developed critical components required to lower life cycle cost of current and future radar systems, including flight tests of an advanced air platform antenna for precision weapon delivery.
- (U) $11,316 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors
	PROJECT 665A

(U) FY 1999 ($ in Thousands):

- (U) $3,953 Develop integrated electro-optical (EO) sensor technologies to detect, locate, and identify targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. This includes fabricating an EO sensor that operates in day or night across multiple bands.
- (U) $1,482 Develop and demonstrate radar electronic counter-countermeasure techniques to negate air intercept and synthetic aperture radar electronic countermeasures, including assessing use of neural nets to identify and remove jamming waveforms.
- (U) $3,543 Develop processing techniques to negate clutter and electromagnetic interference, for uninterrupted sensor performance and increased detection and targeting performance against sophisticated and low radar cross section targets, including conducting laboratory and rooftop demonstrations of advanced mitigation techniques for severe interference and jamming environments.
- (U) $3,253 Develop the radio frequency (RF) sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deception, including ground testing real-time image formation/interference mitigation for foliage penetrating synthetic aperture radars.
- (U) $882 Develop critical components required to lower life cycle cost of current and future radar systems, including flight testing an affordable antenna suitable for unmanned vehicles.
- (U) $368 Identified as a source for SBIR.
- (U) $13,481 Total

(U) FY 2000 ($ in Thousands):

- (U) $1,700 Develop integrated electro-optical (EO) sensor technologies to detect, locate, and identify targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. This includes completing fabrication and initiating flight test of an EO sensor that operates in day or night across multiple bands.
- (U) $4,587 Develop EO sensor technologies to detect and locate deep hide targets from high altitudes and space, including collecting infrared sensor model validation data, conducting space sensor trade studies, and creating hyperspectral imaging/fusion algorithms.
- (U) $2,204 Develop radar signal processing techniques to negate clutter and interference and improve detection and tracking of difficult targets, including developing adaptive processing for fighter detection of low-observable targets, demonstrating improved radar performance via enhanced antenna implementation, and developing integrated processing methods for improved ground target detection and tracking.
- (U) $3,419 Develop RF sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or obscured by deceptive techniques, including flight testing image formation processing and automatic target detection.
- (U) $1,576 Develop technology to lower life cycle costs of radar systems, including laboratory testing low-cost digital receivers and sensor components, evaluating space-based apertures using micro-electro-mechanical systems phase shifters, and demonstrating a millimeter wave array for high-altitude unmanned aerial vehicles.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors
	PROJECT 665A

- (U) $1,584 Develop technology for non-cooperative target identification, including building high resolution algorithms, validating models, flight testing sensor hardware, and evaluating laser vibration as a solution to target identification.
- (U) $15,070 Total

(U) FY 2001 ($ in Thousands):

- (U) $5,715 Develop EO sensor technologies to detect and locate deep hide targets from high altitudes and space, including completing infrared sensor model validation data collection, analyzing sensor performance, completing space sensor trade studies, and testing hyperspectral imaging and fusion algorithms.
- (U) $2,908 Develop radar signal processing techniques to negate clutter and interference and improve difficult target detection and tracking, including flight testing use of adaptive processing for detecting slow moving targets in presence of jamming, developing techniques using highly integrated avionics systems, and developing advanced processing methods.
- (U) $3,797 Develop and demonstrate the radio frequency sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques, including completing flight tests of real-time image formation and automatic target detection algorithms.
- (U) $1,090 Develop technology to lower life cycle costs of radar systems, including field testing low-cost, lightweight, low-power, micro-electro-mechanical system-based apertures.
- (U) $2,180 Develop technology for non-cooperative target identification, including designing a sensor for transition risk reduction, testing high resolution algorithms, analyzing sensor suite utility, and flight testing a sensor suite.
- (U) $1,559 Develop, with international partners, the EO sensor technology needed to integrate wide-area search with non-cooperative identification for automated standoff surveillance, identification, and targeting, including designing and fabricating flight-worthy hyperspectral sensor and laser identification channels and optimizing sensor suite trade studies.
- (U) $17,249 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors
	PROJECT 665A

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0603205F, Flight Vehicle Technology.
- (U) PE 0603707F, Weather Systems Advanced Development.
- (U) PE 062111N, Weapons Technology.
- (U) PE 062232N, Space and Electronic Warfare (SEW) Technology.
- (U) PE 0604249F, LANTIRN Night Precision Attack.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) A memorandum of agreement has been established between the Air Force Research Laboratory and the Defense Advanced Research Projects Agency (DARPA) to jointly develop the technology required to detect high-value, time-critical targets in a variety of environments including deception, camouflage, concealment, and deep hide.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors / PROJECT: 69CK

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
69CK Advanced Electronics	1,114	1,562	815	952	1,430	2,080	2,084	2,088	Continuing	Continuing

(U) A. Mission Description: Develops and demonstrates military specific microwave, microelectronic, and photonic devices, tools, and components that improve performance, reliability, and affordability of aerospace radar, communications, and electronic counter-countermeasure systems for both retrofit and new system applications. Results provide the warfighter with increased sensor capabilities in terms of increased situational awareness, higher accuracy detection and tracking of targets/threats at longer ranges, and more precise weapon employment. This project develops electronics technologies unavailable from commercial sources and includes development of: aerospace radar monolithic solid state transmit/receive modules; high-speed analog-to-digital converters; photonic processing techniques, high reliability electronics power distribution; microwave/microelectronics packaging and interconnect techniques; and radio frequency (RF) photonic distribution subsystems.

(U) FY 1998 ($ in Thousands):

- (U) $423 Developed advanced microelectronics components, power distribution, packaging, and interconnect technologies to reduce power consumption, cost, weight, and volume of emerging military systems. Efforts included demonstration of inorganic coatings for encapsulating microcircuits and development of advanced power supplies for multi-function phased array radars.
- (U) $445 Developed advanced multi-function sensor electronics, such as integrated analog/digital applications, to increase reliability, improve performance, and decrease avionics cost, weight, and volume. This included optimization of very high-speed digital assemblies, development of packaging technologies for minimum size transmit/receive modules, and demonstration of a miniature analog/digital microwave receiver.
- (U) $246 Developed advanced design automation tools and methods for creating complex electronics/avionics. These tools will significantly lower the development cost and subsequent support costs of all electronic systems, including demonstrating the speed of automated design tools.
- (U) $1,114 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,519 Develop advanced multi-function sensor electronics, including integrated analog/digital applications, to increase reliability, improve performance and jam resistance, and decrease cost, weight, and volume in aerospace sensors. Efforts include continued development of very high-speed digital assemblies, fabricating and testing high performance RF/digital multichip assemblies and completing preliminary designs for miniature, all-digital microwave receiver components.
- (U) $43 Identified as a source for SBIR.
- (U) $1,562 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors
	PROJECT 69CK

(U) FY 2000 ($ in Thousands):

- (U) $458 Develop advanced multi-function sensor electronics, including continued development of affordable, high performance radio frequency (RF) circuits and packaging technologies for use in phased array transmit/receive modules on manned and unmanned platforms.
- (U) $357 Perform application trade studies for space-based photonics RF signal distribution, including photonic beamforming for Global Positioning System (GPS) applications.
- (U) $815 Total

(U) FY 2001 ($ in Thousands):

- (U) $525 Develop advanced multi-function sensor electronics, including low-cost multi-chip module/sub array coating approaches. Demonstrate affordable, high performance RF circuits and packaging technologies for use in phased array transmit/receive modules on manned and unmanned platforms.
- (U) $237 Develop analog, digital, and microwave/millimeter wave photonics technology for compact, affordable, optically-controlled RF aerospace applications, including designing dynamically reconfigurable RF signal distribution components, and demonstrating photonic components for wide bandwidth, high-throughput optical processing.
- (U) $190 Develop high performance RF phased array antenna controls for extremely wide angle coverage, including testing and integrating a photonics true-time-delay processor and fabricating and testing an anti-jam GPS antenna. (In FY 2000, this effort was conducted under PE 0603726F, Project 2863.)
- (U) $952 Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) PE 0603739E, Electronic Manufacturing Technology.
- (U) PE 0603706E, Microwave/Millimeter Wave Integrated Circuits.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors

PROJECT: 69DF

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
69DF Target Attack and Recognition Technology	11,514	13,491	13,520	14,129	14,124	14,469	14,839	15,166	Continuing	Continuing

(U) A. Mission Description: Develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition. This includes developing and demonstrating integrated and cooperative fire control techniques to provide for adverse-weather precision air strikes against multiple targets per pass at maximum weapon launch range. Specific fire control technologies include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. These fire control developments will provide force multiplication and reduce exposure to hostile fire. This project also develops and demonstrates technologies for positive, high confidence cueing, recognition, and identification of airborne and ground-based, high-value, time-critical targets at ranges compatible with tactical air-to-air and air-to-surface weapons in all weather, day or night, and in high-threat, multiple target battle areas. Model-based vision algorithms and target signature development techniques are key to target identification and recognition and are pursued in this project in partnership with the Defense Advanced Research Projects Agency. The techniques developed are evaluated to support the Theater Missile Defense efforts in surveillance and attack. The fire control and recognition technologies developed and demonstrated in this project are high leverage, providing for significant advancements in operational capabilities largely through software improvements readily transitioned to new and existing systems.

(U) FY 1998 ($ in Thousands):

- (U) $3,607 Developed and demonstrated advanced air-to-air detection, tracking, identification, and engagement technologies, including transition of synthetic signature generation capability for hostile airborne target identification, investigation of advanced sensor suites using off-board sources, development of a preliminary design for all-aspect fire control, and completion of ground-to-air testing of combined radar modes.
- (U) $2,225 Developed advanced situation awareness technologies to increase air-to-ground engagement lethality and survivability, including design of a real-time information out of the cockpit approach to improve battle damage assessment, demonstration of embedded multi-source fusion of electronic intelligence and synthetic aperture radar data, and development of a concept for real-time embedded multi-source fusion.
- (U) $5,682 Developed and demonstrated innovative air-to-ground Automatic Target Recognition (ATR) and identification technologies to increase capacity to detect, identify, and target hostile ground forces, including development and integration of ATR/fusion design testbed, evaluation of use of current algorithms for longer timelines of reconnaissance platform radars, measurement of the performance of air-to-ground ATR algorithms using enhanced radar with third generation forward looking infrared and multispectral ATR, and completion of a critical design for modifications to a fire control radar for advanced identification of ground forces.
- (U) $11,514 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,563 Develop and demonstrate advanced air-to-air detection, tracking, identification, and engagement technologies, including continuing to investigate advanced sensors suites, and analyzing ground test data for target identification through combined radar modes.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors
	PROJECT 69DF

- (U) $6,663 Develop advanced situation awareness technologies to increase air-to-ground engagement lethality and survivability, including continuing to demonstrate multisource fusion of electronic intelligence with synthetic aperture radar (SAR), flight demonstrating real-time rerouting of an low-observable platform using real-time information in the cockpit (RTIC) technology, and developing and flight testing fusion of forward looking infrared and SAR data on an interdiction fighter.
- (U) $4,896 Develop and demonstrate innovative air-to-ground Automatic Target Recognition (ATR) and identification technologies to increase the ability to detect, identify, and target hostile ground forces, including continuing to develop and integrate an ATR/fusion algorithm testbed, downselecting and integrating an optimal algorithm for longer timelines of reconnaissance radars, performing detailed analysis of air-to-ground ATR algorithms using enhanced radar with third generation forward looking infrared and multispectral ATR and demonstrating the identification of friendly and hostile ground forces.
- (U) $369 Identified as a source for SBIR.
- (U) $13,491 Total

(U) FY 2000 ($ in Thousands):

- (U) $2,699 Develop advanced situation awareness technologies for rapid detection, location, and prosecution of time-critical targets, including demonstrating ground station fusion of SAR and signals intelligence and developing on-board/off-board data and image fusion algorithms.
- (U) $2,947 Develop and demonstrate RTIC technologies, including continuing to flight demonstrate and simulate real-time route replanning and retargeting for stealth strike platforms and developing real-time retargeting algorithms for special operation forces.
- (U) $1,577 Develop and evaluate radar ATR algorithms for tracking moving ground targets, including evaluating radar algorithms for tracking moving ground targets and reducing transition risk by planning affordable upgrades to strike and reconnaissance platforms.
- (U) $ 1,214 Develop target recognition concepts using hyperspectral imaging and other candidate sensor inputs to determine requirements for ATR and target/background phenomenology efforts, including building algorithms using hyperspectral imaging data.
- (U) $3,004 Test and integrate Defense Advanced Research Projects Agency multi-sensor ATR fusion algorithms into the Air Force ATR evaluation test facility for application to Air Force intelligence, surveillance, and reconnaissance functions.
- (U) $2,079 Develop advanced tactical targeting technology in conjunction with Defense Advanced Research Projects Agency (DARPA) for suppression of enemy air defenses, including hardware-in-the-loop testing against threat radio frequency (RF) signals.
- (U) $13,520 Total

(U) FY 2001 ($ in Thousands):

- (U) $2,131 Develop advanced situation awareness technologies for rapid detection, location, and prosecution of time-critical targets, including demonstrating algorithms for fusion of on- and off-board data and images.
- (U) $1,900 Develop and demonstrate real-time information in the cockpit (RTIC) technologies, including completing RTIC simulations and continuing to develop real-time retargeting algorithms for special operation forces applications.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors
	PROJECT 69DF

- (U) $2,329 Demonstrate and laboratory test algorithms for tracking moving ground targets, emphasizing risk reduction for transition via planned sensor upgrades to strike and reconnaissance platforms.
- (U) $1,664 Develop target recognition concepts using hyperspectral imaging and other candidate sensor inputs to determine requirements for automatic target recognition (ATR) and target/background phenomenology efforts, including evaluating algorithms using hyperspectral imaging data.
- (U) $2,618 Continue testing and integrating Defense Advanced Research Projects Agency multi-sensor automatic target recognition fusion algorithms into the Air Force ATR evaluation test facility for application to Air Force intelligence, surveillance, and reconnaissance functions.
- (U) $300 Develop technology to evaluate advanced air-to-air fire control and tracking algorithms, including performing sensor-to-shooter trade studies.
- (U) $3,187 Develop advanced tactical targeting technology in conjunction with DARPA for suppression of enemy air defenses, including ground demonstration of brassboard units that triangulate threat emitter position and provide targeting for precision guided munitions.
- (U) $14,129 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0603253F, Advanced Sensor Integration.
- (U) PE 0603726E, Sensor and Guidance Technology
- (U) Theater Missile Defense System Program Office.
- (U) Low Altitude Night Targeting and Infrared Navigation (LANTIRN) System Program Office.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603205F Flight Vehicle Technology

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	4,998	7,007	5,992	4,258	521	440	0	0	Continuing	Continuing
2978 Flight Vehicle Technologies	3,806	5,151	4,624	3,585	277	270	0	0	Continuing	Continuing
4398 Air Base Technology	1,192	1,856	1,368	673	244	170	0	0	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: This program element (PE) will be eliminated in FY 2004 and the ongoing technical programs will be transferred to PEs 0603245F, Flight Vehicle Technology Integration, and 0603112F, Advanced Materials for Weapon Systems.

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates advanced aerospace vehicle subsystems, aerodynamic/flight controls, and vehicle-pilot interface technologies for improved aerospace vehicle performance, decreased vulnerability, and reduced logistics support. This program also demonstrates technologies for fixed and bare base assets, including airfield pavements, energy systems, air base survivability, air base recovery, protective systems, fire protection, and crash rescue.

(U) B. Budget Activity Justification This program is in the Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing aerospace vehicle system upgrades and/or new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	5,441	7,035	7,476	7,043	Cont
(U) Appropriated Value	5,766	7,035			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-188	-28			
b. SBIR	-140				
c. Omnibus/Other Above Threshold Reprogrammings	-37				
d. Below Threshold Reprogrammings	-403				
(U) Adjustments to Budget Year Since FY 1999 PB			-1,484	-2,785	
(U) Current Budget Submit/FY 2000 PB	4,998	7,007	5,992	4,258	Cont.

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $212 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology	PROJECT 2978

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2978 Flight Vehicle Technologies	3,806	5,151	4,624	3,585	277	270	0	0	Continuing	Continuing

(U) A. Mission Description: This program designs, develops, and demonstrates manned and unmanned aerospace vehicle technologies for improved performance, reliability, maintainability, and supportability while increasing affordability, and mission effectiveness. It is focused on exploiting advancements in aerospace vehicle component and subsystem technologies, aerodynamic/flight control technologies, and vehicle-pilot integration technologies.

(U) FY 1998 ($ in Thousands):
- (U) $2,313 Developed real-time flight attack replanning technologies to enhance high priority target kill. Provides on-board software for automatic in-flight mission replanning for the foundation of future technology developments for aerospace vehicles.
- (U) $462 Developed software for multiple ship integrated control strategies to enable the safe and effective cooperative employment of manned and unmanned strike vehicles for air combat operations.
- (U) $1,031 Developed and demonstrated advanced integrated aerospace vehicle subsystems which included flight worthy electric stabilator to provide increased performance and decreased vulnerability while decreasing both cost and supportability requirements.
- (U) $3,806 Total

(U) FY 1999 ($ in Thousands):
- (U) $2,205 Develop technologies for automatic in-flight replanning for the cockpit to reduce pilot workload. These benefits will be seen in future aerospace vehicle designs and technologies.
- (U) $1,023 Develop algorithms for multiple ship integrated control strategies to enable the safe and effective cooperative employment of manned and unmanned strike aerospace vehicles for air combat operations.
- (U) $1,767 Develop advanced integrated aerospace vehicle subsystems to provide increased performance and decreased vulnerability while decreasing both cost and logistic supportability requirements. Fabricate flight critical stabilator actuator to demonstrate operational and military utility.
- (U) $156 Identified as a source for SBIR.
- (U) $5,151 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology
	PROJECT 2978

(U) FY 2000 ($ in Thousands):
- (U) $2,209 Develop technologies for automatic in-flight replanning for the cockpit to reduce pilot workload. These benefits will be seen in future aerospace vehicle designs and technologies.
- (U) $854 Develop algorithms for multiple ship integrated control strategies to enable the safe and effective cooperative employment of manned and unmanned strike aerospace vehicles for air combat operations.
- (U) $1,561 Develop advanced integrated aerospace vehicle subsystems to provide increased performance and decreased vulnerability while decreasing both cost and logistic supportability requirements. Continue flight critical stabilator actuator test to demonstrate operational and military utility.
- (U) $4,624 Total

(U) FY 2001 ($ in Thousands):
- (U) $1,649 Develop technologies for automatic in-flight re-planning for the cockpit to reduce pilot workload. These benefits will be seen in future aerospace vehicle designs and technologies.
- (U) $694 Develop algorithms for multiple ship integrated control strategies to enable the safe and effective cooperative employment of manned and unmanned strike aerospace vehicles for air combat operations.
- (U) $1,242 Develop advanced integrated aerospace vehicle subsystems to provide increased performance and decreased vulnerability while decreasing both cost and logistic supportability requirements. Continue flight critical stabilator actuator test to demonstrate operational and military utility.
- (U) $3,585 Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0603216F, Aerospace Propulsion and Power.
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology PROJECT 4398

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4398 Air Base Technology	1,192	1,856	1,368	673	244	170	0	0	Continuing	Continuing

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

(U) FY 1998 ($ in Thousands):
- (U) $992 Developed and demonstrated aircraft and air base fire fighting technologies including environmentally-safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems.
- (U) $200 Developed and demonstrated advanced shelter hardening techniques to protect existing air base buildings and assets to support Air Expeditionary Force (AEF) operations
- (U) $1,192 Total

(U) FY 1999 ($ in Thousands):
- (U) $624 Develop aircraft and air base fire fighting and power generation technologies including clean environmentally safe fire fighting agents, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems.
- (U) $1,013 Develop technologies, utilities, and shelters that improve air base operations. These technologies include completion of the acoustic cycle heat pump that reduces airlift requirements in support of AEF operations rapid deployment.
- (U) $163 Construct an air transportable shelter advanced development model for field testing to support AEF operations rapid deployment.
- (U) $56 Identified as a source for SBIR.
- (U) $1,856 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology
PROJECT 4398	

(U) FY 2000 ($ in Thousands):

- (U) $528 Develop aircraft and air base fire fighting and power generation technologies including clean environmentally safe fire fighting agents, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems.
- (U) $727 Develop technologies, utilities, and shelters that improve air base operations. These technologies include completion of the acoustic cycle heat pump that reduces airlift requirements in support of Air Expeditionary Force (AEF) operations rapid deployment.
- (U) $113 Construct an air transportable shelter advanced development model for field testing to support AEF operations.
- (U) $1,368 Total

(U) FY 2001 ($ in Thousands):

- (U) $260 Develop aircraft and air base fire fighting and power generation technologies including clean environmentally safe fire fighting agents, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems.
- (U) $357 Develop technologies, utilities, and shelters that improve air base operations. These technologies include completion of the acoustic cycle heat pump that reduces airlift requirements in support of AEF operations rapid deployment.
- (U) $56 Construct an air transportable shelter advanced development model for field testing to support AEF operations rapid deployment.
- (U) $673 Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603205F Flight Vehicle Technology
	PROJECT 4398

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0603307F, Air Base Operability Advanced Technology Development.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603211F Aerospace Structures

PROJECT: 486U

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
486U Advanced Aerospace Structures	9,593	12,411	13,749	15,182	16,379	17,549	19,092	18,265	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates affordable aerospace vehicle structures by utilizing innovative metallic and composite structures technologies to reduce the cost of airframe ownership. Innovative structural concepts integrate these two types of materials with design and monitoring techniques to develop and demonstrate solutions and repairs for corrosion fatigue, multi-site damage fatigue, and other damage to which aging aircraft are susceptible. The goal of this program is to develop technologies to restore structural integrity, extend life, and improve survivability of the current fleet, and future fleet of manned and unmanned aerospace vehicles. The results are less maintenance intensive, more durable, and more dependable structures for current and future aerospace systems. This yields lower cost of ownership (by delaying acquisition and by reducing support and maintenance costs), restored and improved sortie rates (due to durability, damage or threat tolerance, and design for supportability), and reduced observability (both radar cross section and infrared). The increased funding in this PE is due to the increased emphasis by the Air Force on advanced structures for space applications.

(U) FY 1998 ($ in Thousands):

- (U) $3,923 Developed and assessed processes for the replacement of corrosion sensitive components with the completion of a wing spar for flight test to extend the structural life of aircraft.
- (U) $1,302 Developed and demonstrated durability and performance of manned and unmanned aerospace vehicles structures operating in extreme thermal and acoustic environments, which resulted in a detailed design of an integrated aft fuselage and nozzle section and, thereby, decreasing vulnerability and longevity of aerospace vehicles.
- (U) $4,368 Developed advanced structural concepts and design methods for future and existing aerospace vehicles which identified new design criteria for composite structures and design of sandwich structure component; these technologies were developed to maintain the Air Force's technology edge.
- (U) $9,593 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Structures
	PROJECT 486U

(U) FY 1999 ($ in Thousands):

- (U) $5,700 Improve durability and performance, affordability, and longevity of existing aging aircraft and future aerospace vehicle structures operating in extreme thermal and acoustic environments to decrease vulnerability and increase longevity of aerospace vehicles with the fabrication of an integrated aft fuselage and nozzle section.
- (U) $5,886 Develop advanced structural concepts and design methods for future and existing air vehicles, such as the fabrication of a full-scale structural component for demonstration or flexible wing demo that twists to control flight.
- (U) $461 Develop and apply new analysis methods and design criteria to advanced composite structures for reduction in life cycle costs of current and future aerospace vehicles by maximizing the use of composite structures.
- (U) $364 Identified as a source for SBIR.
- (U) $12,411 Total

(U) FY 2000 ($ in Thousands):

- (U) $7,420 Improve durability and performance, affordability, and longevity of existing aging aircraft and future aerospace vehicle structures operating in extreme thermal and acoustic environments to decrease vulnerability and increase longevity of aerospace vehicles with the fabrication of an integrated aft fuselage and nozzle section.
- (U) $5,844 Develop advanced structural concepts and design methods for future and existing aerospace vehicles, such as the fabrication of a full-scale structural component for demonstration or flexible wing demo that twists to control flight.
- (U) $485 Develop and apply new analysis methods and design criteria to advanced composite structures for reduction in life cycle costs of current and future aerospace vehicles by maximizing the use of composite structures.
- (U) $13,749 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Structures
	PROJECT 486U

(U) FY 2001 ($ in Thousands):

- (U) $8,211 Improve durability and performance, affordability, and longevity of existing aging aircraft and future aerospace vehicle structures operating in extreme thermal and acoustic environments to decrease vulnerability and increase longevity of aerospace vehicles with the fabrication of an integrated aft fuselage and nozzle section.
- (U) $6,436 Develop advanced structural concepts and design methods for future and existing aerospace vehicles, such as the fabrication of a full-scale structural component for demonstration or flexible wing demo that twists to control flight.
- (U) $535 Develop and apply new analysis methods and design criteria to advanced composite structures for reduction in life cycle costs of current and future aerospace vehicles by maximizing the use of composite structures.
- (U) $15,182 Total

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603211F Aerospace Structures / PROJECT: 486U

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	9,734	12,494	14,435	15,041	Cont
(U) Appropriated Value	10,423	12,494			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-437	-83			
b. SBIR	-227				
c. Omnibus/Other Above Threshold Reprogrammings	-66				
d. Below Threshold Reprogrammings	-100				
(U) Adjustments to Budget Year Since FY1999 PB			-686	141	
(U) Current Budget Submit/FY 2000 PB	9,593	12,411	13,749	15,182	Cont

(U) Significant Program Changes: Not Applicable.

FY 1999: $364 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603211F Aerospace Structures
	PROJECT 486U

(U) D. Other Program Funding Summary:

(U) Related Activities:

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

(U) E. Acquisition Strategy: Not Applicable.

(U) F. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

	COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	31,398	36,867	38,778	39,061	37,895	35,081	29,504	30,335	Continuing	Continuing
2480	Aerospace Fuels and Atmospheric Propulsion	1,444	2,052	2,210	2,170	3,087	3,193	3,260	3,328	Continuing	Continuing
3035	Aerospace Power Systems Technology	3,133	3,388	3,162	2,511	2,724	4,261	4,350	4,441	Continuing	Continuing
681B	Advanced Turbine Engine Gas Generator	26,821	31,427	33,406	34,380	32,084	27,627	21,894	22,566	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates affordable turbine engine high pressure core components, advanced airbreathing engine concepts, high heat sink and thermally stable fuels, and power technology for aerospace vehicles. Anticipated technology advances include turbine engine improvements providing a 33% reduction in aircraft takeoff gross weight for tactical fighter aircraft and a 100% increase in aircraft range/loiter; ducted rocket improvements that increase missile average and terminal velocity by 50% and range by 100% for enhanced lethality; higher temperature fuels for propulsion and thermal management; an aircraft battery with a 20-year maintenance-free life expectancy; and electric aircraft power components projected to provide a two- to five-fold improvement in reliability and maintainability, a 20% reduction in power system weight, and enhanced survivability.

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603216F Aerospace Propulsion and Power Technology**

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	33,126	38,984	40,524	42,132	Cont
(U) Appropriated Value	35,183	36,984			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-1,148	-117			
b. SBIR	-885				
c. Omnibus/Other Above Threshold Reprogrammings	-226				
d. Below Threshold Reprogrammings	-1,526				
(U) Adjustments to Budget Year Since FY 1999 PB			-1,746	-3,071	
(U) Current Budget Submit/FY 2000 PB	31,398	36,867	38,778	39,061	Cont

(U) (U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $1,195 identified as a source for SBIR.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT: 2480

COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2480 Aerospace Fuels and Atmospheric Propulsion	1,444	2,052	2,210	2,170	3,087	3,193	3,260	3,328	Continuing	Continuing

(U) A. Mission Description: Develops and demonstrates new thermally stable and high heat sink fuels and advanced fuel system components that minimize cost, reduce maintenance, and improve performance of aircraft and missiles. Emphasis is on demonstrating the effects/benefits of JP-8+100 on current systems, and advanced high temperature fuel system designs and components on upgraded and advanced systems. Demonstrates unconventional airbreathing propulsion subsystems such as ramjets, air turborockets, dual-mode ramjets, and combined/advanced-cycle engines to assure future propulsion options for high-speed missiles.

(U) FY 1998 ($ in Thousands):

- (U) $874 Demonstrated thermally stable JP-8+100 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.
- (U) $185 Demonstrated effectiveness of thermally stable JP-8+100 for reduced maintenance in a variety of aircraft.
- (U) $325 Demonstrated advanced fuel system designs and high temperature components that permit utilization of the increased cooling capacity of JP-8+100 and high heat sink fuels.
- (U) $60 Completed final documentation on Variable Flow Ducted Rocket technology and concepts.
- (U) $1,444 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,364 Demonstrate thermally stable JP-8+100 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.
- (U) $211 Demonstrate effectiveness of thermally stable JP-8+100 for reduced maintenance in a variety of aircraft.
- (U) $311 Demonstrate advanced fuel system designs and high temperature components that permit utilization of the increased cooling capacity of JP-8+100 and high heat sink fuels.
- (U) $100 Develop and demonstrate the design and construction of critical high-speed propulsion components/structures for manned and unmanned applications which will provide technology at lower risk for future missile systems where time-to-target is critical and for next generation reconnaissance/strike vehicles and airbreathing boosters.
- (U) $66 Identified as a source for SBIR.
- (U) $2,052 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology
	PROJECT 2480

(U) FY 2000 ($ in Thousands):

- (U) $884 Demonstrate thermally stable JP-8+100 fuel that reduces fuel system maintenance on current aircraft and provides greater cooling capacity (performance) for upgraded and future aircraft and missiles.
- (U) $771 Demonstrate thermally stable JP-8+225 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.
- (U) $555 Develop and demonstrate the design and construction of critical high-speed propulsion components/structures for manned and unmanned applications which will provide technology at lower risk for future missile systems where time-to-target is critical and for next generation reconnaissance/strike vehicles and airbreathing boosters.
- (U) $2,210 Total

(U) FY 2001 ($ in Thousands):

- (U) $868 Demonstrate thermally stable JP-8+100 fuel that reduces fuel system maintenance on current aircraft and provides greater cooling capacity (performance) for upgraded and future aircraft and missiles.
- (U) $760 Demonstrate thermally stable JP-8+225 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.
- (U) $542 Develop and demonstrate the design and construction of critical high-speed propulsion components/structures for manned and unmanned applications which will provide technology at lower risk for future missile systems where time-to-target is critical and for next generation reconnaissance/strike vehicles and airbreathing boosters.
- (U) $2,170 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology
	PROJECT 2480

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602203F, Aerospace Propulsion.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603216F Aerospace Propulsion and Power Technology**
	PROJECT **3035**

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3035 Aerospace Power Systems Technology	3,133	3,388	3,162	2,511	2,724	4,261	4,350	4,441	Continuing	Continuing

(U) A. Mission Description: Develops and demonstrates aircraft and ground power systems including engine starters, auxiliary power units, and electrical power distribution systems. The principal focus is to provide a two- to five-fold improvement in reliability and maintainability and significantly reduced cost of ownership for aircraft and ground power systems. This will be accomplished by replacing fluid-powered (hydraulics/bleed air) accessories with electrically-powered systems. Representative improvements include increased reliability (900%), improved supportability (15-25%), and reduced vulnerability (15%).

(U) FY 1998 ($ in Thousands):

- (U) $941 Designed, fabricated, and tested an electrical distribution system which ensures fault tolerant architecture, improving aircraft reliability and survivability.
- (U) $386 Designed, fabricated, and tested components supporting a demonstrator aircraft electrical distribution system for increased aircraft reliability and supportability.
- (U) $1,806 Designed, fabricated, and tested a demonstrator aircraft on-board Integrated Power Unit (IPU) which is critical for aircraft engine starting, auxiliary power, and emergency power.
- (U) $3,133 Total

(U) FY 1999 ($ in Thousands):

- (U) $444 Design, fabricate, and test an electrical distribution system which ensures fault tolerant architecture, improving aircraft reliability and survivability.
- (U) $958 Develop an aircraft electrical power generation and distribution system for test validation and flight demonstration which will ensure fault tolerant architecture and will improve aircraft reliability and survivability.
- (U) $1,876 Design, fabricate, and test a demonstrator aircraft on-board IPU which is critical for aircraft engine starting, auxiliary power, and emergency power.
- (U) $110 Identified as a source for SBIR.
- (U) $3,388 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology
	PROJECT 3035

(U) FY 2000 ($ in Thousands):

- (U) $1,839 Develop an aircraft electrical power generation and distribution system for test validation and flight demonstration which will ensure fault tolerant architecture and will improve aircraft reliability and survivability.
- (U) $910 Design, fabricate, and test a demonstrator aircraft on-board Integrated Power Unit (IPU) which is critical for aircraft engine starting, auxiliary power, and emergency power.
- (U) $413 Design, fabricate, and test power sources for electrically-based aircraft for survival and emergency power.
- (U) $3,162 Total.

(U) FY 2001 ($ in Thousands):

- (U) $1,558 Develop an aircraft electrical power generation and distribution system for test validation and flight demonstration which will ensure fault tolerant architecture and improve aircraft reliability and survivability.
- (U) $70 Design, fabricate, and test a demonstrator aircraft on-board IPU which is critical for aircraft engine starting, auxiliary power, and emergency power.
- (U) $883 Design, fabricate, and test power sources for electrically-based aircraft for survival and emergency power.
- (U) $2,511 Total.

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT: 681B

COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
681B Advanced Turbine Engine Gas Generator	26,821	31,427	33,406	34,380	32,084	27,627	21,894	22,566	Continuing	Continuing

(U) A. Mission Description: This project develops turbine engine gas generator technology to meet the requirements of current and future aircraft propulsion systems. The objective is to provide the continued evolution of technologies into an advanced gas generator in which the performance, cost, durability, repairability, and maintainability aspects can be assessed in a real engine environment. The gas generator, or core, is the basic building block of the engine and it consists of a compressor, a combustor, and a high pressure turbine. Experimental core engine testing enhances early, low-risk transition of key engine technologies into engineering development where they can be applied to derivative and/or new systems. These technologies are applicable to a wide range of military and commercial systems including aircraft, missiles, land combat vehicles, and ships. The Advanced Turbine Engine Gas Generator project supports the Integrated High Performance Turbine Engine Technology (IHPTET) program. IHPTET is a three phase, totally integrated DoD, Defense Advanced Research Projects Agency (DARPA), National Aeronautics and Space Administration (NASA), and industry program focused on doubling turbine engine propulsion capabilities while reducing cost of ownership. The IHPTET program structure provides continuous technology transition for military turbine engine upgrades and derivatives and has the added benefit of enhancing the U.S. turbine engine industry's international competitiveness and demonstrates affordable turbine engine high pressure core components.

(U) FY 1998 ($ in Thousands):

- (U) $23,888 Designed, fabricated, and performance tested technology demonstration core engines to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
- (U) $596 Designed, fabricated, and durability tested technology demonstration core engines to provide increased durability and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
- (U) $2,337 Designed, fabricated, and tested technology demonstration core engines to provide improved performance and fuel consumption for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.
- (U) $26,821 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603216F Aerospace Propulsion and Power Technology**
	PROJECT **681B**

(U) FY 1999 ($ in Thousands):

- (U) $25,558 Design, fabricate, and performance test technology demonstration core engines to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
- (U) $650 Design, fabricate, and durability test technology demonstration core engines to provide increased durability and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
- (U) $4,200 Design, fabricate, and test technology demonstration core engines to provide improved performance and fuel consumption for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.
- (U) $1,019 Identified as a source for SBIR.
- (U) $31,427 Total

(U) FY 2000 ($ in Thousands):

- (U) $26,918 Design, fabricate, and performance test technology demonstration core engines to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
- (U) $2,488 Design, fabricate, and durability test technology demonstration core engines to provide increased durability and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
- (U) $4,000 Design, fabricate, and test technology demonstration core engines to provide improved performance and fuel consumption for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.
- (U) $33,406 Total

(U) FY 2001 ($ in Thousands):

- (U) $24,663 Design, fabricate, and performance test technology demonstration core engines to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
- (U) $5,417 Design, fabricate, and durability test technology demonstration core engines to provide increased durability and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
- (U) $4,300 Design, fabricate, and test technology demonstration core engines to provide improved performance and fuel consumption for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.
- (U) $34,380 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology
	PROJECT 681B

(U) (U) B. Project Change Summary - Description of Significant Changes: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603202F, Aircraft Propulsion Subsystem Integration.
- (U) PE 0602122N, Aircraft Technology.
- (U) PE 0603210N, Aircraft Propulsion.
- (U) PE 0603003A, Aviation Advanced Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology
	PROJECT 681B

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603227F Personnel, Training, and Simulation Technology

PROJECT: 2743

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2743 Advanced Training/Force Management	5,655	6,595	4,827	6,538	7,905	8,645	5,829	5,949	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates technologies that will result in improved warfighter readiness. Develops, demonstrates, and evaluates technologies for Distributed Mission Training (DMT) including realistic, effective, and affordable synthetic combat environments, technologies for long distance networking to enhance joint-Service training, visual displays for real-time and post-mission debrief, and instructional strategies to support warfighter training in a joint synthetic battlespace. Provides a technology testbed for examining warfighter skills, cognitive functions, and behaviors contributing to combat readiness. Develops models to support aircrew, space, and information operations, performance measurement systems for air, space and information warfare, and tools for mission planning, rehearsal, execution, and force protection in a distributed mission environment. Develops and demonstrates technologies necessary to provide realistic training for night time warfighting. Develops and demonstrates computer-based intelligent tutoring technology for representative tasks in high technology jobs, and software to enable Air Force training developers to rapidly and affordably build intelligent computer assisted training systems which continually interact with students for effective individualized training. Develops and demonstrates information management technology for the warfighter at the unit level. Work concentrates on aircrew, space, and information dominance domains.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603227F Personnel, Training, and Simulation Technology
	PROJECT 2743

(U) FY 1998 ($ in Thousands):

- (U) $1,242 Developed, demonstrated, and evaluated technologies to create Distributed Mission Training (DMT) capabilities including a four-aircraft testbed with a mobile, interactive, air and ground threat environment, and a simulated command and control module, for use as a multi-Service, nationwide air and ground crew training tool.
- (U) $1,086 Developed, demonstrated, and evaluated simulator visual technologies**.** Continued development of high resolution microlaser projector for visual displays with "real world" resolution. Incorporated scene imagery from actual medium and high altitude imagery on visual displays for simulator/training systems and developed multi-level security manager (MLM) to allow for incorporating different levels of classified information to be used simultaneously on simulation/training systems.
- (U) $2,126 Developed and demonstrated technologies to enable and enhance Night Vision Goggle (NVG) training and rehearsal for aircrews by demonstrating proof-of-concept enhanced real-time NVG simulation for combat mission training, including special effects such as halos, dynamic noise, and goggle gain response. Demonstrated low-cost light emitting diode (LED)-based interim cockpit lighting compatible with NVGs in fighter aircraft.
- (U) $1,201 Developed, demonstrated, and evaluated computer-based training technologies and evaluated knowledge representation and student modeling technologies. Initiated migration of successful techniques to the JAVA computer language for enhanced deployability.
- (U) $5,655 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,200 Develop, demonstrate, and evaluate technologies to create DMT capabilities including electronic combat environment tools to represent threat systems and to allow for a more accurate representation of the battlespace in the DMT environment. Incorporate Semi-Automated Forces (SAF) and Synthetic Theater of War (STOW) to give a more realistic representation of the combat environment and develop a certified dynamic threat system which incorporates representative real-world threat systems.
- (U) $ 956 Develop, demonstrate, and evaluate simulator visual technologies including a high-resolution laser projection system for more accurately portraying friendly and threat airborne systems.
- (U) $2,070 Develop and demonstrate technologies to enable and enhance NVG training and rehearsal for aircrews by developing simulation requirements for physics-based, low-cost, deployable real-time simulation of NVG imagery to support mission training and provide technical support to Air Force and DoD for NVG design, acquisition, flight test, lighting compatibility, mishap investigations, and training syllabus development.
- (U) $2,165 Develop, demonstrate, and evaluate computer-based training technologies and evaluate knowledge representation and student modeling technologies. Evaluate adaptive instruction authored by targeted end users. Incorporate interconnection technology including high level architecture requirements into the virtual and constructive training systems, and advances in display, networking, and computing technology into brief/debrief stations to support squadron-level briefing room and training capability.
- (U) $ 204 Identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603227F Personnel, Training, and Simulation Technology
	PROJECT 2743

– (U) $6,595 Total

(U) FY 2000 ($ in Thousands):

– (U) $1,788 Develop, demonstrate, and evaluate technologies to create Distributed Mission Training (DMT) capabilities including physics-based modeling for constructive simulations to more accurately represent real-world systems and representation technologies including a virtual threat cockpit to allow for human-in-the-loop training scenarios. Develop real-time intelligence fusion into the DMT battlespace environment to simulate real-time intelligence updates and develop technologies to include weapons controller interfaces and wing command and control system to incorporate live ground segments.

– (U) $ 639 Develop, demonstrate, and evaluate simulator visual technologies including affordable, increased performance, personal computer-based image generation systems to allow for higher resolution, more realistic visual displays in the simulation systems.

– (U) $1,500 Develop and demonstrate technologies to enable and enhance Night Vision Goggle (NVG) training and rehearsal for aircrews by demonstrating wide area, networked multi-ship, high fidelity NVG combat mission simulation including a lunar illumination model as well as dynamic shadowing and illumination effects associated with combat related light sources (fires, explosions, flares). Develop perceptual training guidelines for distance estimation, scanning techniques, task management techniques, and maintenance of situational awareness and spatial orientation when wearing NVGs.

– (U) $ 900 Develop guidelines and techniques for incorporating force-on-force modeling into DMT for training force protection units.

– (U) $4,827 Total

(U) FY 2001 ($ in Thousands):

– (U) $1,211 Develop, demonstrate, and evaluate technologies to create DMT capabilities including technologies to cue human sensory systems to changes in the flying environment and information technologies to integrate live/virtual/constructive interfaces.

– (U) $2,027 Develop, demonstrate, and evaluate simulator visual technologies including smaller visual display systems to allow for mobile, realistic training at forward basing locations and including human-computer interfaces to incorporate more flexible and realistic combat training scenarios.

– (U) $1,500 Develop and demonstrate technologies to enable and enhance NVG training and rehearsal for aircrews involving operational aircraft and helicopter aircrews, to evaluate measures of training effectiveness, mission performance and transfer of training from simulator to the aircraft. Conduct field evaluation of NVG training techniques to include distance estimation for helicopter, formation and aerial refueling, and combat maneuvering.

– (U) $1,800 Develop advanced training technologies with force-on-force capabilities to train force protection units to protect against terrorist, nuclear, biological, and chemical threats.

– (U) $6,538 Total

	DATE **February 1999**
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603227F Personnel, Training, and Simulation Technology**

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603227F Personnel, Training, and Simulation Technology
	PROJECT 2743

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	5,668	6,636	6,165	7,013	Cont
(U) Appropriated Value	6,147	6,636			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reduction	-320	-41			
b. SBIR	-133				
c. Omnibus/Other Above Threshold Reprogrammings	-39				
d. Below Threshold Reprogrammings					
(U) Adjustments to Budget Year Since FY 1999 PB			-1,338	-475	
(U) Current Budget Submit/FY 2000 PB	5,655	6,595	4,827	6,538	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $204 identified as a source for SBIR.

(U) D. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602202F, Human Effectiveness Applied Research.
- (U) PE 0604227F, Distributed Mission Training (DMT).
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) E. Acquisition Strategy: Not Applicable.

(U) F. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603231F Crew Systems & Personnel Protection Technology

	COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	28,052	29,818	14,841	15,276	14,661	15,033	15,317	17,658	Continuing	Continuing
2830	Crew Workstations, Life Support, and Escape	12,667	12,086	8,312	8,590	8,165	8,372	8,517	8,764	Continuing	Continuing
3257	Helmet-Mounted Sensory Technologies	15,385	17,732	6,529	6,686	6,496	6,661	6,800	8,894	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates technologies to protect and enhance the performance of Air Force personnel in operational environments. Specific projects within this PE advance and integrate human factors technologies into crew workstation, life support, and protective equipment designs. Technologies encompass the development and demonstration of escape system flight control and life protection devices for high-speed and low-altitude, adverse-attitude flight regimes to include those derived from the Russian ejection seat (U.S. - Russian cooperation). Improves life support technologies principally focused on protecting aircrew from effects of altitude and G-forces in high performance aircraft and adjusting specifications of existing equipment to accommodate the increasing operational envelope and a more diversified population of aircrew members. Technology for an advanced on-board oxygen generation system for transport aircraft will be demonstrated to alleviate the logistics burden of current liquid oxygen systems that require ground-based oxygen generation plants. Technologies improve the ability to quantify crew system automation and information cognition requirements through data from constructive analysis and real-time distributed simulation. Models of human perception and knowledge of cognitive function are developed and applied to improve operator performance in high workload environments. Technologies will be developed that will incorporate advanced helmet-mounted capability tracker and displays for target detection, identification, sighting, and weapons firing. Improved helmet-mounted night vision device capability and laser eye protection capability will be incorporated to address the operational limitations of fighting at night and in hazardous laser environments. Note: Congress added $13.45 million in FY 1999 for ejection seat technology ($2 million), helmet display technology ($5 million), panoramic night vision goggles ($2.2 million), and laser-eye protection ($4.25 million), which explains the perceived decrease in FY 2000 and out.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603231F Crew Systems & Personnel Protection Technology**

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies to protect and enhance the performance of Air Force personnel in operational environments.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget /FY 1999 PB	24,881	16,603	17,356	18,267	Cont
(U) Appropriated Value	26,204	30,053			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-959	-235			
b. SBIR	-649				
c. Omnibus/Other Above Threshold Reprogrammings	4,732				
d. Below Threshold Reprogrammings	-1,276				
(U) Adjustments to Budget Year Since FY 1999 PB			-2,515	-2,991	
(U) Current Budget Submit/FY 2000 PB	28,052	29,818	14,841	15,276	Cont

(U) Significant Program Changes: The Above Threshold Reprogramming in FY 1998 is for a Congressional add for the Wallace-Kettering Neurosciences Institute. Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $977 identified as a source for SBIR.

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DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603231F Crew Systems & Personnel Protection Technology

PROJECT: 2830

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2830 Crew Workstations, Life Support, and Escape	12,667	12,086	8,312	8,590	8,165	8,372	8,517	8,764	Continuing	Continuing

(U) A. Mission Description: This project provides technology to improve operator combat performance; develop rigorous, traceable human-centered design tools; protect aircrews from physiological stresses such as high altitude, high G-forces, high temperature, and aerodynamic forces; and reduce aircrew fatalities and major injuries in emergency ejections at high-speed and at low-altitude, adverse-attitude flight conditions, while improving supportability, affordability, and accommodating the full range of the pilot population.

(U) FY 1998 ($ in Thousands):

- (U) $ 1,245 Developed concept for quantifying future crew system performance requirements with a simulation-based testbed to streamline design and reduce cost/risk of crew system acquisition.
- (U) $ 9,873 Demonstrated advanced escape technologies to reduce aircrew fatalities and major injuries in emergency ejections during high-speed and low altitude, adverse attitude flight conditions, including reducing the science and technology risks associated with adapting the Russian K-36D-3.5A lightweight ejection seat to U.S. aircraft.
- (U) $ 1,304 Demonstrated advanced hybrid oxygen technologies for aeromedical operations.
- (U) $ 245 Developed and demonstrated custom oxygen mask advanced technology for high-G and high altitude operations.
- (U) $12,667 Total

(U) FY 1999 ($ in Thousands):

- (U) $ 1,882 Continue to develop a simulation-based testbed to quantify crew performance requirements, streamline design, and reduce cost/risk of crew system acquisition. Begin to develop a human performance model linking crew performance with predicted mission outcome.
- (U) $ 7,808 Develop and demonstrate subsystems to protect the aircrew member during emergency ejections in current and future high performance fighter aircraft, including reducing the science and technology risks associated with adapting the Russian K-36D-3.5A lightweight ejection seat to U.S. aircraft.
- (U) $ 2,000 Finalize design of advanced hybrid oxygen technologies for transport aircraft.
- (U) $ 396 Identified as a source for SBIR.
- (U) $12,086 Total

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BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603231F Crew Systems & Personnel Protection Technology**
	PROJECT **2830**

(U) FY 2000 ($ in Thousands):

- (U) $ 1,872 Continue to develop a simulation-based testbed to quantify crew performance requirements, streamline design, reduce cost/risk of crew system acquisition, demonstrate the ability to quantify crew performance requirements for a tactical attack mission, and analyze the potential for space support missions.
- (U) $ 2,440 Develop and demonstrate subsystems to protect the aircrew member during emergency ejection in current and future high performance fighter aircraft.
- (U) $ 4,000 Develop and demonstrate subsystems to reduce the science and technology risks associated with adapting the Russian K-36D-3.5A lightweight ejection seat for potential use in future high performance fighter aircraft.
- (U) $ 8,312 Total

(U) FY 2001 ($ in Thousands):

- (U) $ 1,717 Complete functional specification for a simulation-based testbed to quantify crew performance requirements, streamline design, and reduce cost/risk of crew system acquisition. Demonstrate the ability to quantify crew performance requirements for space support missions.
- (U) $ 2,573 Continue to demonstrate subsystems to protect the aircrew member during emergency ejections in current and future high performance fighter aircraft.
- (U) $ 4,300 Develop and demonstrate subsystems to reduce the science and technology risks associated with adapting the Russian K-36D-3.5A lightweight ejection seat for potential use in future high performance fighter aircraft.
- (U) $ 8,590 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology
	PROJECT 2830

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602202F, Human Effectiveness Applied Research.
- (U) PE 0604703F, Aeromedical/Casualty Care Systems Development.
- (U) PE 0604706F, Life Support Systems.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology
	PROJECT 3257

COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3257 Helmet-Mounted Sensory Technologies	15,385	17,732	6,529	6,686	6,496	6,661	6,800	8,894	Continuing	Continuing

(U) A. Mission Description: This project develops and demonstrates advanced helmet-mounted subsystem technologies to improve mission effectiveness and pilot situational awareness during day and night missions in all-weather conditions. Through the development of advanced helmet-mounted tracker and display (HMT/D) technologies, pilots will be able to detect, identify, target, and launch weapons faster and more accurately. This project develops technology for improved aircrew night vision goggles (NVG) to enhance aerial combat capabilities at night. Technologies are also developed to provide protection against lasers and methods to evaluate the biological effects of laser weapons.

(U) FY 1998 ($ in Thousands):

- (U) $ 3,320 Developed and demonstrated HMT/D and subsystem technologies, assessed color symbology, and evaluated eye tracker technologies. Flight demonstrated and transitioned enhanced uplook and upper aiming reticles to provide pilots with an exclusive kill zone, and demonstrated high luminance Cathode Ray Tube.
- (U) $ 2,610 To improve night operations, completed design for panoramic night vision goggle having dynamic symbol overlay and evaluated the state-of-the-art for image intensifier tube technology for NVGs.
- (U) $ 1,555 Advanced the state-of-art for advanced laser eye protection (LEP) technologies and laser susceptibility models, completed version 2 of a Laser Threat Analysis System to evaluate ground-based laser threat, completed flight test of dielectric stack technology, and evaluated technology for protection from airborne laser threats.
- (U) $ 3,000 Developed a passive matrix, high luminance, miniature, flat-panel image source technology for use in HMT/Ds.
- (U) $ 4,900 Conducted Advanced Neuroscience Interface Research program focused on advanced magnetic resonance imaging visualization and segmentation, next generation neuro-navigation, and Positron Emission Tomography (PET) biochemical imaging. All projects are collaborative research efforts focused on maximizing the effectiveness of human performance in both clinical and military settings.
- (U) $15,385 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology
	PROJECT 3257

(U) FY 1999 ($ in Thousands):

–	(U) $ 8,019	Continue to develop and demonstrate helmet-mounted tracker and display (HMT/D) and subsystem technologies including color symbology, conduct risk reduction for the Joint Helmet-Mounted Cueing System (JHMCS) program, and document advanced air-to-air capabilities for HMT/D with High Off-Boresight Angle (HOBA) missiles.
–	(U) $ 3,340	Demonstrate the operational potential of panoramic night vision goggles (PNVGs) with symbology overlay.
–	(U) $ 5,792	Continue to develop and demonstrate laser eye protection (LEP) technologies and susceptibility models, and begin to integrate a Laser Threat Analysis System (LTAS) into a distributed simulation to evaluate laser, directed energy, and broadband optical threats. Develop reflectivity analysis tool to evaluate high-energy laser hazard. Complete flight test of dielectric stack technology.
–	(U) $ 581	Identified as a source for SBIR.
–	(U) $17,732	Total

(U) FY 2000 ($ in Thousands):

–	(U) $ 3,608	Continue to develop and demonstrate HMT/D and subsystem technologies including color symbology, pre-planned product improvement technologies for JHMCS, HMT/D with LEP visors and spectacles, and inertial head-mounted tracker.
–	(U) $ 1,615	Continue to evaluate the operational potential of PNVGs with imaging sensor overlay and symbology overlay.
–	(U) $ 1,306	Continue to integrate a LTAS into a distributed simulation to evaluate laser, directed energy, and broadband optical threats. Begin human factors evaluation of optical materials for frequency-agile laser eye protection. Develop Laser Range Safety Tool for high energy laser.
–	(U) $ 6,529	Total

(U) FY 2001 ($ in Thousands):

–	(U) $ 4,247	Continue to develop and demonstrate HMT/D and subsystem technologies including color symbology, retrofit miniature flat displays to replace cathode ray tubes in HMT/Ds, and demonstrate HMT/D for air-to-ground missions.
–	(U) $ 1,103	Evaluate LEP visors integrated with PNVGs.
–	(U) $ 1,336	Deliver certified Laser Range Safety Tool for high energy lasers to flight test ranges to support airborne laser testing. Deliver laser eye protection to support airborne laser testing. Begin initial integration of LTAS with Laser Warning Receivers. Continue human factors evaluation of optical materials for frequency-agile laser eye protection.
–	(U) $ 6,686	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999	
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603231F Crew Systems & Personnel Protection Technology	PROJECT 3257

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602202F, Human Effectiveness Applied Research.
- (U) PE 0602102F, Materials.
- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) PE 0603319F, Airborne Laser.
- (U) PE 0604706F, Life Support Systems.
- (U) PE 0604201F, Common Avionics Planning/Development.
- (U) PE 0207130F, F-15 Squadrons.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603245F Flight Vehicle Technology Integration

PROJECT: 2568

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2568 Flight Vehicle Technology Integration	5,618	7,642	8,335	9,711	11,031	12,066	12,301	14,237	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program integrates and demonstrates advanced flight vehicle technologies that will improve the performance and supportability of existing and future manned and unmanned aerospace vehicles. System level integration brings together the aerospace vehicle technologies along with avionics, propulsion, and weapon systems to flight demonstrate them in a near-realistic operational environment. Integration and flight test demonstrations reduce the risk and time required to transition technologies into operational aircraft. This program provides proven aerospace vehicle technologies for all-weather, day or night operations, and technologies for improved affordability.

(U) FY 1998 ($ in Thousands):

- (U) $2,041 Developed and integrated advanced aeromechanics, propulsion, and flight control technologies for increased combat effectiveness. Completed detailed design and initiated fabrication of selected critical components required for the next generation exhaust nozzle and airframe integration.
- (U) $555 Initiated development of control strategies that extended range, ensured safe operation, and allowed precision close operations for mixed manned and unmanned aerospace vehicles.
- (U) $3,022 Developed and completed design and fabrication of aerospace vehicle structural components, integrated, and demonstrated advanced subsystem technologies
- (U) $5,618 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603245F Flight Vehicle Technology Integration

(U) FY 1999 ($ in Thousands):

- (U) $2,443 Develop and integrate advanced aeromechanics, propulsion, and flight control technologies, and complete fabrication of next generation exhaust nozzle and airframe structural critical components for increasing combat effectiveness for current and future aerospace vehicle systems.
- (U) $ 1,017 Complete development and flight-test control strategies to extend range, ensure safe operation, and allow precision close operations of mixed manned and unmanned aerospace vehicles.
- (U) $3,927 Develop flight test units of electric actuator stabilators for reducing weight and manufacturing technologies as they relate to the unmanned aerospace vehicle mission. Integrate and demonstrate advanced subsystem technologies for evaluation of significant improvement in air-to-air combat effectiveness for aerospace vehicles.
- (U) $255 Identified as a source for SBIR.
- (U) $7,642 Total

(U) FY 2000 ($ in Thousands):

- (U) $2,430 Develop and integrate advanced aeromechanics, propulsion, and flight control technologies, and complete fabrication of next generation exhaust nozzle and airframe structural critical components for increasing combat effectiveness for Air Force aircraft systems.
- (U) $ 1,919 Continue development and flight-test control strategies to extend range, ensure safe operation, and allow precision close operations of mixed manned and unmanned aerospace vehicles. Continue unmanned aerospace vehicle development.
- (U) $3,986 Develop flight test units of electric actuator stabilators for reducing weight and manufacturing technologies as they relate to the unmanned aerospace vehicle mission. Integrate and demonstrate advanced subsystem technologies for evaluation of significant improvement in air-to-air combat effectiveness for aerospace vehicles.
- (U) $8,335 Total

(U) FY 2001 ($ in Thousands):

- (U) $3,265 Develop and integrate advanced aeromechanics, propulsion, and flight control technologies, and complete fabrication of next generation exhaust nozzle and airframe structural critical components for increasing combat effectiveness for current and future aerospace vehicles systems.
- (U) $1,286 Complete development and flight-test control strategies to extend range, ensure safe operation, and allow precision close operations of mixed manned and unmanned aerospace vehicles. Continue unmanned aerospace vehicle development.
- (U) $5,160 Develop flight test units of electric actuator stabilators for reducing weight and manufacturing technologies as they relate to the unmanned aerospace vehicle mission. Integrate and demonstrate advanced subsystem technologies for evaluation of significant improvement in air-to-air combat effectiveness for aerospace vehicles.
- (U) $9,711 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603245F Flight Vehicle Technology Integration
	PROJECT 2568

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	6,062	7,674	8,807	10,884	Cont
(U) Appropriated Value	6,423	7,674			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-210	-32			
b. SBIR	-155				
c. Omnibus/Other Above Threshold Reprogrammings	-41				
d. Below Threshold Reprogrammings	-399				Cont
(U) Adjustments to Budget Year Since FY1999 PB			-472	-1,173	
(U) Current Budget Submit/FY 2000 PB	5,618	7,642	8,335	9,711	Cont

(U) Significant Program Changes: Not Applicable.

FY 1999: $255 identified as a source for SBIR.

(U) D. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603106F, Logistics Systems Technology.
- (U) PE 0603205F, Flight Vehicle Technology.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0604237F, Variable Stability In-Flight Simulation Test Aircraft.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) E. Acquisition Strategy: Not Applicable.

(U) F. Schedule Profile: Not Applicable.

	DATE **February 1999**
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603245F Flight Vehicle Technology Integration**

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603253F Advanced Sensor Integration

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	11,825	10,462	9,443	11,984	13,043	13,677	13,516	13,343	Continuing	Continuing
2735	Avionics Integration Technology	5,696	5,974	5,976	6,796	6,945	7,443	7,174	7,085	Continuing	Continuing
3833	Integrated Avionics for Aging Aircraft	2,349	0	0	0	0	0	0	0	Continuing	Continuing
666A	Reference and Information Transmission Technology	3,780	4,488	3,467	5,188	6,098	6,234	6,342	6,258	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FYs 1999 and out, Project 3833 transferred into Project 2735.

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates advanced radio frequency sensors for performing integrated intelligence, surveillance, and reconnaissance functions. Specificially, this program develops and improves: digital receiver components for space-based radar and advanced unmanned aerial vehicle applications; advanced Global Positioning System receivers and anti-jam techniques for aerospace platforms; aircraft communications, navigation, and identification technologies; technologies for low-probability-of-detection communication between aircraft to improve aircrew situation awareness; and collaborative engineering environments to evaluate the integration of on-board and off-board sensor data.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Sensor Integration

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	12,012	10,536	8,747	10,796	Cont
(U) Appropriated Value	12,716	10,536			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-422	-74			
b. SBIR	-290				
c. Omnibus/Other Above Threshold Reprogrammings	-81				
d. Below Threshold Reprogrammings	-98				
(U) Adjustments to Budget Year Since FY 1999 PB			696	1,188	
(U) Current Budget Submit/FY 2000 PB	11,825	10,462	9,443	11,984	Cont

(U) Significant Program Changes: Not Applicable.

FY 1999: $233 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603253F Advanced Sensor Integration	PROJECT: 2735

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2735 Avionics Integration Technology	5,696	5,974	5,976	6,796	6,945	7,443	7,174	7,085	Continuing	Continuing

(U) A. Mission Description: Develops and demonstrates advanced radio frequency sensors for integrated intelligence, surveillance, and reconnaissance functions on aerospace platforms. These advanced technologies will enable sensors to gather and process information from air- and space-based assets, integrate on-board and off-board sensors, and perform sensor management functions.

(U) FY 1998 ($ in Thousands):

- (U) $3,902 Developed and demonstrated advanced modular, sharable radio frequency (RF) sensor processing technologies to provide for avionics cost and weight savings, improved reliability, and increased sensor data fusion opportunities. This included integration of components for demonstrating integrated sensor system technology for simultaneously performing radar, electronic warfare (EW), communication, navigation, and identification functions.
- (U) $1,228 Developed integrated avionics architecture components which leverage prior technology developments and incorporate additional user requirements for multi-platform commonality, open system architecture compliance, standard high-level software language, affordability, and expandability. This included flight demonstrations of low-level covert penetration capability and demonstration of improved threat location.
- (U) $566 Developed architectural components required to convert RF functions (radar, EW, communications) from bulky, analog electronics to more compact, reliable digital technology which provides significant cost/performance payoffs, including assessment of commercial developments.
- (U) $5,696 Total

(U) FY 1999 ($ in Thousands):

- (U) $3,936 Develop and demonstrate advanced modular, sharable RF sensor processor technologies to provide for avionics cost and weight savings, increased multimission capability, improved reliability, and increased sensor data fusion opportunities. This includes demonstrating integrated sensor system technology for simultaneously performing radar, EW, communication, navigation, and identification functions.
- (U) $500 Develop technologies for collecting and integrating sensor data from various sources in a collaborative engineering environment in order to reduce risks and costs of advanced technology demonstration and to enable faster transition of affordable technology to meet warfighter needs, including developing a collaborative engineering capability and evaluating sensor data in a collaborative environment.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Sensor Integration
	PROJECT 2735

- (U) $1,405 Develop and demonstrate technologies to support maximum use of existing avionics software in concert with newly developed software in a real-time avionics environment, thereby providing a cost-effective incremental upgrade capability, including optimizing testing of technology for simultaneous execution of existing 16-bit avionics software with 32-bit application software and develop preliminary architectural framework. (In FY 1999, this work transferred from Project 3833, Integrated Avionics for Aging Aircraft.)
- (U) $133 Identified as a source for SBIR.
- (U) $5,974 Total

(U) FY 2000 ($ in Thousands):

- (U) $1,867 Develop and demonstrate advanced modular, sharable radio frequency (RF) sensor technologies for aerospace sensor suites performing intelligence, reconnaissance, and surveillance applications. This includes designing a dual-use modular, digital RF receiver and conducting trade studies for space-based radar components.
- (U) $2,482 Develop technologies for collecting and integrating on- and off-board sensors over multiple platforms in a collaborative engineering environment, reducing cost and risk of advanced technology demonstration. This includes evaluating on-board and off-board sensors and multiple platforms in a collaborative engineering environment.
- (U) $444 Develop and demonstrate technologies to support maximum use of existing avionics software together with new software in real-time environments, including transitioning these technologies to fighter and transport aircraft.
- (U) $1,183 Develop and demonstrate advanced architecture concepts to support seamless information flow and fusion for application in space and unmanned aerial vehicles (UAVs), including developing UAV architecture concepts applicable to multiple UAV applications and developing an Assured Space Access Architecture (ASAA) for the space maneuver vehicle as well as the command and control (C2) information infrastructure needed for ASAA.
- (U) $5,976 Total

(U) FY 2001 ($ in Thousands):

- (U) $3,095 Develop and demonstrate advanced modular, sharable digital RF sensor technologies for aerospace sensor suites performing intelligence, reconnaissance, and surveillance applications. This includes completing the design and initiating fabrication of dual-use, modular, digital RF receiver components for space-based radar.
- (U) $2,261 Develop technologies for collecting and integrating network-centric sensor data in collaborative engineering environment in order to reduce risk of transitioning advanced technology.
- (U) $1,440 Develop and demonstrate advanced architecture concepts to support seamless information flow and fusion for application in space and UAVs, including demonstrating UAV and space maneuvering vehicle architecture and C2 strategy and assessing performance, reliability, and affordability.
- (U) $6,796 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Sensor Integration
	PROJECT 2735

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603204F, Aerospace Sensors.
- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) PE 0603270F, Electronic Warfare Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603253F Advanced Sensor Integration	PROJECT: 3833

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3833 Integrated Avionics for Aging Aircraft	2,349	0	0	0	0	0	0	0	Continuing	Continuing

(U) A. Mission Description: Develops and demonstrates affordable avionics technology to extend the useful life of Air Force aging aircraft and provide the flexibility and supportability needed to support worldwide operations with reduced force structure. This project focuses on technologies to support transition of modular avionics, commercially available products, and commercial open system standards for cost-effective retrofit of user-required upgrades to existing avionics systems. In FY 1999 and out, this project transfers to Project 2735.

(U) FY 1998 ($ in Thousands):

- (U) $388 Developed and demonstrated programmable integrated communications, navigation, and identification hardware/software modules for currently fielded aircraft applications to provide fleet wide commonality, attendant economies of scale, and increased platform availability.
- (U) $1,377 Developed and demonstrated technologies to support maximum use of existing avionics software in concert with newly developed software in a real-time avionics environment and, thereby, provide a cost-effective incremental upgrade capability.
- (U) $584 Developed avionics integration technologies to enable commercial-off-the-shelf components to function reliably in a combat aircraft environment for cost-effective modernization of aging avionics.
- (U) $2,349 Total

(U) FY 1999: Not Applicable.

(U) FY 2000: Not Applicable.

(U) FY 2001: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Sensor Integration
	PROJECT 3833

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

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

(U) Related Activities:
- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0602301E, Intelligence System Program.
- (U) PE 0602232N, Navy Command, Control, and Communications (C3) Technology.
- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) PE 0604201F, Common Avionics.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Sensor Integration PROJECT 666A

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
666A Reference and Information Transmission Technology	3,780	4,488	3,467	5,188	6,098	6,234	6,342	6,258	Continuing	Continuing

(U) A. Mission Description: Develops and demonstrates the advanced reference and information transmission technologies required for precise navigation and targeting and reliable information links for future Air Force information architectures. Specifically, this projects develops the advanced techniques for exploiting and protecting the capabilities of the Global Positioning System (GPS) to provide highly accurate reference information for precision targeting and the precision location of enemy air defense radars. In addition, this project develops high-speed, jam-resistant, low-probability-of-detection information transmission technologies and techniques to improve overall aircrew situation awareness. These technologies will also reduce the electromagnetic signatures of navigation and communication systems, increasing aircraft survivability. The focus is on transitioning transceivers, intertial components, navigation system technology into air vehicles. Technologies demonstated under this project are needed for real-time information in the cockpit, stealth operations, precision targeting and strike, timely bomb damage assessment, force multiplication through multi-platform shared resources, and affordable and supporatable weapon systems.

(U) FY 1998 ($ in Thousands):

- (U) $2,409 Developed enhancements to GPS user equipment and system integration techniques to maximize position accuracy and jam resistance and exploit the benefits of GPS to improve offensive and defensive combat capabilities at reduced costs. This included completion of flight experiments for GPS-based rapid location and countering of emitters, development of optimum anti-jam techniques that fully exploit digital architectures, and development of precision attack techniques using improved GPS signals and all-digital user equipment.
- (U) $1,371 Developed multi-user, medium to high capacity, jam-resistant airborne network technology to provide for low probability of detection exchange of time-critical threat, sensor, and other information between aircraft and cooperative assets, including completion of a brassboard design and ground-tests of high-speed, high-bandwidth data transfer technology.
- (U) $3,780 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,706 Develop enhancements to GPS user equipment and system integration techniques to maximize position accuracy and jam resistance and exploit the benefits of GPS to improve offensive and defensive combat capabilities at reduced costs. This includes continuing development of optimum anti-jam techniques and techniques for precision attack using improved GPS.
- (U) $1,682 Develop multi-user, medium to high capacity, jam-resistant airborne network technology to provide for low probability of detection exchange of time-critical threat, sensor, and other information between aircraft and cooperative assets, including completing the evaluation of a common, affordable, open system architecture for unmanned aerial vehicles.
- (U) $100 Identified as a source for SBIR.
- (U) $4,488 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Sensor Integration
	PROJECT 666A

(U) FY 2000 ($ in Thousands):

- (U) $2,647 Develop technologies to maximize Global Positioning System (GPS) jam resistance, position accuracy, and exploitation techniques to improve offensive and defensive combat capabilities at reduced costs. This includes completing GPS space-time adaptive algorithms and trade studies and evaluating impacts of GPS signal modernization to legacy and research user equipment
- (U) $820 Develop and evaluate multi-user, medium to high capacity airborne platform information transfer technology to provide jam-resistant, lower probability of detection exchange of information between aircraft and cooperating space, airborne, and surface communication assets. This includes fabrication of a space-based air traffic communications and positioning brassboard.
- (U) $3,467 Total

(U) FY 2001 ($ in Thousands):

- (U) $4,301 Develop technologies to maximize GPS jam resistance, position accuracy, and exploitation techniques to improve offensive and defensive combat capabilities at reduced costs, including integrating algorithms and receiver processor techniques and developing direct acquisition techniques to improve delivery of precision munitions.
- (U) $887 Develop technology to increase airborne platform information transfer capacity while providing jam-resistant, low probability of detection exchange of time-critical threat, sensor, and command and control information between aircraft and cooperating space, airborne, and surface communication assets, including developing advanced radio frequency switching and amplification technologies.
- (U) $5,188 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603253F Advanced Sensor Integration
	PROJECT 666A

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0602782A, Command, Control, and Communications (C3) Technology.
- (U) PE 0602232N, Navy C3 Technology.
- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603270F Electronic Combat (EC) Technology

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	33,170	25,476	27,334	26,775	26,969	27,606	28,332	28,971	Continuing	Continuing
2432	Defensive System Fusion Technology	8,083	7,150	8,336	6,278	7,573	8,148	8,318	8,491	Continuing	Continuing
431G	Radio Frequency (RF) Warning and Countermeasures	12,278	9,187	8,501	7,639	8,696	8,775	8,957	9,143	Continuing	Continuing
691X	Electro-Optical/Infrared (EO/IR) Warning and Countermeasures	12,809	9,139	10,497	12,858	10,700	10,683	11,057	11,337	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates technologies to support critical Air Force EC requirements. The projects are categorized by the development of components, subsystems, and technologies that have potential application to satisfy combat, space, special operations, and airlift EC requirements and to reduce acquisition and life cycle costs of EC systems. The program develops and demonstrates: radio frequency; infrared; electro-optical; warning; and command, control, and communications countermeasure technologies for air and space platforms. Technology demonstrations include flyable brassboards against validated threat simulators. In addition, the program develops and demonstrates technologies and concepts for signature reduction, advanced electronic warfare transmitters, receivers, and power management. This program ensures the Air Force maintains demonstrated technology solutions to current and next generation threat capabilities. Note: In FY 1998, Congress added $3.75 million for Closed-Loop Infrared Countermeasures technology and $5.0 million for Precision Location and Identification technologies, which explains the perceived decrease in FYs 1999 and out.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	32,540	25,553	26,533	27,486	Cont
(U) Appropriated Value	34,371	25,553			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-1,125	-77			
b. SBIR	-754				
c. Omnibus/Other Above Threshold Reprogrammings	-221				
d. Below Threshold Reprogrammings	899				
(U) Adjustments to Budget Year Since FY1999 PB			801	-711	
(U) Current Budget Submit/FY 2000 PB	33,170	25,476	27,334	26,775	Cont

(U) Significant Program Changes: Not Applicable.

FY 1999: $792 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology	PROJECT 2432

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2432 Defensive System Fusion Technology	8,083	7,150	8,336	6,278	7,573	8,148	8,318	8,491	Continuing	Continuing

(U) A. Mission Description: This project develops and demonstrates techniques and technologies for integrating electronic combat sensors and system fusion. It also develops the advanced algorithms and assessment techniques necessary to cope with the projected multi-spectral threat and countermeasure environments for combat aircraft as well as those technology efforts required for command and control warfare, standoff jamming, and support countermeasures for denial, disruption, and suppression of adversary air defense operations. Included in these are: 1) advanced components and techniques needed to jam enemy radar; 2) novel electronic collection methods to inform the field commander of changes in the electronic environment; and 3) advanced standoff jammer technologies.

(U) FY 1998 ($ in Thousands):

- (U) $5,180 Developed low-cost technologies to demonstrate data fusion (e.g., threat, targeting, command and control, etc.) from off-board and on-board sensors to enhance situation awareness in both new and existing aerospace platforms, including hardware-in-the-loop demonstration of optimized sensor fusion technology suitable for tactical aircraft.
- (U) $2,379 Developed and investigated command and control (C2) warfare electronic attack (EA) techniques to suppress and counter adversary C2 networks. This included critical design of hardware/software designs for jamming modern digital C2 network links and preliminary technique designs to counter advanced navigation systems.
- (U) $524 Developed and evaluated advanced defensive techniques based on fusion of multiple information sources such as defensive sensors, offensive sensors, off-board broadcast information, off-board data links, and cooperative off-board sensors. This included completion of a preliminary design of a combat information system that integrates defensive avionics functions.
- (U) $8,083 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,335 Develop low-cost technologies to demonstrate data fusion (e.g., threat, targeting, command and control, etc.) from off-board and on-board sensors to enhance situation awareness in both new and existing aerospace platforms, including code optimization and completing preliminary design trade offs for candidate techniques and algorithms using commercial technology architectures.
- (U) $5,593 Develop and investigate C2 warfare EA techniques to suppress and counter adversary C2 networks. This includes completing critical hardware/software designs and fabricating components for denying modern digital C2 network links, fabricating EA demonstration model hardware, and preparing to test designs against advanced telemetry links.
- (U) $222 Identified as a source for SBIR.
- (U) $7,150 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 2432

(U) FY 2000 ($ in Thousands):

- (U) $1,894 Develop low-cost technologies to demonstrate data fusion (e.g., threat, targeting, command and control (C2), etc.) from off-board and on-board sensors to enhance situation awareness in both new and existing aerospace platforms, including ground demonstrating optimized sensor fusion algorithms in a coalition environment.
- (U) $1,500 Develop, as part of international cooperative effort, the combat information management technologies necessary to provide real-time situation awareness in a joint or coalition theater environment.
- (U) $3,514 Develop and investigate C2 warfare electronic attack (EA) techniques to suppress and counter adversary C2 networks. This includes completing a brassboard demonstration model, conducting ground/field testing against modern digital C2 network links, completing EA laboratory testing and threat exploitation, and designing experimental hardware/software to counter navigation and tracking systems.
- (U) $1,428 Conduct evaluations and risk reduction demonstrations of defensive sensors and fusion of multiple information sources for situational awareness, including conducting technology survivability trade studies for advanced fighter applications.
- (U) $8,336 Total

(U) FY 2001 ($ in Thousands):

- (U) $904 Develop low-cost technologies to demonstrate data fusion (e.g., threat, targeting, C2, etc.) from off-board and on-board sensors to enhance situation awareness in both new and existing aerospace platforms, including flight demonstrating optimized sensor fusion algorithms on a joint coalition tactical platform as part of international cooperative effort.
- (U) $3,446 Develop and investigate C2 warfare EA techniques to suppress and counter adversary C2 networks, including transitioning an EA suite and fabricating experimental hardware/software for countering navigation and tracking systems.
- (U) $1,441 Conduct evaluations and risk reduction demonstrations of defensive sensors and fusion of multiple information sources for situational awareness, including evaluating in the laboratory receiver technology for advanced fighter applications.
- (U) $487 Develop affordable threat alert technologies for combat aircraft to increase survivability against advanced, integrated radio frequency air defense systems, including trade study analyses for techniques to defeat future threat radar guided missile systems.
- (U) $6,278 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 2432

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0604270F, Electronic Warfare (EW) Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology	PROJECT 431G

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
431G Radio Frequency (RF) Warning and Countermeasures	12,278	9,187	8,501	7,639	8,696	8,775	8,957	9,143	Continuing	Continuing

(U) A. Mission Description: This project develops and demonstrates advanced technologies for radio frequency (RF) electronic countermeasures (ECM) suites to enhance survivability of air and space vehicles and to provide crew situation awareness. One major area addressed covers technologies for missile/threat warning, radar frequency receivers, EC preprocessors, advanced sorting/preprocessing algorithms, and expert software for applications on existing and future EC systems. Another major technology area focuses on the development and demonstration of subsystems and components for generating on-board/off-board RF countermeasure techniques. This includes the development of novel ECM techniques as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc. Note: In FY 1998, Congress added $5.0 million for Precision Location and Identification technologies.

(U) FY 1998 ($ in Thousands):

- (U) $2,135 Developed low-cost advanced radar and RF emitter warning concepts and techniques, including demonstration of evolving jam-on-pulse RF receiver technology and development of wideband digital receiver technology based on PE 0602204F brassboard test.
- (U) $6,649 Developed aircraft self-protection technologies to counter advanced RF threats associated with current and future air defense weapon systems, including completion of design of critical flight-worthy components necessary to jam monopulse radar systems and trade studies for improving performance of current inventory RF countermeasures suites.
- (U) $3,494 Developed technology for multiaperture precision location and identification (PLAID) of ground and airborne RF emitters, including modification of PLAID algorithms for use with the antenna baselines of slow-moving, large aircraft and completion of initial design of a common radar warning receiver subcomponent to reduce risk of transitioning PLAID technology to large aircraft.
- (U) $12,278 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,554 Develop low-cost advanced radar and RF emitter warning concepts and techniques, including a preliminary design for a wideband digital receiver for affordable electronic support measures and radar warning receiver suites and completing a design for an advanced antenna that improves gain by a factor of ten at half the cost of current designs.
- (U) $6,347 Develop aircraft self-protection and support jamming technologies to counter advanced RF threats associated with current and future air defense weapon systems, including developing and demonstrating monopulse angle jamming electronic countermeasures, developing steerable high-power arrays, completing design trade offs for affordable improvements to existing ECM suites, and developing multifunction, compact, modular ECM jamming technology.
- (U) $286 Identified as a source for SBIR.
- (U) $9,187 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 431G

(U) FY 2000 ($ in Thousands):

- (U) $1,534 Develop low-cost advanced radar and radio frequency (RF) emitter warning concepts and techniques, including completing fabrication of a wideband digital receiver for affordable electronic support measures (ESM) and radar warning receiver suites.
- (U) $3,883 Develop wideband, multimode, multifunction apertures for electronic warfare applications, including fabricating an advanced antenna that improves gain by a factor of ten at half the cost of current designs.
- (U) $3,084 Develop aerospace platform self-protection and support jamming technologies to counter advanced RF threats associated with current and future air defense weapon systems, including developing electronic countermeasure (ECM) techniques to increase satellite survivability, laboratory testing a steerable high-power array, and demonstrating advanced monopulse angle jamming techniques.
- (U) $8,501 Total

(U) FY 2001 ($ in Thousands):

- (U) $1,100 Develop low-cost advanced radar and RF emitter warning concepts and techniques, including evaluating a wideband digital receiver for affordable ESM and radar warning receiver suites.
- (U) $4,260 Develop wideband, multimode, multifunction apertures for electronic warfare applications, including integrating and testing multimode antennas to demonstrate much improved performance in determining angle to a threat radar.
- (U) $2,279 Develop aerospace platform self-protection and support jamming technologies to counter advanced RF threats associated with current and future air defense weapon systems, including conducting laboratory evaluations of ECM techniques to increase satellite survivability, completing demonstration of a steerable high-power array, and designing and developing a flight-worthy brassboard for monopulse angle jamming integrated electronic countermeasures.
- (U) $7,639 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 431G

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0604270F, Electronic Warfare (EW) Development.
- (U) PE 0604270N, EW Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603270F Electronic Combat (EC) Technology / PROJECT: 691X

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
691X Electro-Optical/Infrared (EO/IR) Warning and Countermeasures	12,809	9,139	10,497	12,858	10,700	10,683	11,057	11,337	Continuing	Continuing

(U) A. Mission Description: This project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical (EO), infrared (IR), and laser threat systems. The off-board (decoys and expendables) and on-board countermeasure technologies developed will provide robust, affordable solutions for protection against IR missiles with autonomous seekers, multi-spectral threats, laser-guided weapons, and EO/IR tracking systems used to direct EO/IR/radio frequency (RF) missiles. Countermeasure capability against advanced EO, IR, and laser-guided threats are vital for operational platforms survival in wartime, peacekeeping, and supply mission environments. Note: In FY 1998, Congress added $3.75 million for Closed-Loop Infrared Countermeasures technology.

(U) FY 1998 ($ in Thousands):

- (U) $11,270 Developed on-board, threat adaptable, laser-based infrared countermeasure (IRCM) technology and off-board (active decoy) technology to defeat current and future IR missiles in multiple scenarios. This effort included tower tests of threat-adaptable, laser-based jamming codes, fabrication and integration of brassboard demonstration hardware, hardware-in-the-loop and digital simulation experiments, field tests and demonstration of signature management technologies, development and fabrication of a two-color missile warning sensor to hand-off missile detection to the countermeausure system, and development of a miniature pointer-tracker.
- (U) $1,069 Developed laser warning and countermeasure technologies necessary to defeat advanced day/night EO/IR acquisition/tracking sensors on threat air defense systems, including completion of technique development for laser beamrider missile detection, development of non-mechanical beam-steering technologies, and completion of threat definition for concept design of IR/RF decoys for multimode threat seekers.
- (U) $470 Developed IR missile warning technologies to detect advanced, low signature threat missiles, including evaluation of uncooled IR focal plane arrays, assessment of use of commercial image processors for IR threat algorithms, and design of IR sensors and algorithms.
- (U) $12,809 Total

(U) FY 1999 ($ in Thousands):

- (U) $5,184 Develop on-board, closed-loop, laser-based infrared countermeasure technology and off-board (active decoy) technology to defeat current and future infrared (IR) missiles in multiple scenarios, including continued tower testing of threat-adaptable, laser-based jamming codes, live fire IR demonstrations at White Sands Missile Range against brassboard demonstration hardware, and design of flight-worthy closed-loop laser IRCM hardware for flight demonstrations in a C-17 or other large aircraft.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
	PROJECT 691X

- (U) $751 Conduct in-house experiments to analyze current and future infrared (IR) threat missiles, including developing digital threat models of threat IR missiles, and validating countermeasure techniques for conventional IR missiles, and developing a target simulator for imaging IR seekers.
- (U) $1,998 Develop aerospace laser warning and countermeasure technologies necessary to defeat advanced laser acquisition/tracking sensors on threat air defense systems, including detecting and locating both high power (dazzle/damage) and low-power (laser guided ordinance) signals, and completing threat modeling technologies to counter dual-mode missile seekers.
- (U) $922 Develop infrared (IR) missile warning technologies to detect advanced, low signature threat missiles, including developing distributed aperture algorithms and clutter rejection techniques.
- (U) $284 Identified as a source for SBIR.
- (U) $9,139 Total

(U) FY 2000 ($ in Thousands):

- (U) $5,786 Develop on-board, closed-loop, laser infrared countermeasures (IRCM) for large aircraft to defeat current and future IR missiles in multiple scenarios, including completing live fire aerial cable car testing at White Sands Missile Range and fabricating a flight-worthy closed-loop IRCM suite for demonstration on C-17 or other large aircraft.
- (U) $1,725 Conduct in-house analysis of current and future IR threat missiles, including refining digital threat models, creating countermeasure techniques for imaging IR missiles, and integrating a target simulator for imaging IR seekers.
- (U) $942 Develop aerospace laser warning technologies for timely alert and response to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser guided ordnance) signals, and developing low-cost warning technologies for special operations aircraft.
- (U) $2,044 Develop IR missile warning technologies to detect advanced, low signature threat missiles, including evaluating distributed aperture algorithms, collecting data, and demonstrating real-time missile warning algorithms for low-cost, uncooled sensors.
- (U) $10,497 Total

(U) FY 2001 ($ in Thousands):

- (U) $3,634 Develop on-board, closed-loop, laser IRCM for large aircraft to defeat current and future IR missiles in multiple scenarios, including integration and flight testing of closed-loop IRCM technology on a C-17 or other large aircraft.
- (U) $1,325 Conduct in-house analysis of current and future IR threat missiles, developing digital models of IR threat missiles and testing countermeasure techniques for conventional and imaging IR missiles.
- (U) $1,092 Develop aerospace laser warning technologies for timely alert and response to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser guided ordnance) signals, testing low-cost warning for special operations aircraft, and space-based laser warning sensors.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270F Electronic Combat (EC) Technology
PROJECT 691X	

- (U) $2,109 Develop infrared (IR) missile warning technologies to detect advanced, low signature threat missiles, including evaluating hyperspectral imaging technology for use in missile warning and/or as a distributed aperture sensor.
- (U) $2,766 Develop the laser countermeasure technology to defeat advanced electro-optical/infrared (EO/IR) acquisition/tracking sensors that allow threat air defense systems to track air and space platforms in day or night, including gimballess beam steering technologies.
- (U) $1,932 Develop technology to defeat imaging IR missiles, including decoys and lethal expendables.
- (U) $12,858 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602204F, Aerospace Sensors.
- (U) PE 0604270F, Electronic Warfare (EW) Development.
- (U) PE 0604270N, EW Development.
- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	15,407	23,982	11,231	10,863	11,498	12,269	22,992	22,472	Continuing	TBD
0003	Launch Vehicle Technology	608	584	0	0	0	0	0	0	0	TBD
4373	Launch and Orbit Transfer Propulsion Technology	13,240	21,598	9,457	9,374	10,003	10,766	21,457	20,905	Continuing	Continuing
6339	Tactical Propulsion Technology	144	292	288	0	0	0	0	0	0	TBD
6340	Satellite Control and Maneuvering Propulsion Technology	1,415	1,508	1,486	1,489	1,495	1,503	1,535	1,567	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Project 0003 transfers to PE 0603401F, Project 1026, starting in FY 2000. Strategic sustainment efforts have been consolidated in Project 4373; this involved moving the Post-Boost Control and Non-Destructive Evaluation efforts and associated funding from Project 6340 to Project 4373. The electric propulsion efforts, originally in Project 4373, have been moved to Project 6340. Efforts in Project 6339 will be terminated at the end of FY 2000. Finally, solar thermal efforts have been moved from Project 6340 to Project 4373.

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates advanced rocket propulsion and space launch technologies. This program provides the technological step necessary to transition the most promising rocket propulsion and space launch technologies to applications using full-scale, proof-of-principle demonstrations. The projects within this program are structured to support Air Force Space Command's and Air Combat Command's mission area requirements for space and missile technologies which include the goals established in the Integrated High Payoff Rocket Propulsion Technology Initiative, a multi-agency/industry effort to focus the development of U.S. rocket propulsion technology. New and improved components will be integrated with the environmentally improved propellants developed in this program to create new propulsion systems for the next generation of launch vehicles and satellites. Anticipated technological advances in this program will improve the performance of expendable systems' payload capabilities by 21% and reduce the launch and operations and support (O&S) costs by 28%. In a reusable launch system, the anticipated improvements are an increase in payload capability of 170% and a reduction in launch and O&S costs of 79%. The advances in propulsion in this program result from the achievement of the 2010 goals of the Integrated High Payoff Rocket Propulsion Technology Initiative. The development of these technologies has been coordinated with National Aeronautics and Space Administration (NASA) to eliminate duplication of efforts. The space launch and missile propulsion industry will leverage the technologies from this program to enhance the country's industrial competitiveness. Note: In FY 1999, Congress added $3 million for Integrated High Payoff Rocket Propulsion Technology (IHPRPT).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	17,249	21,121	21,622	21,332	Cont
(U) Appropriated Value	18,147	24,121			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-609	-139			
b. SBIR	-302				
c. Omnibus/Other Above Threshold Reprogrammings	-116				
d. Below Threshold Reprogrammings	-1,713				
(U) Adjustments to Budget Year Since FY 1999 PB			-10,391	-10,469	
(U) Current Budget Submit/FY 2000 PB	15,407	23,982	11,231	10,863	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $682 identified as a source for SBIR.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

PROJECT: 0003

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
0003 Launch Vehicle Technology	608	584	0	0	0	0	0	0	0	TBD

(U) A. Mission Description: This project develops advanced and innovative launch vehicle technologies in the areas of structures (i.e., fairings, interstages, struts, thermal protection systems, etc.), tanks, and operations. Project 0003 transfers to PE 0603401F, Project 1026, starting in FY 2000.

(U) FY 1998 ($ in Thousands):

- (U) $125 Defined technological needs for future reusable military launch vehicles including lightweight airframe structures, durable composite cryogenic tanks, lightweight combined thermally protecting structures, and integrated acoustic attenuation.
- (U) $57 Defined technological needs for future expendable launch vehicles including operations technologies, lightweight structures, durable composite cryogenic tanks, secondary payload insertion structures, and integrated acoustic attenuation.
- (U) $426 Fabricated advanced composite launch vehicle structures including full-size interstage and grid stiffened shrouds.
- (U) $608 Total

(U) FY 1999 ($ in Thousands):

- (U) $150 Continue to define technological needs for future reusable military launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and structure multifunctionality including thermal and acoustic tailorability.
- (U) $100 Continue to define technological needs for future expendable launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and structure multifunctionality including thermal and acoustic tailorability.
- (U) $317 Develop advanced composite launch vehicle structures including grid stiffened shrouds.
- (U) $17 Identified as a source for SBIR.
- (U) $584 Total

(U) FY 2000: Not Applicable.

(U) FY 2001: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
	PROJECT 0003

(U) B. Project Change Summary - Description of Significant Changes: In FY 2000, efforts currently in this project move to PE 0603401F, Project 1026.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603401F, Advanced Spacecraft Technology.
- (U) PE 0603853F, Evolved Expendable Launch Vehicle Program.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
	PROJECT 4373

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4373 Launch and Orbit Transfer Propulsion Technology	13,240	21,598	9,457	9,374	10,003	10,766	21,457	20,905	Continuing	Continuing

(U) A. Mission Description: This project develops advanced and innovative, low-cost rocket turbomachinery and components, low-cost space and missile launch propulsion system manufacturing technologies, and advanced propellants. Characteristics such as environmental acceptability, affordability, reliability, reduced weight, reduced operation and launch costs, and increased life and performance of propulsion systems are emphasized in this project. Technological advances developed in this program will improve the performance of expendable systems' payload capabilities by 21% and reduce the launch and operations and support (O&S) costs by 28%. The advances in propulsion in this program will result from the achievement of the 2010 goals of the Integrated High Payoff Rocket Propulsion Technology Initiative.

(U) FY 1998 ($ in Thousands):

- (U) $8,004 Developed propulsion technologies for existing and future launch vehicles. Fabricated and tested cryogenic engine turbomachinery that provide higher reliability for large liquid engines.
- (U) $1,336 Developed propulsion technologies for existing and future upper stage and orbit transfer vehicles. Fabricated and tested combustion chamber for liquid upper stage engines, solar electric propulsion, and solar thermal propulsion.
- (U) $3,900 Developed technologies for the sustainment of strategic systems. Initiated a multi-use, less detonable (Class 1.3) solid propellant project which meets all Intercontinental Ballistic Missile (ICBM) requirements, reduces hardware costs by 25%, and sustains current performance levels.
- (U) $13,240 Total

(U) FY 1999 ($ in Thousands):

- (U) $14,889 Continue to develop propulsion technologies for existing and future launch vehicles. Complete fabrication and testing of oxygen and hydrogen turbopump assemblies and preburner components for integration into an advanced liquid booster engine.
- (U) $3,096 Continue to develop propulsion technologies for existing and future upper stage and orbit transfer vehicles. Complete component testing and begin integration of components into demonstrator engine. Demonstrate solar thermal propulsion technology in ground test to prove performance increase up to 800 seconds specific impulse (Isp).
- (U) $3,000 Develop technologies for the sustainment of strategic systems. Continue development of a multi-use, less detonable (Class 1.3) solid propellant which meets all ICBM requirements, reduces hardware costs by 25%, and sustains current performance levels.
- (U) $613 Identified as a source for SBIR.
- (U) $21,598 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
	PROJECT 4373

(U) FY 2000 ($ in Thousands):

- (U) $3,864 Begin developing propulsion components for existing and future launch vehicles. Initiate fabrication and assembly of combustion chamber and injector for use in large liquid engines.
- (U) $3,000 Continue testing of oxygen and hydrogen turbopump assemblies and preburner components for integration into an advanced liquid booster engine. Testing will demonstrate a 1% increase in performance of cryogenic engines.
- (U) $2,593 Develop propulsion technologies for existing and future upper stage and orbit transfer vehicles. Complete integration of components into high-pressure cryogenic upper stage test bed engine.
- (U) $9,457 Total

(U) FY 2001 ($ in Thousands):

- (U) $7,374 Initiate the Phase II cryogenic booster engine demonstration by performing engine concept selection. This engine has the goal of reducing costs by 50%, reducing weight by 40%, and increasing thrust to weight by 60%.
- (U) $1,000 Begin preliminary design of Phase II cryogenic booster engine.
- (U) $1,000 Begin investigating new materials and fabrication processes that can reduce the cost of the Phase II cryogenic booster.
- (U) $9,374 Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603853F, Evolved Expendable Launch Vehicle Program.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

PROJECT: 6339

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
6339 Tactical Propulsion Technology	144	292	288	0	0	0	0	0	0	TBD

(U) A. Mission Description: This project develops highly energetic propellants and propulsion systems. Improved case, insulation, and propellant interfaces as well as better performing nozzles will be developed. Technology such as thrust vector control, thrust modulation, signature characterization, and signature reduction will be developed in this project. The emphasis in this project is on rocket propulsion system affordability and weight reduction. Anticipated payoffs from these developments, identified through the Integrated High Payoff Rocket Propulsion Technology Initiative (IHPRPT), include a 49% range increase, 50% size reduction, 100% payload increase, and 21% reduction in time-to-target.

(U) FY 1998 ($ in Thousands):

- (U) $144 Developed and evaluated advanced solid propellants, in small quantities, that can be incorporated into the design and manufacturing of future tactical missile systems. These propellants have acceptable hazards, higher performance, lower environmental impact, and reduced exhaust signature characteristics. After propellant development, began to characterize solid propellant formulations in lab-size quantities. In conjunction with France, Germany, and the United Kingdom, downselected to two propellant formulations and scale-up to gallon quantities for further evaluation. Initiated propellant scale-up for rheological and hazards properties. Provided initial propellant formulations and ingredient samples to the France, Germany, and the United Kingdom for their internal evaluation.
- (U) $144 Total

(U) FY 1999 ($ in Thousands):

- (U) $283 Begin scale-up of selected solid propellant formulations that can be incorporated into the design and manufacture of future air-to-air missile systems for the U.S., France, Germany, and the United Kingdom. These propellants will have acceptable hazards, higher performance, lower environmental impact, and reduced exhaust signature characteristics. Complete solid propellant scale-up and finalize rheological and hazards properties. Complete ballistic performance evaluation in U.S. test motors (15 lbs.) and manufacture initial European test motors for their internal evaluation.
- (U) $9 Identified as a source for SBIR.
- (U) $292 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
	PROJECT 6339

(U) FY 2000 ($ in Thousands):

- (U) $288 Integrate component technologies and an advanced tactical missile propellants that improve missile thrust and reduce plume exhaust signatures. Manufacture European test motors and selected propellant samples incorporating an advanced high performance, acceptable hazards, low environmental impact, and reduced signature propellant. Ship these rocket test motors to our European partners (France, Germany, and the United Kingdom) and participate in their evaluations of performance, signature, hazards, mechanical, and aging properties.
- (U) $288 Total

(U) FY 2001: Not Applicable.

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602303A, Missile Technology.
- (U) PE 0603313A, Missile and Rocket Advanced Technology.
- (U) PE 0603792N, Advanced Technology Transition.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603302F Space and Missile Rocket Propulsion

PROJECT: 6340

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
6340 Satellite Control and Maneuvering Propulsion Technology	1,415	1,508	1,486	1,489	1,495	1,503	1,535	1,567	Continuing	Continuing

(U) A. Mission Description: Chemical, electric, and solar rocket propulsion system technologies for station keeping and on-orbit maneuvering applications are developed in this project. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy chemical propellants. The payoffs for the Integrated High Payoff Rocket Propulsion Technology Initiative (IHPRPT) include a seven-year increase in satellite on-orbit time, a 50% increase in satellite maneuvering capability, a 25% reduction in orbit transfer operational costs, and a 15% increase in satellite payload.

(U) FY 1998 ($ in Thousands):

- (U) $215 Flight-qualified water resistojet for use on the first flight of the MightySat space demonstration.
- (U) $200 Performance goals of a water resistojet were successfully evaluated for use on the first flight of the MightySat space demonstration.
- (U) $1,000 Initiated the Non-Destructive Evaluation (NDE) data processing technologies project to predict solid rocket motor service life to ten years with a 90% confidence level. The NDE project will avoid the current necessity of condemning an entire population of motors when only a few are unacceptable.
- (U) $1,415 Total

(U) FY 1999 ($ in Thousands):

- (U) $500 Complete plume diagnostic experiment, flight qualification testing, spacecraft integration, and test of a water resistojet for the MightySat space demonstration.
- (U) $175 Launch the high power 30kW Class ammonia arcjet thruster aboard the ARGOS satellite, collect flight data, and correlate with ground test data to assess on-orbit performance and spacecraft interaction. Evaluate possibilities of using arcjet in flight systems.
- (U) $410 Complete Critical Design Review (CDR) and fabricate a high performance Hall thruster system for ground demonstration of system life.
- (U) $380 Continue the development of NDE data processing technologies project to predict solid rocket motor service life to ten years with a 90% confidence level. Finalize the NDE system specification, finalize the test imager design, and begin software development.
- (U) $43 Identified as a source for SBIR.
- (U) $1,508 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603302F Space and Missile Rocket Propulsion
	PROJECT 6340

(U) FY 2000 ($ in Thousands):

- (U) $455 Launch the MightySat space flight experiment with water resistojet for primary propulsion. Perform in-flight measurements of thruster performance and satellite contamination for comparison to ground measurements.
- (U) $131 Complete component tests, integration of components, and scheduled ground demonstration of a flight-qualified high performance Hall thruster system. Engine demonstration will prove 1% performance specific impulse (Isp) improvement for integration into future upper stage engines.
- (U) $900 Continue engine testing of the high-pressure cryogenic upper stage engine.
- (U) $1,486 Total

(U) FY 2001 ($ in Thousands):

- (U) $517 Demonstrate solar electric propulsion technologies for satellite stationkeeping, repositioning, and orbit transfer. Analyze data from MightySat space flight and validate against ground measurements. Develop models for spacecraft interaction with water resistojet propulsion exhaust.
- (U) $472 Complete engine testing of the high-pressure cryogenic upper stage engine.
- (U) $500 Begin analysis of test data from high-pressure cryogenic upper stage engine, focusing on potential improvements for the Phase II upper stage engine demonstrations.
- (U) $1,489 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603311F Ballistic Missile Technology

PROJECT: 4091

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4091 Missile Electronics	7,485	15,955	0	0	0	0	0	0	0	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program funds the development, and particularly the integrated demonstration, of advanced guidance, navigation, and control packages for ballistic missiles. These technologies are flown as Missile Technology Demonstration flights. Efforts directly support strategic force sustainment, space force applications, and space navigation. Also funded are upgrades for range and safety instrumentation for ballistic missiles. Emphasis is on technologies which increase safety, reduce maintenance, and improve reliability of the currently deployed intercontinental ballistic missile (ICBM) force at a lower life cycle cost. Future precision guidance and navigation technologies are demonstrated on sounding rocket and ICBM flights that support conventional ballistic missiles and hard and deeply buried target defeat capability technology needs. Note: This program was eliminated at the end of FY 1997; however, Congress added funds for Missile Technology Demonstration (MTD) flight testing and Radiation Hardened Electronics in FY 1998 and for Ballistic Missile Technology and Range Safety in FY 1999.

(U) FY 1998 ($ in Thousands):

- (U) $4,240 Developed advanced boost guidance technology to reduce current operations costs and improve reliability and maintainability of existing systems. Developed precision navigation systems for future ICBM-delivered conventional munitions. Began development, integration, and testing of advanced solid state navigation technology for ICBM and space applications.
- (U) $250 Developed advanced navigation technology to support range instrumentation and improved safety requirements. Flight tested Global Positioning System (GPS)-based navigation packages coupled directly with Inertial Navigation Systems (INS) to improve the accuracy, range, and safety of ballistic missiles and space systems.
- (U) $715 Developed radiation hardened analog circuit technology for missile guidance systems. Designed and fabricated a twelve-bit analog converter. Stimulated a new second source supplier for radiation hardened analog components.
- (U) $2,280 Improved radiation hardened digital circuit fabrication processes to facilitate evolutionary missile technology. Established new design tools for miniaturizing radiation hardened computer components. Initiated design effort to decrease digital circuit size by 50% while keeping pace with commercial computer performance.
- (U) $7,485 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603311F Ballistic Missile Technology
	PROJECT 4091

(U) FY 1999 ($ in Thousands):

– (U)	$11,985	Develop technologies for integration of advanced Global Positioning System - Inertial Navigation System (GPS-INS) technology into ballistic missile guidance systems and range instrumentation to meet more stringent range safety requirements. Transition proven advanced technologies into range qualification test programs.
– (U)	$2,980	Enhance GPS-INS navigation technologies to improve performance during the plasma blackout phase of ballistic missile reentry by applying current GPS anti-jamming technologies to ballistic missile technologies, developing advanced anti-jamming antenna architectures, and extending radiation hardening technologies to ballistic missile electronics systems.
– (U)	$500	Develop technologies for evaluating the service life and aging properties of ballistic missile components and materials such as the component polymeric materials.
– (U)	$490	Identified as a source for SBIR.
– (U)	$15,955	Total

(U) FY 2000: Not Applicable.

(U) FY 2001: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603311F Ballistic Missile Technology
	PROJECT 4091

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	7,537	0	0	0	Cont
(U) Appropriated Value	8,000	16,000			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-262	-45			
b. SBIR	-202				
c. Omnibus/Other Above Threshold Reprogrammings	-51				
d. Below Threshold Reprogrammings	0				
(U) Adjustments to Budget Year Since FY 1999 PB					
(U) Current Budget Submit/FY 2000 PB	7,485	15,955	0	0	TBD

(U) Significant Program Changes: Not Applicable.

FY 1999: $490 identified as a source for SBIR.

(U) D. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602204F, Aerospace Sensors.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) E. Acquisition Strategy: Not Applicable.

(U) F. Schedule Profile: Not Applicable

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

	COST *($ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	91,754	75,542	76,229	116,300	100,863	74,852	64,876	54,501	Continuing	Continuing
1026	Space Structures and Controls Technology	1,520	1,773	3,700	4,390	3,953	4,134	4,220	4,308	Continuing	Continuing
2181	Space Electronics and Software Technology	11,223	12,864	13,295	13,104	14,387	12,206	12,500	12,871	Continuing	Continuing
3784	Space Sensors and Satellite Communication Technology	2,410	1,745	4,702	5,913	4,080	3,426	3,473	3,544	Continuing	Continuing
3834	Integrated Space Technology Demonstrations	46,185	33,172	18,893	18,792	20,009	22,862	24,235	22,735	Continuing	Continuing
4400	Satellite Survivability Technology	5,353	5,779	2,616	3,859	4,773	4,661	4,340	4,006	Continuing	Continuing
4599	Reusable Launch Vehicle Technology	21,780	0	0	0	0	0	0	0	TBD	TBD
4782	Discoverer II	0	15,479	28,670	67,216	48,501	21,522	9,668	0	0	191,056
682J	Space Power and Thermal Management Technology	3,283	4,730	4,353	3,026	5,160	6,041	6,440	7,037	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 1998, the low-cost launch vehicle technology development program was moved from PE 0603302F, Project 4373, to this PE in Project 4599. Discoverer II funding has been moved from PE 0603856F to Project 4782 for FY 1999 and beyond. In FY 2000, the spectral sensing work in PE 0603605F, Project 3150, moves into this PE, Project 3784. Also in FY 2000, PE 0603302F, Project 0003, Launch Vehicle Technology, was combined with Project 1026 in this PE.

(U) A. Mission Description: This Advanced Technology Development program develops advanced spacecraft technologies such as structures, electronics, thermal management systems, power, and sensors and demonstrates them in an appropriate fashion (i.e., component or system, ground, or flight). The broad goals of the program are to decrease the time for innovative space technology to be transitioned to the warfighter and to reduce the associated development costs and risks of future Air Force space-based systems. Developmental efforts are focused on six high-payoff, satellite technology areas: (1) reusable and low-cost launch vehicle technologies; (2) advanced space structures and structural controls; (3) radiation hardened space electronics, satellite control software, and intelligent satellite systems; (4) advanced passive/active

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology

space-based sensors; (5) compact, low-cost space power and thermal management; and (6) satellite survivability and protection. In FYs 1999 and out, additional emphasis has been placed

on evolutionary growth in space technologies. Also starting in FY 1999, the technology development work supporting the integrated demonstrations of advanced guidance, navigation, and control packages for ballistic missiles is funded by this PE. Note: Congress added $57.5 million in FY 1998 ($5 million for Low-Cost Launch Vehicle Technologies (previously funded in PE 0603302F/0634373), $7.5 million for Solar Thermionics Orbital Transfer Vehicle, $5 million for Miniature Threat Reporting System (MSTRS), $10 million for Reusable Launch Vehicle (Military Spaceplane), and $30 million for Microsat Technology (Clementine 2)), and $18 million in FY 1999 ($2.5 million for Low-Cost Launch Vehicle Technologies, $4.5 million for Solar Thermionics Orbital Transfer Vehicle (SOTV), $5 million for Miniature Threat Reporting System, and $6 million for Microsat Technology). The Low-Cost Launch Vehicle Technologies and Solar Thermionics Orbital Transfer Vehicle Congressional Add programs were funded in Project 4599 in FY 1998, but were shifted to Project 3834 in FY 1999.

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	54,899	42,571	47,005	50,961	Cont
(U) Appropriated Value	98,346	60,571			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-2,112	-508			
b. SBIR	-964				
c. Omnibus/Other Above Threshold Reprogrammings	-372	15,479			
d. Below Threshold Reprogrammings	-3,144				
(U) Adjustments to Budget Year Since FY 1999 PB			29,224	65,339	
(U) Current Budget Submit/FY 2000 PB	91,754	75,542	76,229	116,300	Cont

(U) Significant Program Changes: FY 2000 and FY 2001 funding adjustments continue the Discoverer II demonstration and risk reduction program. Funding will begin the development of two satellites and associated technologies to be ready for launches in FYs 2003 and 2004.

FY 1999: $1,215 identified as a source for SBIR.

FY 1999: $15,479 for Discover II is being executed under PE 0603856F, but is being reported here for continuity purposes.

	DATE **February 1999**
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603401F Advanced Spacecraft Technology**

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 1026

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
1026 Space Structures and Controls Technology	1,520	1,773	3,700	4,390	3,953	4,134	4,220	4,308	Continuing	Continuing

(U) A. Mission Description: This project demonstrates advanced composite structures and structural control technologies for future Air Force space and missile systems. Prior to FY 1995, the Air Force relied on Ballistic Missile Defense Organization (BMDO) funding to address its needs in this technology area. As BMDO budgets have declined, so has their funding in this area, necessitating an increased Air Force investment to maintain critical spacecraft structures and controls technologies. Advanced space structure component efforts focus on the demonstration of new composite structure technologies. The goal is to significantly improve the payload mass fraction and reduce overall spacecraft fabrication time and cost. This project also pays for the development of advanced passive and active spacecraft structural control technologies. Structural vibration and shock suppression technologies are intended to significantly enhance space platform stability, improving the focusing/imaging ability of space-based optical components such as focal plane arrays developed in Project 3784 or solar cells developed in Project 682J.

(U) FY 1998 ($ in Thousands):
- (U) $676 Developed composites for launch vehicle and spacecraft structures for applications such as the MightySat experimental spacecraft.
- (U) $260 Developed revolutionary spacecraft structural control and mechanisms technologies for applications such as advanced solar array subsystems and sensitive payload isolation systems.
- (U) $584 Developed advanced launch vehicle vibration isolation and payload isolation systems; demonstrated the first whole spacecraft isolation system on the Taurus launch vehicle.
- (U) $1,520 Total

(U) FY 1999 ($ in Thousands):
- (U) $785 Develop composites for launch vehicle and spacecraft structures for applications such as the lightweight space antenna. Develop spacecraft to demonstrate multifunctional structures technologies.
- (U) $272 Develop revolutionary spacecraft structural control and mechanisms technologies for applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems for sensors and communications systems.
- (U) $680 Develop launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements.
- (U) $36 Identified as a source for SBIR.
- (U) $1,773 Total

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BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology
	PROJECT: 1026

(U) FY 2000 ($ in Thousands):

- (U) $1,101 Develop composites for launch vehicle and spacecraft structures for applications such as the lightweight space antenna. Develop spacecraft to demonstrate multifunctional structures technologies.
- (U) $288 Develop and demonstrate revolutionary spacecraft structural control and mechanisms technologies for applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems for sensors and communications systems.
- (U) $1,256 Develop launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements.
- (U) $1,055 Develop advanced composite launch vehicle structures such as grid stiffened shrouds for launch vehicles and lightweight thermal protection structures for reusable launch vehicles. Define technological needs for future military launch vehicles.
- (U) $3,700 Total

(U) FY 2001 ($ in Thousands):

- (U) $1,249 Develop composites for launch vehicle and spacecraft structures for applications such as the lightweight space antenna. Develop spacecraft to demonstrate multifunctional structures technologies.
- (U) $239 Develop and demonstrate revolutionary spacecraft structural control and mechanisms technologies for applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems for sensors and communications systems.
- (U) $1,584 Develop launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements.
- (U) $1,318 Develop advanced composite launch vehicle structures such as lightweight thermal protection structures for reusable launch vehicles and lightweight acoustically damped launch vehicle structures. Define technological needs for future military launch vehicles.
- (U) $4,390 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology
	PROJECT 1026

(U) B. Project Change Summary - Description of Significant Changes: In FY 2000, efforts currently in PE 0603302F, Project 0003 (Launch Vehicle Technology), move into this project.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603218C, Research and Support.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 2181

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2181 Space Electronics and Software Technology	11,223	12,864	13,295	13,104	14,387	12,206	12,500	12,871	Continuing	Continuing

(U) A. Mission Description: This project funds the development, demonstration, and evaluation of radiation hardened space electronic hardware, and satellite control hardware and software for advanced satellite surveillance operations. Improved space-qualifiable electronics and software for data and signal processing are to be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (i.e., hardening) commercial data and signal processor technologies for use in Air Force space systems. Advanced electronic packaging technologies that reduce weight and volume are being developed for military space applications. Space data processor technologies like the Advanced Technology Insertion Module (ATIM 32-bit) technology are developed and demonstrated. The Advanced Spaceborne Computer Module (ASCM), ATIM's 16-bit predecessor, is currently baselined into 65 DoD, National Aeronautics and Space Administration (NASA), and commercial programs. Also developed and demonstrated are space signal processor technologies like the Hardened Ada Signal Processor (HASP) program. For mid-term applications, the Improved Space Computer Program (ISCP) will merge advanced, radiation-hardened space processor, memory, and interconnect technologies with commercially-derived, open system architectures to develop and demonstrate robust, on-board processing capabilities for 21st century DoD satellites. Additionally, this project demonstrates very low-power electronics allowing dramatic size, weight, and power reductions for future Air Force space applications. Low-cost, easily modifiable software and hardware architectures for enhanced satellite ground control and intelligent, autonomous satellite operations to support the space surveillance mission are also developed. The Multi-mission Advanced Ground Intelligent Control (MAGIC) program in this project developed a low-cost, flexible architecture for satellite control and mission operations. In the long-term, this project area focuses on developing fully autonomous constellations of intelligent satellites capable of performing all mission related functions without operator intervention.

(U) FY 1998 ($ in Thousands):

- (U) $8,603 Developed and demonstrated affordable, space-qualifiable, radiation hardened, low-power, high performance microelectronic devices such as data processors and digital signal processors.
- (U) $1,453 Developed space-qualifiable, high density advanced packaging technology for micro-electro-mechanical systems (MEMS) and microelectronics. Developed MEMS components and applications.
- (U) $1,167 Developed reusable, standardized satellite operations software for applications such as intelligent satellite ground control workstations and an autonomous satellite operations software testbed.
- (U) $11,223 Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology
	PROJECT 2181

(U) FY 1999 ($ in Thousands):

– (U)	$8,389	Develop and demonstrate affordable, space-qualifiable, radiation hardened, low-power, high performance microelectronic devices such as advanced data processors, and integrated and next generation digital signal processors.
– (U)	$1,148	Develop space-qualifiable, high density advanced packaging technology for digital, analog, and mixed-signal electronic devices. Develop micro-electro-mechanical systems (MEMS) components and MEMS-based space system applications.
– (U)	$2,182	Develop enhanced, standardized satellite operations software for application in satellite health and status verification and an autonomous satellite operations software testbed.
– (U)	$885	Develop modeling and simulation applications for space-based surveillance and distributed satellite system payloads.
– (U)	$260	Identified as a source for SBIR.
– (U)	$12,864	Total

FY 2000 ($ in Thousands):

– (U)	$8,844	Develop and demonstrate affordable, space-qualifiable, radiation hardened, low-power, high performance microelectronic devices such as advanced data processors and next generation digital signal processors.
–(U)	$1,440	Develop space-qualifiable, high density advanced packaging technology for digital, analog, and mixed-signal electronic devices. Develop and demonstrate MEMS components and applications.
– (U)	$2,115	Develop enhanced, standardized satellite operations software for application in autonomous satellite command and control systems and an autonomous satellite operations software testbed.
– (U)	$896	Develop modeling and simulation applications for space-based surveillance, distributed satellite system payloads, and autonomous/intelligent satellite systems.
– (U)	$13,295	Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology
	PROJECT 2181

FY 2001 ($ in Thousands):

–	(U)	$8,086	Develop and demonstrate affordable, space-qualifiable, radiation hardened, low-power, high performance microelectronic devices such as advanced data processors and next generation digital signal processors.
–	(U)	$1,317	Develop next generation high density packaging technology for digital, analog, and mixed signal devices in space environment. Develop and demonstrate MEMS components and applications.
–	(U)	$2,099	Develop enhanced, standardized satellite operations software for application in autonomous satellite command and control systems and an autonomous satellite operations software testbed.
–	(U)	$1,207	Enhance modeling and simulation applications for space-based surveillance, distributed satellite system payloads, and autonomous/intelligent satellite systems.
–	(U)	$395	Develop and test software architecture for the Space Hazards Analysis Workstation software.
–	(U)	$13,104	Total

(U) B. Project Change Summary - Description of Significant Changes: In FY 1999, the Modeling and Simulation efforts funded under Project 3834, in this PE, transition into this project.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0303601F, MILSTAR Satellite Communications System.
- (U) PE 0305160F, Defense Meteorological Satellite Program (DMSP).
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603311F, Ballistic Missile Technology.
- (U) PE 0603215C, Limited Defense System.
- (U) PE 0603218C, Research and Support.
- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.
- (U) PE 0604609F, Reliability and Maintainability Technology Insertion Program (RAMTIP).
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 3784

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3784 Space Sensors and Satellite Communication Technology	2,410	1,745	4,702	5,913	4,080	3,426	3,473	3,544	Continuing	Continuing

(U) A. Mission Description: This project funds the development of military space-based ground surveillance technologies. The project's work focuses on advancing space-based applications of commercial sensors while improving the performance, schedule, maturity, cost, and/or risk reduction. The focus of the space sensor effort is to meet spaceborne sensor needs for national missile defense and intelligence, surveillance, and reconnaissance missions.

(U) FY 1998 ($ in Thousands):
- (U) $1,339 Developed space-based reconnaissance/surveillance sensor technologies for reliable, large format focal plane arrays and advanced mid-wave infrared detectors.
- (U) $810 Developed technologies for Space-Based Radar (SBR) including the Transmit and Receive Antenna Module (TRAM) and a Radio Frequency (RF)/mechanical characterization laboratory for investigating structure and antenna performance.
- (U) $261 Developed SBR models and clutter database for SBR system antenna simulation.
- (U) $2,410 Total

(U) FY 1999 ($ in Thousands):
- (U) $286 Develop and demonstrate space-based reconnaissance/surveillance sensor technologies for advanced mid-wave infrared detectors and hybrid detector arrays.
- (U) $1,234 Develop technologies for SBR such as the next iteration TRAM module, antenna beamsteering algorithms for improved detection and tracking, and antenna vibration compensation schemes.
- (U) $190 Develop models for the SBR system. Model five antenna designs to simulate their performance in a wargaming environment.
- (U) $35 Identified as a source for SBIR.
- (U) $1,745 Total

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(U) FY 2000 ($ in Thousands):

- (U) $1,916 Develop space-based reconnaissance/surveillance sensor technologies such as advanced long wavelength infrared focal plane arrays, hyperspectral quantum well photodetectors, and detector and readout arrays for dual waveband infrared detection in moderate optical backgrounds.
- (U) $2,067 Develop and demonstrate technologies for Space-Based Radar (SBR) such as the Transmit and Receive Antenna Module (TRAM) II panel, integrated TRAM/multifunctional technologies, and antenna vibration compensation schemes. Extend SBR system models.
- (U) $719 Develop and refine technologies for spectral remote sensing data collection and exploitation to validate satellite precision orbit-prediction methodology and for ultra-spectral imaging concepts.
- (U) $4,702 Total

(U) FY 2001 ($ in Thousands):

- (U) $2,303 Develop space-based reconnaissance/surveillance sensor technologies such as advanced long wavelength infrared focal plane arrays, hyperspectral quantum well photodetectors, and multi-waveband focal plane arrays for operation in low optical backgrounds and hyperspectral imaging applications.
- (U) $2,283 Develop and demonstrate technologies for SBR such as a larger scale TRAM panel for extended performance testing, clutter algorithms to improve target discrimination, and integrated advanced processing algorithms. Extend SBR system models.
- (U) $1,327 Develop and demonstrate technologies for spectral remote sensing using an ultra-spectral imaging sensor and an airborne remote sensing spectropolarimeter for realistic military applications.
- (U) $5,913 Total

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(U) B. Project Change Summary - Description of Significant Changes: In FY 2000, spectral sensing (hyperspectral technology) efforts currently in PE 0603605F, Project 3150, move into this project.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0303601F, MILSTAR Satellite Communications System.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602702F, Command/Control/Communication Technology.
- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.
- (U) PE 0604711F, Extremely High Frequency Satellite Communications Research and Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

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

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BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 3834

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3834 Integrated Space Technology Demonstrations	46,185	33,172	18,893	18,792	20,009	22,862	24,235	22,735	Continuing	Continuing

(U) A. Mission Description: The Integrated Space Technology Demonstration (ISTD) program is a series of demonstrations, or projects established to address the latest Air Force Space Command (AFSPC) Mission Area Plan (MAP) deficiencies. The ISTD program provides for the integration of government and commercially developed technologies onto satellites. The ISTD program also seeks to validate and demonstrate the value of these new technologies to address new space tactics, techniques, procedures, doctrine, and possibly revolutionize future acquisitions of DoD space systems. The ISTD program will enhance commercial and civil space assets in a cost-effective manner, allowing the warfighter to assess the utility of new space technologies through leveraging opportunities and, when required, through dedicated space flight demonstrations. In general, the ISTD series of space technology demonstrations will allow users to assess new space technologies, which, when integrated, will become technology options for future space systems. The highly successful Technology for Autonomous Operational Survivability (TAOS) satellite was the first of the ISTD series. TAOS was launched in March 1994 and is currently demonstrating advanced warfighter concepts and the viability of advanced computers, autonomous navigation hardware/software, laser sensors, radar sensors, and data busses in space. In FY 1995, the ISTD program office initiated a cooperative agreement with National Aeronautics and Space Administration's (NASA) to leverage the NASA Clark satellite with Air Force funding and technologies. Clark was set for launch in February 1998, but the program was terminated prior to launch due to NASA funding constraints. The Warfighter-1 program, started in August 1997, is the second in the ISTD series and leverages commercial investments. Beginning in FY 1999, the technology development work supporting the integrated demonstrations of advanced guidance, navigation, and control packages for ballistic missiles is supported by this project. The Congressionally-funded microsatellite technology development and demonstration program (designated Clementine II in FY 1998 and prior years and now known as XSS-10) is also included in this project. In FY 1999, Congress added the funds for the low-cost launch vehicle technology development program, which is conducted jointly with Ballistic Missile Defense Organization (BMDO), and the orbital transfer vehicle program to this project; these two programs were previously funded under Project 4599 in this PE.

(U) FY 1998 ($ in Thousands):

- (U) $15,311 Developed components for the Warfighter-1 Integrated Space Technology Demonstration Program, including payload and mobile ground station components and modified data exploitation algorithms.
- (U) $50 Planned the Warfighter-2 Integrated Space Technology Demonstration Program.
- (U) $824 Developed simulation applications for integrated satellite payloads for Space-Based Radar, Ultra Lightweight Imaging Technology (UltraLITE), and Hyperspectral Imaging (HSI) programs.
- (U) $30,000 Developed technologies for autonomous and manual on-orbit control of microsatellites and for autonomous microsatellite navigation and inspection. Designed and developed a microsatellite to demonstrate the "proof of principle".
- (U) $46,185 Total

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(U) FY 1999 ($ in Thousands):

– (U)	$18,462	Develop and integrate components for the Warfighter-1 Integrated Space Technology Demonstration Program, including payload and mobile ground station components and the modified data exploitation algorithms.
– (U)	$100	Define concept and develop acquisition strategy for Warfighter-2 Integrated Space Technology Demonstration Program.
– (U)	$1,235	Develop advanced precision ballistic missile navigation technologies to support range instrumentation and safety requirements, improve accuracy after reentry, and support conventional weapon delivery systems.
– (U)	$5,862	Develop technologies for autonomous and manual on-orbit control of microsatellites and for autonomous microsatellite navigation and inspection. Conduct the XSS-10 flight demonstration of a microsatellite to demonstrate the "proof of principle".
– (U)	$2,443	Develop the two-stage near-orbital demonstrator for low-cost liquid launch vehicle technologies.
– (U)	$4,398	Develop and test technologies for solar orbital transfer vehicles (SOTV) such as high performance thermionic energy converters and high temperature insulation materials. Develop preliminary design of a space experiment to validate key solar orbital transfer vehicle technologies such as thermionic energy converters, lightweight solar concentrators, and cryogenic propellant systems.
– (U)	$672	Identified as a source for SBIR.
– (U)	$33,172	Total

(U) FY 2000 ($ in Thousands):

– (U)	$11,382	Complete development of the Warfighter-1 mission data center and mobile ground station. Perform pre-operations testing, launch satellite, conduct early orbit checkout, and begin data exploitation analysis and assessment.
– (U)	$5,990	Develop Warfighter-2 Integrated Space Technology Demonstration Program system.
– (U)	$491	Develop an end-to-end performance prediction model for a generalized, user-specified hyperspectral imaging (HSI) sensor applicable to a variety of different operating environments.
– (U)	$1,030	Develop advanced precision ballistic missile navigation technologies to improve accuracy during reentry and in plasma and jamming environments, and to support application on conventional weapon delivery systems.
– (U)	$18,893	Total

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(U) FY 2001 ($ in Thousands):

– (U)	$3,822	Conduct Warfighter-1 satellite operations, including user utility demonstrations, satellite technology validation, and data exploitation analysis and assessment.
– (U)	$13,851	Continue Warfighter-2 system development. Continue design of Warfighter-2 system; begin fabrication of payload. Define user requirements and plan; coordinate and design user utility demonstrations.
– (U)	$139	Develop an end-to-end performance prediction model for a generalized, user-specified hyperspectral imaging (HSI) sensor applicable to a variety of different operating environments.
– (U)	$980	Develop advanced precision ballistic missile navigation technologies to improve accuracy during reentry and in plasma and jamming environments, and to support application on conventional weapon delivery systems.
– (U)	$18,792	Total

(U) B. Project Change Summary - Description of Significant Changes: In FY 1999, the Modeling and Simulation efforts transition from this project to Project 2181 in this PE. The low-cost launch vehicle and orbital transfer vehicle efforts, both funded by Congressional Adds, were moved to this project from Project 4599 in this PE.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 4400

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4400 Satellite Survivability Technology	5,353	5,779	2,616	3,859	4,773	4,661	4,340	4,006	Continuing	Continuing

(U) A. Mission Description: This project funds the development and demonstration of technologies required to assure operation of U.S. space assets in potentially hostile warfighting environments. Work performed includes assessment of critical components, subsystems, and systems' threat susceptibility and vulnerability. This project also develops technologies to mitigate identified vulnerabilities. Further, technology options are developed and demonstrated to support balanced satellite protection strategies for detecting, avoiding, and operating in a hostile space environment. Efforts under this project will be closely integrated with exploratory space technologies such as those developed under PE 0602601F, Project 8809, and advanced space technologies developed under this PE in Projects 1026, 2181, 3784, and 682J. Where appropriate, end products include integrated demonstrations with technologies developed in Project 3834. Through this project, the Air Force assumes responsibility for critical spacecraft survivability technology from the Ballistic Missile Defense Organization (BMDO).

(U) FY 1998 ($ in Thousands):

- (U) $180 Completed state-of-the-art technology assessment of hostile/stressing environmental impact on subsystem performance parameters.
- (U) $184 Refined multi-threat sensor performance modeling tool to include natural radiation environments.
- (U) $185 Initiated countermeasure analysis task to examine countermeasure payoffs with respect to weight and power improvements.
- (U) $4,804 Initiated next phase of miniaturization of the Miniaturized Satellite Threat Reporting System (MSTRS) to further reduce the weight and power of the on-board threat warning package.
- (U) $5,353 Total

(U) FY 1999 ($ in Thousands):

- (U) $150 Expand the capability of the multi-threat assessment tool by adding selected directed energy effects.
- (U) $150 Complete countermeasure analysis task, examining weight and power improvements.
- (U) $476 Complete fabrication and begin testing of the radio frequency (RF) threat warning/attack reporting (TW/AR) receiver.
- (U) $4,886 Complete radar warning receiver miniaturization for power and weight savings for the Miniaturized Satellite Threat Reporting System (MSTRS). Begin preparation for the MSTRS prototype hardware space flight. Begin integration of the radar warning receiver with the prototype laser detection system.
- (U) $117 Identified as a source for SBIR.
- (U) $5,779 Total

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	PROJECT 4400

(U) FY 2000 ($ in Thousands):
- (U) $1,270 Use the multi-threat assessment tool to assess electo-optical sensor response for various candidate laser countermeasures. Begin fixed wavelength countermeasure development.
- (U) $560 Fabricate and test laser threat warning/attack reporting (TW/AR) receiver brassboard.
- (U) $786 Integrate and test radio frequency (RF) TW/AR receiver on the host space experiment platform.
- (U) $2,616 Total

(U) FY 2001($ in Thousands):
- (U) $1,983 Complete development and test of fixed wavelength laser countermeasure.
- (U) $1,091 Optimize sensor suite for combined RF/laser threat warning/TW/AR receiver.
- (U) $785 Complete payload/spacecraft integration for RF TW/AR receiver space experiment.
- (U) $3,859 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603410F, Space Systems Environmental Interactions Technology.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 4599

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4599 Reusable Launch Vehicle Technology	21,780	0	0	0	0	0	0	0	TBD	TBD

(U) A. Mission Description: This project currently funds the development of technologies for reusable, long-life space vehicles, advanced and innovative low-cost launch vehicles, and orbital transfer vehicles. The Military Spaceplane technology project (previously designated the Reusable Launch Vehicle (RLV) program) directly complements and leverages off of the National Aeronautics and Space Administration (NASA)-led RLV program, with the goal of developing responsive, reusable space access systems such as the Space Maneuver Vehicle (SMV). The Space Launch Modernization Plan (SLMP) chartered the DoD to be the lead in Expendable Launch Vehicle (ELV) systems and technologies. The technologies being developed in this project are in support of this charter. The development of the low- cost expendable launch technology is being conducted jointly with Ballistic Missile Defense Organization (BMDO).

(U) FY 1998 ($ in Thousands):

- (U) $3,882 Developed low-cost launch vehicle technologies and conducted suborbital flight tests using a testbed vehicle.
- (U) $830 Developed scaleable preburner liquid propellant injector technology.
- (U) $7,068 Developed technologies for upper stages that can operate as orbit transfer vehicles.
- (U) $4,500 Developed technologies for reusable, long-life space vehicles such as the Space Maneuver Vehicle (SMV). Conducted flight experiments to demonstrate an advanced concept upperstage engine and to collect X40A SMV vehicle performance data in a critical operational regime.
- (U) $5,500 Enhanced the capabilities of the NASA Pathfinder vehicle to improve the military utility of the vehicle; demonstrated these Air Force-unique mission capabilities.
- (U) $21,780 Total

(U) FY 1999: Not Applicable.

(U) FY2000: Not Applicable.

(U) FY 2001: Not Applicable.

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	PROJECT 4599

B. Project Change Summary - Description of Significant Changes: In FY 1999, the low-cost launch vehicle and orbital transfer vehicle efforts, both funded by Congressional Adds, were moved to Project 3834 in this PE.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602102F, Materials.
- (U) PE 0602269F, Hypersonic Technology Program.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) PE 0603853F, Evolved Expendable Launch Vehicle Program.
- (U) UPN 242, National Aeronautics and Space Administration (NASA) Reusable Launch Vehicle Program.
- (U) This project has been coordinated through the Reliance process and with NASA to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 4782

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4782 Discoverer II	0	15,479	28,670	67,216	48,501	21,522	9,668	0	0	191,056

(U) A. Mission Description and Budget Item Justification: Discoverer II (D II) is a space-based radar/ground moving target indicator (SBR/GMTI) risk reduction demonstration. Air Force participation in this effort begins with FY 1999 RDT&E funds appropriated in PE 0603856F and defined in the FY 1999 President's Budget PE 0603856F Descriptive Summary as, "Conduct joint demonstrations, operations, and space activities in support of the Air Force/National Reconnaissance Office (AF/NRO) Integration Planning Group (ANIPG)." Discoverer II is a two-satellite technical demonstration recommended by the Defense Science Board which develops and demonstrates the technologies that would be inherent to an SBR/GMTI tactical surveillance architecture. The cost goal of the program is to enable an affordable acquisition of an operational SBR architecture for worldwide surveillance and targeting by mitigating the technical risks in the D II demonstration. NRO is an investment partner in this project and submits their budget request under the "Discoverer II MTI Demo." Defense Advanced Research Projects Agency (DARPA) is also a funding partner due to the technical innovation and development nature of D II. DARPA submits its budget request under the "Aerospace Surveillance Technologies, Project SGT-02." The Air Force also budgets for the launch integration and vehicle costs under PE 0305953F, Evolved Expendable Launch Vehicle. A senior oversight group consisting of SAF/AQ, NRO, and DARPA oversees D II. The Air Force has the Senior Acquisition Executive responsibilities and DARPA has program management responsibilities.

(U) FY 1998 ($ in Thousands): Not Applicable.

(U) FY 1999 ($ in Thousands):

- (U) $7,696 Support jointly funded effort to conduct design trades and analyses leading to candidate objective system and demonstration system designs by awarding approximately four System Integration contracts. Core activities will focus on cost/performance trades and completion of an Integrated Master Plan/Schedule. An initial Interim Evaluation Review will be conducted.
- (U) $7,033 Support jointly funded risk reduction efforts in key risk areas to include antenna design and fabrication, and exploitation software. Complete Thinned Transmitter/Receiver (T/R) Module Electronically Scanned Array Design.
- (U) $750 Conduct mission utility analysis and conops studies.
- (U) $15,479 Total

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	PROJECT 4782

(U) FY 2000 ($ in Thousands):

- (U) $12,500 Support jointly funded effort to complete objective system and demonstration system preliminary designs through conduct of a competitive downselect process culminating in selection of a single System Integrator contractor's design.
- (U) $4,005 Support jointly funded risk reduction efforts in key risk areas to include antenna design and fabrication, advanced signal processing, and exploitation software. Conduct mission utility analyses and conops studies.
- (U) $12,165 Support jointly funded effort to begin detailed design and long lead procurement for selected demonstration system.
- (U) $28,670 Total

(U) FY 2001 ($ in Thousands):

- (U) $31,469 Support jointly funded development of detailed demonstration design culminating in Critical Design Review.
- (U) $22,574 Support jointly funded construction and component testing of spacecraft bus and payload.
- (U) $9,966 Support jointly funded software testing, integration, test, and data reduction.
- (U) $3,207 Support jointly funded risk reduction efforts in key risk areas to include antenna design and fabrication, advanced signal processing, and exploitation software. Conduct mission utility analyses and conops studies.
- (U) $67,216 Total

B. Project Change Summary - Description of Significant Changes: Discoverer II funding has been moved from PE 0603856F to Project 4782 in this PE for FY 1999 and beyond.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0305953F, Evolved Expendable Launch Vehicle.
- (U) National Reconnaissance Office (NRO) MTI Radar Technology Project.
- (U) SGT-02, DARPA Aerospace Surveillance Technologies.

(U) D. Acquisition Strategy: All major contracts awarded within this program will be awarded following full and open competition.

(U) E. Schedule Profile: Not Applicable

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BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 682J

COST (*$ In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
682J Space Power and Thermal Management Technology	3,283	4,730	4,353	3,026	5,160	6,041	6,440	7,037	Continuing	Continuing

(U) A. Mission Description: This project develops and demonstrates compact, low-cost, spacecraft and ballistic missile power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. Power generation work focuses on lightweight, low-cost, low volume, and survivable solar cell arrays. Energy storage work focuses on lightweight nickel hydrogen (NiH_2) and sodium sulfur (NaS) spacecraft batteries and flywheel energy storage systems for extended (five-ten year) satellite missions. Power distribution efforts focus on producing lightweight, high efficiency, standardized power busses for use on future Air Force space programs. This project also funds the development and demonstration of the non-nuclear technologies associated with space nuclear power systems such as power conversion, conditioning, and power system thermal management. In addition, investigations into alternative technologies to increase space vehicle power subsystem performance, lifetime, survivability, and safety while reducing costs/risks are conducted. In FY 1995, the Air Force assumed responsibility for the Ballistic Missile Defense Organization's (BMDO) goal to develop spacecraft thermal management technologies. Examples of this are cryogenic coolers necessary to maintain passive (e.g., infrared focal plane array) sensors in low-light backgrounds through this project.

(U) FY 1998 ($ in Thousands):

- (U) $2,401 Developed and demonstrated space conventional power generation technologies such as advanced multijunction solar cells and solar-to-electric converter solar cells.
- (U) $322 Developed and performance tested space conventional energy storage technologies such as the Sodium Sulfur Battery Cell Flight Experiment flown on shuttle flight STS-87.
- (U) $560 Developed advanced cryocooler technology for application to a 10K cryocooler capable of meeting the load, weight, and power requirements for space-based infrared concepts.
- (U) $3,283 Total

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	PROJECT 682J

(U) FY 1999 ($ in Thousands):

- (U) $1,772 Develop and evaluate performance of space conventional power generation technologies such as advanced multijunction solar cells, thin film solar cells, and a solar-to-electric converter power system for space operation.
- (U) $1,768 Develop space conventional energy storage technologies such as the lightweight flywheel integrated power and attitude control system.
- (U) $951 Develop advanced cryocooler technology for application to a 10K cryocooler capable of meeting the load, weight, and power requirements for space-based infrared concepts.
- (U) $144 Develop spacecraft thermal management systems such as advanced capillary pumped loop systems.
- (U) $95 Identified as a source for SBIR.
- (U) $4,730 Total

(U) FY 2000 ($ in Thousands):

- (U) $1,707 Develop and evaluate performance of space conventional power generation technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible arrays of thin film solar cells, and radiation resistant solar cell modules.
- (U) $1,392 Develop space conventional energy storage technologies such as the lightweight flywheel integrated power and attitude control system.
- (U) $910 Complete development of the advanced cryocooler technology for application to a 10K demonstration.
- (U) $344 Complete development of an advanced capillary pumped loop system. Develop thermal management systems such as thermal control systems using high density electronics technologies.
- (U) $4,353 Total

(U) FY 2001($ in Thousands):

- (U) $1,758 Develop and test space conventional power generation technologies such as next generation thin film solar cells, integrated power cells, and high power radiation resistant solar cell modules.
- (U) $1,123 Develop space conventional energy storage technologies such as the lightweight flywheel integrated power and attitude control system and advanced energy storage systems for geosynchronous orbit spacecraft applications.
- (U) $145 Develop spacecraft thermal management systems such as thermal control systems using high density electronics technologies.
- (U) $3,026 Total

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	PROJECT 682J

B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) PE 0603218C, Research and Support.
- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603410F Space Systems Environmental Interactions Technology

PROJECT: 2822

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2822 Space Environmental Impact Tests	2,828	3,436	3,677	4,021	4,361	4,845	4,925	5,006	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program's objectives are to improve the survivability and reliability of current and future DoD space systems, and develop and demonstrate cost-effective solutions to mitigate hazardous space-environmental interactions. These hazards include dangerous electrical discharges due to excess charge buildup on spacecraft components, degradation, and failure of structures and electronics due to long-term radiation doses, and single-event upsets (processor errors, memory corruption, etc.) due to high-energy penetrating radiation. As DoD dependence on space systems for mission critical operations and the use of unhardened commercial components increase, these effects will become more prevalent and serious. Advanced technology goals of this program are: (1) develop and demonstrate small, low-power, high performance space environmental monitoring systems; (2) provide improved specifications and analysis tools for design and application of advanced components and systems in DoD space systems; and (3) develop an autonomous on-board space-environmental hazard detection and control system to provide real-time warning and mitigation of space-environmental conditions likely to cause degraded satellite performance. These goals will be achieved through continued analysis and exploitation of data from current and past space experiments and through space flight of new experiments and prototype systems that investigate areas of concern to DoD spacecraft operations.

(U) FY 1998 ($ in Thousands):

- (U) $2,316 Launched prototype sensor and fabricated and tested upgraded sensors to improve Air Force Space Command environment specification and forecast systems for improved space system design and operations.
- (U) $181 Conducted joint National Aeronautics and Space Administration (NASA)-Air Force flight experiment to specify and predict the radiation environment and associated spacecraft charging hazards to enhance spacecraft survivability.
- (U) $331 Delivered three first-generation on-board radiation and charging hazard-warning detectors for test flights to enhance spacecraft survivability and situational awareness.
- (U) $2,828 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology
	PROJECT 2822

(U) FY 1999 ($ in Thousands):

- (U) $2,014 Launch upgraded space plasma sensor and begin development of a third-generation sensor for a flight with the Communications/Navigation Outage Forecast System (C/NOFS) to support Air Force Space Command environment specification and forecast systems.
- (U) $662 Execute joint program with National Aeronautics and Space Administration (NASA) to improve high-voltage spacecraft charging hazard analysis tools for DoD and NASA spacecraft.
- (U) $679 Support joint United States/British Space Test Program to provide on-board hazard detection of space environmental conditions that degrade satellite performance. Begin design of small passive spacecraft charge control system to eliminate spacecraft charging hazards.
- (U) $81 Identified as a source for SBIR.
- (U) $3,436 Total

(U) FY 2000 ($ in Thousands):

- (U) $1,215 Complete design and fabrication of environmental sensors to support flight systems such as the C/NOFS and the National Polar-orbiting Operational Environmental Satellite System (NPOESS) to specify and forecast scintillation and other hazardous space environmental conditions that degrade satellite systems and communications.
- (U) $1,341 Support joint NASA-Air Force space initiatives to improve capability to specify and predict space environmental impacts on operational space systems.
- (U) $1,121 Develop systems to warn of spacecraft charging and other hazards for DoD and commercial spacecraft and investigate possibilities for alteration of space radiation environment.
- (U) $3,677 Total

(U) FY 2001 ($ in Thousands):

- (U) $1,441 Complete ground testing of space environmental sensor for flight with the C/NOFS. Support launch and on-orbit operations of Air Force and Joint Air Force-NASA instrumentation to provide improved space radiation hazard specification and forecasting.
- (U) $1,105 Support joint NASA-Air Force space initiative to advance spacecraft survivability, through collaborative experiments and design tool development.
- (U) $1,475 Develop systems to warn of spacecraft charging and other hazards to DoD and commercial spacecraft and begin design of systems to alter the space particle environment.
- (U) $4,021 Total

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology
	PROJECT 2822

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	3,012	3,457	3,718	3,755	Cont
(U) Appropriated Value	3,151	3,457			
(U) Adjustments to Appropriated Value					
a. Congressional General Reductions	-102	-21			
b. SBIR	-39				
c. Omnibus/Other Above Threshold Reprogrammings	-20				
d. Below Threshold Reprogrammings	-162				
(U) Adjustments to Budget Year Since FY 1999 PB			-41	266	
(U) Current Budget Submit/FY 2000 PB	2,828	3,436	3,677	4,021	Cont

(U) Significant Program Changes: Not Applicable.

FY 1999: $81 identified as a source for SBIR.

(U) D. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602601F, Phillips Laboratory.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) E. Acquisition Strategy: Not Applicable.

(U) F. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	22,406	22,791	21,479	22,077	21,792	23,880	24,479	25,088	Continuing	Continuing
670A Ordnance Technology	8,724	9,786	11,263	11,882	10,205	10,177	10,701	11,758	Continuing	Continuing
670B Guidance Technology	13,682	13,005	10,216	10,195	11,587	13,703	13,778	13,330	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates conventional weapons technologies including advanced guidance and ordnance technologies for conventional weapons. This program includes development of: (1) conventional ordnance technologies, including warheads, fuzes, explosives, munition integration, and lethality and vulnerability assessments; and (2) advanced guidance technologies, including seekers, navigation and control, signal and image processing/algorithms, and simulation assessments for low-cost precision and adverse weather autonomous seekers for use on manned and unmanned aerospace vehicles. Payoff from this program is increased warhead penetration effectiveness, enhanced blast and fragmentation weapons, and precision fuze control for increased probability of target kill; and precision terminal guidance and the capability to operate autonomous weapons in adverse weather.

(U) B. Budget Activity Justification: This program is in the Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE
	February 1999
BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced Technology Development	0603601F Conventional Weapons Technology

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	21,622	23,244	23,983	23,848	Cont
(U) Appropriated Value	24,687	23,244			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-1,072	-453			
b. SBIR	-468				
c. Omnibus/Other Above Threshold Reprogrammings	-147				
d. Below Threshold Reprogrammings	-594				
(U) g. Adjustments to Budget Years Since FY 1999 PB			-2,504	-1,771	
(U) Current Budget Submit/FY 2000 PB	22,406	22,791	21,479	22,077	Cont

(U) Significant Program Changes: Changes to this program since the previous President's are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $685 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology / PROJECT: 670A

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
670A Ordnance Technology	8,724	9,786	11,263	11,882	10,205	10,177	10,701	11,758	Continuing	Continuing

(U) A. Mission Description: This project develops and demonstrates the operational effectiveness and utility of conventional (non-nuclear) ordnance technologies for current and future weapons delivered from manned and unmanned aerospace vehicles. The project includes development of conventional ordnance, including warheads, fuzes, explosives, sensitive explosives; hard target warheads; bombs, submunitions, and their dispensing mechanisms; weapon airframes and carriage; smart submunitions; munition integration; and lethality and vulnerability assessments.

(U) FY 1998 ($ in Thousands):

- (U) $4,297 Developed and demonstrated advanced conventional armament warhead technologies, including heavy metal liners, less sensitive, high blast penetrator explosives, dense metal warhead cases, fragmentation of thick-walled penetrators, advanced warhead shapes for improved penetration, improved warhead metals and design for high impact loading, and directional mass focus warheads. Advanced warhead technologies will provide better target penetration capabilities, enhanced kill probability against fragmentation sensitive targets.
- (U) $1,108 Developed and demonstrated advanced conventional armament fuze technologies, including hard target penetration, low-cost proximity for surface targets, and target imaging detection devices for air target defeat.
- (U) $3,319 Integrated advanced conventional armament technologies, including innovative aerospace vehicle carriage and release equipment, release concepts for small weapons, compact fin folding and deployment mechanisms, and compact airframe design and subsystem integration. Munition integration technologies will provide the capability of multiple carriage of small weapons, and allow communication between the aerospace vehicle and the weapons.
- (U) $8,724 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology
	PROJECT 670A

(U) FY 1999 ($ in Thousands):

– (U) $3,418	Develop and demonstrate advanced conventional armament warhead technologies, including heavy metal liners, less sensitive, high blast penetrator explosives, dense metal warhead cases, fragmentation of thick-walled penetrators, advanced warhead shapes for improved penetration, improved warhead metals and design for high impact loading, and directional mass focus warheads. Advanced warhead technologies will provide better target penetration capabilities, enhanced kill probability against fragmentation sensitive targets.
– (U) $1,974	Develop and demonstrate advanced conventional armament fuze technologies, including hard target penetration, low-cost proximity for surface targets, and target imaging detection devices for air target defeat.
– (U) $4,100	Integrate advanced conventional armament technologies, including innovative aerospace vehicle carriage and release equipment, release concepts for small weapons, compact fin folding and deployment mechanisms, and compact airframe design and subsystem integration. Munition integration technologies will provide the capability of multiple carriage of small weapons, and allow communication between the aerospace vehicle and the weapons.
– (U) $294	Identified as a source for SBIR.
– (U) $9,786	Total

(U) FY 2000 ($ in Thousands):

– (U) $3,705	Develop and demonstrate advanced conventional armament warhead technologies, including heavy metal liners, less sensitive, high blast penetrator explosives, dense metal warhead cases, fragmentation of thick-walled penetrators, advanced warhead shapes for improved penetration, improved warhead metals and design for high impact loading, and directional mass focus warheads. Advanced warhead technologies will provide better target penetration capabilities, enhanced kill probability against fragmentation sensitive targets.
– (U) $5,387	Develop and demonstrate advanced conventional armament fuze technologies, including hard target penetration, low-cost proximity for surface targets, and target imaging detection devices for air target defeat.
– (U) $2,171	Integrate advanced conventional armament technologies, including innovative aerospace vehicle carriage and release equipment, release concepts for small weapons, compact fin folding and deployment mechanisms, and compact airframe design and subsystem integration. Munition integration technologies will provide the capability of multiple carriage of small weapons, and allow communication between the aerospace vehicle and the weapons.
– (U) $11,263	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology
PROJECT 670A	

(U) FY 2001 ($ in Thousands):

- (U) $4,003 Develop and demonstrate advanced conventional armament warhead technologies, including heavy metal liners, less sensitive, high blast penetrator explosives, dense metal warhead cases, fragmentation of thick-walled penetrators, advanced warhead shapes for improved penetration, improved warhead metals and design for high impact loading, and directional mass focus warheads. Advanced warhead technologies will provide better target penetration capabilities, enhanced kill probability against fragmentation sensitive targets.
- (U) $5,990 Develop and demonstrate advanced conventional armament fuze technologies, including hard target penetration, low-cost proximity for surface targets, and target imaging detection devices for air target defeat.
- (U) $1,889 Integrate advanced conventional armament technologies, including innovative aerospace vehicle carriage and release equipment, release concepts for small weapons, compact fin folding and deployment mechanisms, and compact airframe design and subsystem integration. Munition integration technologies will provide the capability of multiple carriage of small weapons, and allow communication between the aerospace vehicle and the weapons.
- (U) $11,882 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology / PROJECT: 670A

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602602F, Conventional Munitions.
- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0603792N, Advanced Technology Demonstrations.
- (U) PE 0604407D, Joint Standoff Weapon.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology / PROJECT: 670B

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
670B Guidance Technology	13,682	13,005	10,216	10,195	11,587	13,703	13,778	13,330	Continuing	Continuing

(U) A. Mission Description: This project develops and demonstrates affordable, autonomous, and adverse-weather advanced guidance technologies for air-to-air and air-to-ground conventional armament delivered from manned and unmanned aerospace vehicles. This project develops the following technologies: precision terminal seekers for enhanced target destruction; autonomous seekers for operation in adverse weather for increased accuracy; midcourse navigation sensors for standoff delivery weapons; and target detection and identification processing algorithms for reducing target location error and false alarm rates, while improving target kill probability.

(U) FY 1998 ($ in Thousands):

- (U) $6,504 Developed and demonstrated advanced conventional armament seeker technologies, including laser radar, millimeter wave, synthetic aperture radar, and conformal seeker arrays for multi-mode applications. These affordable seeker technologies will provide the capability to autonomously detect, acquire, and guide to targets of interest in adverse weather conditions while increasing probability of kill.
- (U) $2,964 Developed and demonstrated advanced conventional armament navigation and control technologies, including weapon guidance laws, state vector estimators, autopilots, inertial navigation, aerodynamic control, and anti-jam global positioning system techniques. These technologies will provide increased armament navigation accuracy and enhanced weapon control and operation in a electronic jamming environment.
- (U) $4,214 Integrated advanced conventional guidance technologies including seekers, navigation and control, signal and image processing/algorithm technologies, laser radar algorithms, super resolution techniques for millimeter waves and synthetic aperture radar, optical processing techniques, and demonstrated advanced conventional armament guidance capabilities. This guidance capability will provide better adverse weather performance, faster processing of target information, higher probability of target detection, and an operationally acceptable target false alarm rate.
- (U) $13,682 Total

	DATE **February 1999**
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603601F Conventional Weapons Technology**

(U) FY 1999 ($ in Thousands):

- (U) $7,823 Develop and demonstrate advanced conventional armament seeker technologies, including laser radar, millimeter wave, synthetic aperture radar and conformal seeker arrays for multi-mode applications. These affordable seeker technologies will provide the capability to autonomously detect, acquire, and guide to targets of interest in adverse weather conditions while increasing probability of kill.
- (U) $1,002 Develop and demonstrate advanced conventional armament navigation and control technologies, including weapon guidance laws, state vector estimators, autopilots, inertial navigation, aerodynamic control, and anti-jam global positioning system techniques. These technologies will provide increased armament navigation accuracy and enhanced weapon control and operation in a electronic jamming environment.
- (U) $3,789 Integrate advanced conventional guidance technologies including seekers, navigation and control, signal and image processing/algorithm technologies, laser radar algorithms, super resolution techniques for millimeter waves and synthetic aperture radar, optical processing techniques, and demonstrated advanced conventional armament guidance capabilities. This guidance capability will provide better adverse weather performance, faster processing of target information, higher probability of target detection, and an operationally acceptable target false alarm rate.
- (U) $391 Identified as a source for SBIR.
- (U) $13,005 Total

(U) FY 2000 ($ in Thousands):

- (U) $2,699 Develop and demonstrate advanced conventional armament seeker technologies, including laser radar, millimeter wave, synthetic aperture radar and conformal seeker arrays for multi-mode applications. These affordable seeker technologies will provide the capability to autonomously detect, acquire, and guide to targets of interest in adverse weather conditions while increasing probability of kill.
- (U) $1,438 Develop and demonstrate advanced conventional armament navigation and control technologies, including weapon guidance laws, state vector estimators, autopilots, inertial navigation, aerodynamic control, and anti-jam global positioning system techniques. These technologies will provide increased armament navigation accuracy and enhanced weapon control and operation in a electronic jamming environment.
- (U) $6,079 Integrate advanced conventional guidance technologies including seekers, navigation and control, signal and image processing/algorithm technologies, laser radar algorithms, super resolution techniques for millimeter waves and synthetic aperture radar, optical processing techniques, and demonstrated advanced conventional armament guidance capabilities. This guidance capability will provide better adverse weather performance, faster processing of target information, higher probability of target detection, and an operationally acceptable target false alarm rate.
- (U) $10,216 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE
	February 1999

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced Technology Development	0603601F Conventional Weapons Technology	670B

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology / PROJECT: 670B

(U) FY 2001 ($ in Thousands):

– (U) $2,570	Develop and demonstrate advanced conventional armament seeker technologies, including laser radar, millimeter wave, synthetic aperture radar and conformal seeker arrays for multi-mode applications. These affordable seeker technologies will provide the capability to autonomously detect, acquire, and guide to targets of interest in adverse weather conditions while increasing probability of kill.
– (U) $2,782	Develop and demonstrate advanced conventional armament navigation and control technologies, including weapon guidance laws, state vector estimators, autopilots, inertial navigation, aerodynamic control, and anti-jam global positioning system techniques. These technologies will provide increased armament navigation accuracy and enhanced weapon control and operation in a electronic jamming environment.
– (U) $4,843	Integrate advanced conventional guidance technologies including seekers, navigation and control, signal and image processing/algorithm technologies, laser radar algorithms, super resolution techniques for millimeter waves and synthetic aperture radar, optical processing techniques, and demonstrated advanced conventional armament guidance capabilities. This guidance capability will provide better adverse weather performance, faster processing of target information, higher probability of target detection, and an operationally acceptable target false alarm rate.
– (U) $10,195	Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology
	PROJECT 670B

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0603792N, Advanced Technology Demonstrations.
- (U) PE 0604618F, Joint Direct Attack Munitions.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	51,753	53,317	38,995	34,225	38,911	41,763	47,703	50,995	Continuing	Continuing
3150	Advanced Optics Technology	16,976	14,769	925	1,175	1,296	1,352	4,895	5,776	Continuing	Continuing
3151	High Power Semiconductor Laser Technology	5,556	9,783	10,975	4,907	9,597	10,418	12,855	13,540	Continuing	Continuing
3152	High Power Microwave Technology	6,601	7,327	7,581	8,916	9,561	10,020	8,770	8,953	Continuing	Continuing
3647	High Energy Laser Technology	22,620	21,438	19,514	19,227	18,457	19,973	21,183	22,726	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program demonstrates advanced directed energy and optical imaging concepts. Speed-of-light weapons and long-range, high resolution optical imaging through the turbulent atmosphere offer significant payoffs for many Air Force missions, such as theater missile defense, suppression of enemy air defenses, and control of space. This program has already demonstrated many major technological breakthroughs such as removing significant atmospheric distortions from optical transmissions (e.g., laser beams) and producing small, relatively high power laser diode phased arrays. Major emphasis areas include: high power microwave and high energy laser technologies; long-range optical imaging; and high power laser diodes and diode arrays. Because of the unique effects associated with high power microwaves there are many potential applications ranging from low power disruptions to high power destruction of electronic devices. Thus, a wide range of high power microwave technologies are being developed. Within high energy lasers the emphasis is on developing methods to increase the power on target. This is done by continuing to remove more of the atmospheric degradations and to develop more efficient laser devices. Long-range optical imaging offers high resolution images of space objects from the ground for applications such as satellite status assessments. High power diodes offer great potential for very small optical sources at many wavelengths for applications such as infrared illuminators and infrared countermeasure sources as well as high data rate secure communications. This PE will continue to develop a wide range of directed energy technologies for many DoD applications. Note: Congress added $10 million for space laser imaging and $6 million for Field Laser Demonstrator upgrades in FY 1998 and $6 million for Field Laser Radar upgrades plus $7.5 million for Geo Space Object Imaging in FY 1999 which explains the perceived decrease in FYs 2000 and out.

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	50,832	40,153	40,138	39,975	Cont
(U) Appropriated Value	55,238	53,653			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-3,629	-336			
b. SBIR	-454				
c. Omnibus/Other Above Threshold Reprogrammings	-343				
d. Below Threshold Reprogrammings	941				
(U) Adjustments to Budget Year Since FY 1999 PB			-1,143	-5,750	
(U) Current Budget Submit/FY 2000 PB	51,753	53,317	38,995	34,225	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $1,654 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT 3150

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3150 Advanced Optics Technology	16,976	14,769	925	1,175	1,296	1,352	4,895	5,776	Continuing	Continuing

(U) A. Mission Description: This project develops advanced optical technologies for locating, identifying, and analyzing distant and/or dim objects. This work supports high energy laser technologies because an imaging subsystem is required for target verification, accurate and sustainable laser beam placement on target, and near-real-time damage assessment. Several advanced technologies including nonlinear optics, adaptive optics, and specialized signal processing are being developed. The goal is high quality optical image reconstruction, concentrating on removing turbulent atmosphere-induced distortions. Many of the technologies developed/being developed have significant application to astronomy research.

(U) FY 1998 ($ in Thousands):

- (U) $829 Developed and demonstrated advanced, very long-range optical imaging technologies which increase resolution and data fusion to support missions such as space object identification and ground target identification from space.
- (U) $637 Developed nonlinear optics technologies for non-mechanical corrections in optical imaging.
- (U) $356 Developed and demonstrated signature technology for identifying and assessing health and status of satellites out to geosynchronous orbit.
- (U) $9,441 Developed technologies for active imaging of geosynchronous space objects.
- (U) $5,713 Upgraded the Field Laser Demonstrator for increased sensitivity to obtain very accurate data on space object and techniques for remote sensing of the atmosphere.
- (U) $16,976 Total

(U) FY 1999 ($ in Thousands):

- (U) $721 Develop and demonstrate advanced technologies which increase resolution and data fusion for very long-range optical imaging to support missions such as space object identification and ground target identification from space.
- (U) $548 Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.
- (U) $101 Develop and demonstrate signature technology for identifying and assessing health and status of satellites out to geosynchronous orbit.
- (U) $7,196 Develop technologies for active imaging of geosynchronous space objects.
- (U) $5,756 Upgrade the Field Laser Demonstrator for increased sensitivity to obtain very accurate data on space object and techniques for remote sensing of the atmosphere.
- (U) $447 Identified as a source for SBIR.
- (U) $14,769 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
	PROJECT 3150

(U) FY 2000 ($ in Thousands):

– (U)	$330	Develop nonlinear optics technologies for non-mechanical corrections to optical imaging and beam projections.
– (U)	$50	Investigate advanced concepts to deploy and use very large optical mirrors in orbit for applications that support missions such as imaging and laser projection.
– (U)	$545	Investigate novel signature techniques for assessing the operational status of satellites out to geosynchronous orbit.
– (U)	$925	Total

(U) FY 2001 ($ in Thousands):

– (U)	$1,005	Develop nonlinear optics technologies for non-mechanical correction to beam projection and optical imaging.
– (U)	$85	Investigate concepts/technologies to allow projection through orbiting optical telescopes for applications such as imaging and laser beam projection.
– (U)	$85	Investigate novel signature techniques for assessing the operational status of satellites out to geosynchronous orbit.
– (U)	$1,175	Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0305910F Spacetrack.
- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3151

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3151 High Power Semiconductor Laser Technology	5,556	9,783	10,975	4,907	9,597	10,418	12,855	13,540	Continuing	Continuing

(U) A. Mission Description: This project continues to yield revolutionary breakthroughs in compact, robust, and affordable laser system technology for a wide range of military applications requiring small compact laser sources with low to moderate optical power. This is a long-term technology development project with both near-term and long-term goals. Near-term goals include developing compact, reliable infrared sources for a range of applications including night vision systems, landing zone markers, remote sensing, and covert communication systems. Longer-term goals focus on producing compact, significantly higher power sources for military applications including aircraft protection. This project leads the development of, and builds upon, a wide range of commercial advancements. Commercially available semiconductor lasers are widely used due to their low-cost, small size and weight, high reliability, and high efficiency in converting electricity to laser energy. This project preserves these attractive features while continually scaling output to higher powers/efficiencies and/or to military application-specific wavelengths. The project is divided into three technology areas. The first area investigates methods to increase output power from individual laser diodes while increasing power density onto a small spot. Secondly, semiconductor laser array integration methods, which produce a single, high quality laser beam at significantly higher power levels, are developed. Thirdly, wavelength-specific laser diodes for military applications are developed. Project scientists/managers also work directly with field users to develop proof-of-capability demonstrations and field tests for these revolutionary laser sources. This technology has many commercial applications, especially for eye-safe lasers.

(U) FY 1998 ($ in Thousands):

- (U) $1,157 Developed laser diodes for improved performance/higher power as sources in near-term applications such as infrared countermeasures, illumination, designation, and communication and for incorporation into laser diode array architectures.
- (U) $969 Developed coherent laser diode arrays for improved performance/higher power as sources in applications requiring power levels beyond those available from single diodes.
- (U) $1,674 Developed semiconductor diode lasers and optically-pumped semiconductor lasers to support current advanced infrared countermeasures system upgrades for tactical fixed and rotary-wing aircraft. Development focused on concepts with the potential for high efficiency, compact infrared laser sources covering Bands 2 and 4.
- (U) $1,756 Developed the basic laser source and target coupling technology needed to damage/destroy missile seeker components of next generation advanced imaging infrared-guided air-to-air and surface-to-air missiles.
- (U) $5,556 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
PROJECT 3151	

(U) FY 1999 ($ in Thousands):

- (U) $1,869 Develop laser diodes for improved performance/higher power as sources in near-term applications such as illumination, designation, and communication and for incorporation into laser diode array architectures.
- (U) $1,127 Develop scaleable laser arrays (fiber/diode) for improved performance in applications requiring high power levels and beam quality such as designating/tracking sources for the airborne laser and ground-based laser applications and as weapon sources for degrade and damage in aircraft self-protection applications.
- (U) $3,908 Develop semiconductor diode lasers and optically-pumped semiconductor lasers to support current advanced infrared countermeasures system upgrades to tactical fixed and rotary-winged aircraft. Development will focus on concepts with the potential for high efficiency, compact infrared laser sources covering Bands 2 and 4.
- (U) $2,576 Develop the basic laser source and target coupling technology needed to damage/destroy missile seeker components of next generation advanced imaging infrared-guided air-to-air and surface-to-air missiles.
- (U) $303 Identified as a source for SBIR.
- (U) $9,783 Total

(U) FY 2000 ($ in Thousands):

- (U) $895 Develop and demonstrate high brightness solid state/semiconductor lasers requiring unique properties such as wavelength agility or long coherence length for applications such as remote sensing/identification of chemicals or structures.
- (U) $1,533 Develop and demonstrate, scaleable, solid state laser arrays (fiber/diode) for improved performance in applications requiring high brightness (high power levels and improved beam quality), such as designation/tracking sources for airborne laser and ground-based laser applications and as weapon sources for tactical applications such as damage/destroy aircraft protection programs.
- (U) $4,174 Develop and demonstrate semiconductor diode lasers and optically-pumped semiconductor lasers to support advanced infrared countermeasures system upgrades to tactical fixed and rotary-winged aircraft. Development will focus on concepts with the potential for high efficiency, compact infrared laser sources covering Bands 2 and 4.
- (U) $4,373 Develop and demonstrate the laser source, beam control, and target coupling technology needed to damage/destroy next generation imaging advanced infrared-guided air-to-air and surface-to-air missiles.
- (U) $10,975 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
	PROJECT 3151

(U) FY 2001 ($ in Thousands):

- (U) $1,448 Develop and demonstrate high brightness solid state/semiconductor lasers requiring unique properties such as wavelength agility or long coherence length for applications such as remote sensing/identification of chemicals or structures.
- (U) $1,224 Develop and demonstrate, scaleable, solid state laser arrays (fiber/diode) for improved performance in applications requiring high brightness (high power levels and improved beam quality), such as designation/tracking sources for airborne laser and ground-based laser applications and as weapon sources for tactical applications such as damage/destroy aircraft protection programs.
- (U) $2,235 Develop and demonstrate semiconductor diode lasers and optically-pumped semiconductor lasers to support advanced infrared countermeasures (IRCM) system upgrades to tactical fixed and rotary-winged aircraft. Development will focus on concepts with the potential for high efficiency, compact infrared laser sources covering Bands 2 and 4.
- (U) $4,907 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602234N, Systems Support Technology.
- (U) Representatives from Army, Navy, Ballistic Missile Defense Organization, National Laboratories, and Air Force using commands are members of the government review team for this technology.
- (U) Joint field demonstrations of this technology are ongoing with: the Air Force Pararescue School; the Air Force Special Operations Command; the U.S. Coast Guard; and the U.S. Customs Service.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3152

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3152 High Power Microwave Technology	6,601	7,327	7,581	8,916	9,561	10,020	8,770	8,953	Continuing	Continuing

(U) A. Mission Description: This project develops high power microwave (HPM) generation technologies. It also develops a susceptibility/vulnerability/lethality data base to identify potential vulnerabilities of U.S. systems to HPM threats and to provide a basis for future offensive and defensive weapons system decisions. Representative U.S. and foreign assets will be tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) technologies are being developed. The technologies developed in this project will demonstrate the applicability of high power microwaves that can damage/degrade/deny/ destroy electronic systems and subsystems for missions such as suppression of enemy air defense, command and control warfare, and aircraft self-protection.

(U) FY 1998 ($ in Thousands):
- (U) $2,811 Developed and demonstrated HPM suppression of enemy air defense technologies to render inoperative electronic components of an adversary's Integrated Air Defense System.
- (U) $2,216 Developed HPM technologies to support advanced tactical applications to defend large aircraft from attack by precision guided missiles of all types.
- (U) $1,143 Developed and demonstrated HPM technologies to render inoperative command and control warfare technologies.
- (U) $431 Developed and demonstrated nonlethal active denial technology.
- (U) $6,601 Total

(U) FY 1999 ($ in Thousands):
- (U) $3,081 Develop and demonstrate HPM suppression of enemy air defense technologies to render inoperative electronic components of an adversary's Integrated Air Defense System.
- (U) $2,357 Develop HPM technologies to support advanced tactical applications.
- (U) $1,172 Develop and demonstrate HPM technologies to render inoperative command and control warfare technologies.
- (U) $490 Develop and demonstrate nonlethal active denial technology.
- (U) $227 Identified as a source for SBIR.
- (U) $7,327 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
PROJECT 3152	

(U) FY 2000 ($ in Thousands):

- (U) $4,061 Develop and demonstrate high power microwave (HPM) technologies to render inoperative sample electronic components of an adversary's Integrated Air Defense System.
- (U) $2,932 Develop and demonstrate HPM technologies to render inoperative sample command and control components of an adversary.
- (U) $588 Develop and demonstrate nonlethal directed energy weapons and data for multiple mission applications including future peacekeeping assignments.
- (U) $7,581 Total

(U) FY 2001 ($ in Thousands):

- (U) $4,720 Develop and demonstrate HPM technologies to render inoperative electronic components of an adversary's Integrated Air Defense System.
- (U) $3,460 Develop and demonstrate HPM technologies to render inoperative command and control components of an adversary.
- (U) $736 Develop and demonstrate nonlethal directed energy weapons and data for multiple mission applications including future peacekeeping assignments.
- (U) $8,916 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602120A, Electronic Survivability and Fuzing Technology.
- (U) PE 0602111N, Anti-Air Warfare, Anti-Surface Warfare Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3647

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
3647 High Energy Laser Technology	22,620	21,438	19,514	19,227	18,457	19,973	21,183	22,726	Continuing	Continuing

(U) A. Mission Description: This project provides for the development, demonstration, and detailed assessment of technology needed for high energy laser weapons. Near-term focus is on ground-based and airborne high energy laser missions, although the technology developed for this project is directly applicable to most high energy laser applications. Critical technologies demonstrated include: scaleable laser devices, with near-term emphasis on the Chemical Oxygen-Iodine Laser (COIL); optical components; and laser beam control to efficiently compensate and propagate laser radiation through the atmosphere to a target. Detailed computational models to establish high energy laser weapon effectiveness and satellite and missile vulnerability will be developed. Correcting the laser beam for distortions induced by propagation through the turbulent atmosphere is the key technology in most high energy laser applications. The beam control technology developed in this project has a significant benefit to the astronomy community.

(U) FY 1998 ($ in Thousands):

- (U) $2,516 Developed and demonstrated the technology for scaleable, high efficiency, high energy laser devices for potential weapon applications.
- (U) $1,645 Performed vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats.
- (U) $881 Investigated and developed advanced, high energy laser optical components.
- (U) $9,632 Performed atmospheric compensation and laser beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification.
- (U) $7,946 Characterized atmospheric attenuation and distortion on laser beam propagation, conducted atmospheric compensation and beam control experiments, and developed an airborne ultra-precision inertial pointing brassboard to enhance boost phase theater ballistic missile tracking.
- (U) $22,620 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
PROJECT 3647	

(U) FY 1999 ($ in Thousands):

- (U) $2,185 Develop and demonstrate the technology for scaleable, high efficiency, high energy laser devices for potential weapon applications.
- (U) $1,693 Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats.
- (U) $746 Investigate and develop advanced, high energy laser optical components.
- (U) $10,388 Perform atmospheric compensation and laser beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification.
- (U) $5,749 Characterize atmospheric attenuation and distortion on laser beam propagation, conduct atmospheric compensation and beam control experiments, and develop an airborne ultra-precision inertial pointing brassboard to enhance boot phase theater ballistic missile tracking.
- (U) $677 Identified as a source for SBIR.
- (U) $21,438 Total

(U) FY 2000 ($ in Thousands):

- (U) $2,300 Develop and demonstrate the technology for scaleable, high efficiency, high energy laser devices for potential weapon applications.
- (U) $960 Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats.
- (U) $200 Investigate and develop advanced, high energy laser optical components for future weapon systems.
- (U) $9,014 Perform atmospheric compensation/beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification.
- (U) $7,040 Characterize atmospheric attenuation and distortion on laser beam propagation from airborne platforms, investigate and evaluate advanced concepts for atmospheric compensation and beam control in modeling and laboratory experiments, and conduct atmospheric compensation and beam control field tests to develop and demonstrate feasibility and performance in realistic environments for applications such as theater missile defense.
- (U) $19,514 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
PROJECT 3647	

(U) FY 2001 ($ in Thousands):

– (U)	$2,101	Develop and demonstrate the technology for scaleable, high efficiency, high laser devices for potential weapon applications.
– (U)	$702	Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats.
– (U)	$202	Investigate and develop advanced, high energy laser optical components for future weapon systems.
– (U)	$9,301	Perform atmospheric compensation/beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification.
– (U)	$6,921	Characterize atmospheric attenuation and distortion on laser beam propagation from airborne platforms, investigate and evaluate advanced concepts for atmospheric compensation and beam control in modeling and laboratory experiments, and conduct atmospheric compensation and beam control field tests to develop and demonstrate feasibility and performance in realistic environments for applications such as theater missile defense.
– (U)	$19,227	Total

B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603319F, Airborne Laser Demonstration.
- (U) PE 0305910F, Spacetrack.
- (U) PE 0603217C, Ballistic Missile Defense, Advanced Development (High Altitude Balloon Experiment).
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603707F Weather Systems Technology

PROJECT: 2688

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2688 Weather Support Technology	1,869	1,564	0	0	0	0	0	0	0	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: This project will be terminated at the end of FY 1999.

(U) A. Mission Description: This Advanced Technology Development program demonstrates and transitions new technologies for warfighters and their associated weather support forces to enable full spectrum dominance. Technologies developed include new impact decision aids that will be incorporated into automated mission planning systems to optimize tactics and precision guided munitions selection. Other technologies will support operational laser system design and operational concept development. Initiatives are also planned to improve the accuracy of environmental forecasts produced by the Air Force Weather Agency and Air Force Space Command. Technologies delivered will enhance information superiority by improving tailored weather forecasts in data denied areas. Other models will enhance satellite survivability by improving space environmental forecasts.

(U) FY 1998 ($ in Thousands):

- (U) $500 Developed and delivered Night Vision Goggle Operations Weather Software Version 4.0 to Air Force Special Operations Command (AFSOC) and Air Combat Command (ACC) for evaluation. Software improves flight safety by predicting changes in goggle detection ranges due to night illumination and weather.
- (U) $709 Transitioned infrared scene visualization system to the Air Force Mission Support System Program Office at Electronic Systems Center for planning sorties employing infrared guided munitions.
- (U) $319 Initiated development of new target acquisition software and mission impact modules for calculating impact of weather on electro-optical weapon and navigation systems.
- (U) $246 Delivered validated thunderstorm, aircraft icing, and turbulence algorithms to Air Force Weather Agency (AFWA) for tailored operational forecasts of aviation hazards.
- (U) $95 Developed and delivered module for Coupled Ionospheric-Thermospheric Forecast Model for predicting satellite communication outages to the Air Force Space Command.
- (U) $1,869 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603707F Weather Systems Technology
	PROJECT 2688

(U) FY 1999 ($ in Thousands):

- (U) $814 Develop and transition Target Acquisition Weather Software V1.0 to Air Combat Command (ACC). Software will be used in predicting impact of weather on precision guided munitions during mission execution planning.
- (U) $614 Develop and demonstrate software that incorporates the impact of weather on precision guided munitions during preparation of the Air Tasking Order (Weather Automated Mission Planning Software) to ACC.
- (U) $104 Transition, for operational use, upgraded software that incorporates ACC and Air Force Special Operations Command (AFSOC) feedback on performance of Night Vision Goggle Operations Weather Software.
- (U) $32 Identified as a source for SBIR.
- (U) $1,564 Total

(U) FY 2000: Not Applicable.

(U) FY 2001: Not Applicable.

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603707F Weather Systems Technology
	PROJECT 2688

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	1,943	1,568	1,562	1,361	Cont
(U) Appropriated Value	2,036	1,568			
(U) Adjustments to Appropriated Value					
a. Congressional General Reductions	-66	-4			
b. SBIR	-29				
c. Omnibus/Other Above Threshold Reprogrammings	-13				
d. Below Threshold Reprogrammings	-59				
(U) Adjustments to Budget Year Since FY 1999 PB			-1,562	-1,361	
(U) Current Budget Submit/FY 2000 PB	1,869	1,564	0	0	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $32 identified as a source for SBIR.

(U) D. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0305111F, Weather Service.
- (U) PE 0602601F, Phillips Laboratory Exploratory Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) E. Acquisition Strategy: Not Applicable.

(U) F. Schedule Profile: Not Applicable.

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

DATE: **February 1999**

BUDGET ACTIVITY: **3 - Advanced Technology Development**

PE NUMBER AND TITLE: **0603723F Environmental Engineering Technology**

PROJECT: **2103**

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2103 Environmental Quality Technology	3,562	2,579	0	0	0	0	0	0	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 1998, Project 2103, Environmental Quality Technology, and Project 3037, Noise and Sonic Boom Impact Technology, are combined within Project 2103, Environmental Quality Technology. In FY 1999, the Noise and Sonic Boom Impact Technology portions of Project 2103 are eliminated.

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates advanced technologies to address Air Force-unique environmental compliance, site remediation, and pollution prevention problems. Specific projects develop and demonstrate advanced technologies to reduce hazardous emissions from weapon systems, minimize Air Force industrial waste, eliminate toxic pollutant releases from Air Force operations as directed by the National Environmental Policy Act, and solve environmental reclamation problems. Improving these capabilities aids the Air Force in maintaining environmental quality, preparing timely responses to public concerns, preparing accurate environmental impact statements, and minimizing unfavorable legal challenges to Air Force operations.

(U) FY 1998 ($ in Thousands):

- (U) $ 828 Demonstrated technologies and design criteria for monitoring, characterization, assessment, process control, and disposal to reduce environmental impact of Air Force operations by evaluating chemical fate and environmental transport of Air Force compounds; initiating development of immunochemical systems to provide inexpensive, accurate, and robust measurements of Air Force toxic wastes; and initiating adaptation of environmental sensor networks to monitor air toxicity.
- (U) $1,594 Demonstrated technologies to reduce/destroy wastes and reduce contamination of the environment by Air Force materials and operations to comply with the Clean Air Act. Continued development of a recirculating paint booth with biofilter and Volatile Organic Compounds (VOCs) emissions control technology and developed chemical/physical processes to treat oil/water wastes, emulsions, and aqueous film forming foam (AFFF) in waste water.
- (U) $1,140 Conducted study to determine the effect of animal sleep-disturbance habituation from aircraft noise. Characterized the habitat of marine mammals exposed to military aircraft noise and developed baseline noise levels for Air Force use. Completed and transitioned the Assessment System for Aircraft Noise (ASAN) to Air Force Center for Environmental Excellence and Air Combat Command.
- (U) $3,562 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603723F Environmental Engineering Technology
	PROJECT 2103

(U) FY 1999 ($ in Thousands):

- (U) $ 732 Develop and demonstrate technologies and design criteria for monitoring, characterization, assessment, process control, and disposal to reduce environmental impact of Air Force operations by integrating real-time Dense Non-Aqueous Phase Liquid (DNAPL) sensing instrumentation with horizontal directional drilling technology. Complete development and demonstration of protocol for intrinsic remediation of DNAPLs.
- (U) $1,590 Develop scientific and engineering tools to reduce weapon system sustainment costs by initiating integration of energy generation and water recovery unit operations with treatment systems for Air Force operations, including Air Logistics Centers.
- (U) $ 200 Demonstrate technologies to reduce/destroy wastes and reduce contamination of the environment by Air Force operations and to comply with the Clean Air Act by completing development of the recirculating paint booth with biofilter.
- (U) $ 57 Identified as a source for SBIR.
- (U) $2,579 Total

(U) FY 2000: Not Applicable

(U) FY 2001: Not Applicable

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates advanced technologies to address Air Force-unique environmental problems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603723F Environmental Engineering Technology / PROJECT: 2103

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	3,786	2,663	3,202	1,431	Cont
(U) Appropriated Value	4,084	2,663			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-217	-84			
b. SBIR	-64				
c. Omnibus/Other Above Threshold Reprogrammings	-26				
d. Below Threshold Reprogrammings	-215				
(U) Adjustments to Budget Year Since FY 1999 PB			-3,202	-1,431	
(U) Current Budget Submit/ FY 2000 PB	3,562	2,579	0	0	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $57 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603723F Environmental Engineering Technology	PROJECT: 2103

(U) D. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602202F, Human Effectiveness Applied Research.
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603112F, Advanced Materials for Weapon Systems
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0603716D, Strategic Environmental Research and Development Program.
- (U) PE 0603851D, Environmental Security Technology Certification Program.
- (U) PE 0604706F, Life Support Systems.
- (U) PE 0604708F, Other Operational Equipment.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) E. Acquisition Strategy: Not Applicable.

(U) F. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603726F C3 Subsystem Integration

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	7,591	10,993	9,122	4,920	5,852	6,752	6,893	7,036	Continuing	Continuing
2810	Advanced Image/Information/Optical Memory Technology Applications	3,890	5,832	3,562	4,920	5,852	6,752	6,893	7,036	Continuing	Continuing
2863	Integrated Photonics	3,701	5,161	5,560	0	0	0	0	0	0	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, Project 2810, Advanced Image/Information Applications, and Project 3192, Advanced Optical Memory Technology, were combined into Project 2810, Advanced Image/Information/Optical Memory Technology Applications. In FY 2001, the efforts in Project 2863, Integrated Photonics, will be conducted in Project 69CK, PE 0603203F.

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates Command, Control, and Communications (C3) technologies in the areas of processing and fusion of digital databases, photonics technology, optical disk storage/processing of digital information, and distributed processing technology for interoperability between dispersed command centers. These technologies provide increased storage, processing, and transmission of digital data received from a broad variety of sensors and sources.

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have a military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	9,364	11,025	11,295	6,606	Cont
(U) Appropriated Value	9,922	11,025			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-324	-32			
b. SBIR	-239				
c. Omnibus/Other Above Threshold Reprogrammings	-63				
d. Below Threshold Reprogrammings	-1,705				
e. Rescissions					
(U) Other Adjustments to Budget Years Since FY 1999 PB			-2,173	-1,686	
(U) Current Budget Submit/FY 2000 PB	7,591	10,993	9,122	4,920	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $322 identified as a source for SBIR.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603726F C3 Subsystem Integration

PROJECT: 2810

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2810 Advanced Image/Information/Optical Memory Technology Applications	3,890	5,832	3,562	4,920	5,852	6,752	6,893	7,036	Continuing	Continuing

(U) A. Mission Description: This project develops and demonstrates techniques and algorithms to meet weapon systems requirements for processed and fused multi-source information needed for mission planning, navigation, targeting, and terrain analysis. It provides generic language translation processing techniques, state-of-the-art algorithms for Air Force exploitation of digitally processed image and spatial (i.e., latitude, longitude, and elevation) database products, automated capabilities to reference and display hypermedia (multi-media) information, and defensive information warfare technologies. This project also develops erasable optical data storage systems with high capacity and fast input/output speed for fighter aircraft (to provide fast airborne access to mission-oriented data and the digital terrain system) and electronic surveillance aircraft (for on-board sensor data recording, operational mission planning requirements, and large data storage requirements (i.e., high-volume, soft-copy, digital imagery exploitation)). Algorithms will be developed to automate the selection, retrieval, and downloading of information stored on mass storage devices that are distributed across the data network. An array of optical disk drives will be developed for high-throughput speed and fault-tolerant requirements. Three-dimensional (3-D) optical memory systems will be developed for volumetric digital data storage. This new mass storage technology will demonstrate ultra-high data density and fast, parallel data access within a low-cost, compact system.

(U) FY 1998 ($ in Thousands):

- (U) $3,000 Developed and demonstrated advanced imagery information, spatial data base, and information correlation technologies to enhance warfighter mission planning, navigation, targeting, and terrain analysis.
- (U) $155 Developed and demonstrated automated capabilities to collect, integrate, extract, and disseminate hypermedia (integrated text, imagery, audio, and video) information which fully exploit relationships between data available to the field commander in a timely manner.
- (U) $430 Developed and demonstrated optical, 3-D information data handling, storage, and access technologies for strategic and tactical applications.
- (U) $305 Designed, developed, and demonstrated optical disk and interface technologies that can be implemented in joint theater operations.
- (U) $3,890 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration
	PROJECT 2810

(U) FY 1999 ($ in Thousands):

- (U) $574 Develop and demonstrate advanced imagery information, sensor fusion, and spatial database technologies to enhance warfighter mission planning, navigation, targeting, and terrain analysis.
- (U) $1,657 Design, develop, and demonstrate automated capabilities to harvest, process, disseminate, and display intelligence and sensor data to improve the sensor exploitation process.
- (U) $2,396 Continue to develop and demonstrate three-dimensional (3-D) optical information data handling, storage, and access technologies including erasable and read-only memories.
- (U) $361 Continue to design, develop, and demonstrate optical disk and interface technologies that can be implemented in joint theater operations, including a parallel Write Once Read Many Times (WORM) 3-D memory and Jukebox Redundant Array of inexpensive devices.
- (U) $673 Design, develop, and demonstrate mission planning and rehearsal capabilities for theater battle management including semi-automated, objectives-based planning and assessment for Command and Control requirements.
- (U) $171 Identified as a source for SBIR.
- (U) $5,832 Total

(U) FY 2000 ($ in Thousands):

- (U) $600 Develop and demonstrate advanced imagery and signal intelligence information, sensor fusion engine, and spatial database technologies to enhance warfighter mission planning, navigation, targeting, and terrain analysis.
- (U) $1,262 Develop and demonstrate automated capabilities to locate, retrieve, process, distribute, and display intelligence and sensor data to improve the sensor exploitation process.
- (U) $600 Initiate development of Smart Memory/Associative Recall module optical information data handling, storage, and access technologies to enable advanced fusion processing techniques.
- (U) $300 Continue to develop and demonstrate optical disk and interface technologies that can be implemented in joint theater operations, including WORM devices.
- (U) $800 Design, develop, and demonstrate mission planning and rehearsal capabilities for theater battle management, including the demonstration of software for joint Command and Control (C2) requirements.
- (U) $3,562 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration
	PROJECT 2810

(U) FY 2001 ($ in Thousands):

- (U) $1,100 Develop and demonstrate advanced imagery and signal intelligence information, adaptive sensor fusion engine, and spatial database technologies for transition to Theater Battle Management Core Systems.
- (U) $2,076 Develop and demonstrate automated capabilities to access, extract, process, and display multi-source intelligence and sensor databases to improve the sensor exploitation process for near-real-time situational awareness.
- (U) $544 Continue to develop Smart Memory and related optical information data handling, storage, and access technologies for strategic and tactical applications. Initiate a DNA-based, four-dimensional, Petabyte memory brassboard.
- (U) $200 Design and develop optical disk and interface technologies for a three-dimensional, self-organizing storage and management system that can be implemented and tested in joint theater operations to provide information handling, fusion, exploitation, dynamic planning, and execution.
- (U) $1,000 Design, develop, and demonstrate Command and Control (C2) mission planning and rehearsal capabilities for theater battle management, including the initial demonstration of fully functional software for assessment against Air Force and joint Command and Control requirements.
- (U) $4,920 Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the S&T Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0603789F, C3 Advanced Development.
- (U) PE 0603728F, Advanced Computing Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603726F C3 Subsystem Integration	PROJECT: 2863

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2863 Integrated Photonics	3,701	5,161	5,560	0	0	0	0	0	0	TBD

(U) A. Mission Description: Current electronic systems are susceptible to electromagnetic interference, electromagnetic pulse, and radio frequency (RF) interference. Size constraints, speed, and reliability also limit traditional electronic systems. Photonics-based systems process information in the form of light (photonic) signals and will provide major improvements in tactical and strategic Command, Control, and Communications (C3) systems by enabling small-size, high-performance, high-capacity, survivable alternatives to electronic-based systems. This project develops and demonstrates advanced hardware technology in optical processing, adaptive transmission, and nonlinear optical processing.

(U) FY 1998 ($ in Thousands):

- (U) $337 Developed and demonstrated analog and digital optical components and processing technologies to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems.
- (U) $1,145 Developed and demonstrated microwave/millimeter-wave photonics components, processing and subsystems for advanced, optically-controlled radio frequency (RF) systems at increased frequencies, bandwidth, and dynamic range.
- (U) $2,219 Developed and tested high performance optical control systems for RF (super high frequency (SHF) and extremely high frequency (EHF)) phased array antennas providing extreme agility, wide angle coverage, broadband performance, and anti-jam capability.
- (U) $3,701 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,405 Develop, demonstrate, and test analog and digital hardened optical component processing technologies to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems (air and space).
- (U) $1,440 Develop and demonstrate microwave/millimeter-wave photonics components, processing, and subsystems for advanced, optically-controlled, reconfigurable RF systems at increased frequencies.
- (U) $2,165 Develop high performance optical control systems for RF (SHF) phased array antennas providing extremely wide angle coverage, broadband performance, and anti-jam capability for satellite communications. Start development of a True Time Delay processor.
- (U) $151 Identified as a source for SBIR.
- (U) $5,161 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration
	PROJECT 2863

(U) FY 2000 ($ in Thousands):

– (U)	$282	Develop, integrate, demonstrate, and test analog and digital optical micro-network processing technologies and components to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems for air and space platforms.
– (U)	$1,968	Develop and demonstrate microwave/millimeter-wave photonics processing and subsystems for advanced, optically-controlled, radio frequency (RF) systems at increased frequencies.
– (U)	$700	Develop high performance control systems for RF phased array antennas providing extremely wide angle coverage, broadband performance, and anti-jam capability for Global Positioning System (GPS) applications. Continue to develop a photonics True Time Delay processor. (In FY 2001, this effort will be conducted in Project 69CK, PE 0603203F.)
– (U)	$2,610	Complete development and demonstration of three-dimensional optical information data handling, storage, and access technologies including erasable and read-only memories.
– (U)	$5,560	Total

(U) FY 2001: Not Applicable.

B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603726F C3 Subsystem Integration
	PROJECT 2863

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0603789F, C3 Advanced Development.
- (U) PE 0603728F, Advanced Computing Technology.
- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603728F Advanced Computing Technology

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	7,520	7,748	4,507	5,932	6,782	8,349	8,522	8,701	Continuing	Continuing
2527	Software Life Cycle Tools	2,218	2,267	340	789	981	2,412	2,462	2,513	Continuing	Continuing
2530	Distributed Systems Reliability and Survivability	2,302	2,382	1,798	2,219	2,484	2,546	2,599	2,654	Continuing	Continuing
2532	Knowledge-Based Systems	3,000	3,099	2,369	2,924	3,317	3,391	3,461	3,534	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates technologies needed to control cost, reduce risk, and increase efficiency and effectiveness of software and computers required for Air Force mission critical combat systems. The Air Force has experienced a dramatic escalation in the cost of acquiring and maintaining embedded computer software for increasingly complex military systems which must be reliable and survivable in the battlefield environment. The requirement for survivable tactical and strategic computing systems has driven the need for automatic integration and interoperability of multiple processing elements, automatic redistribution of data and functions, and location-independent access to data. Distributed processing techniques, which can dynamically reconfigure Command, Control, Communications, and Computer (C4) systems to accommodate lost components or nodes, are required to ensure survivable mission critical command and control functions.

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	5,270	7,827	8,050	8,082	Cont
(U) Appropriated Value	5,613	7,827			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-214	-79			
b. SBIR	-129				
c. Omnibus/Other Above Threshold Reprogrammings	-36				
d. Below Threshold Reprogrammings	2,286				
e. Rescissions					
(U) Other Adjustments to Budget Years Since FY 1999 PB			-3,543	-2,150	
(U) Current Budget Submit/FY 2000 PB	7,520	7,748	4,507	5,932	Cont

(U) Significant Program Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

FY 1999: $216 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603728F Advanced Computing Technology	PROJECT: 2527

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2527 Software Life Cycle Tools	2,218	2,267	340	789	981	2,412	2,462	2,513	Continuing	Continuing

(U) A. Mission Description: Advanced computer systems in Air Force weapon systems require software life cycle tools and technology to reduce costs, improve quality, and enhance productivity. This project develops, evaluates, and transitions new software technology that reduces cost, while improving software, systems, and productivity factors. It develops software life cycle support environments which incorporate both laboratory and commercial off-the-shelf (COTS) products. This project provides a vehicle for software technology integration, transition, and evaluation under operational and field conditions. Technologies for system requirements analysis, reuse of software components, software quality specification, measurement, assessment, and high performance (parallel) computer software engineering are also produced.

(U) FY 1998 ($ in Thousands):

- (U) $561 Designed, developed, and tested technology for the capture and exploitation of design information for building systems that readily and economically evolve. Developed and tested technologies for packaging diverse software capabilities such as visualization, hyper-programming, and dynamic testing.
- (U) $1,406 Developed high performance, advanced parallel computer software and architecture for weapon and information system applications, including the Parallel Assessment Window System.
- (U) $251 Designed the capability to integrate program code of dynamic and static languages within the same module, and designed dynamic language software development tools.
- (U) $2,218 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,087 Demonstrate technology for the capture and exploitation of design information for building systems that readily and economically evolve. Demonstrate technologies for packaging diverse software capabilities such as visualization, hyper-programming, dynamic testing, and object-oriented languages to reduce life cycle costs of software intensive Air Force systems.
- (U) $831 Develop and test the ability to mathematically represent architectural, functional, and Quality of Service (safety, performance, reliability, security, fault tolerance, etc.) properties to enable automatic design analysis and performance evaluation of software systems.
- (U) $300 Develop and test the capability to integrate program code of dynamic and static languages within the same module, and develop and test dynamic language software development tools.
- (U) $49 Identified as a source for SBIR.
- (U) $2,267 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology
	PROJECT 2527

(U) FY 2000 ($ in Thousands):

- (U) $140 Continue to demonstrate technology for the capture and exploitation of design information for building systems that readily and economically evolve
- (U) $100 Continue to develop and demonstrate the ability to mathematically represent architectural, functional, and Quality of Service (safety, performance, reliability, security, fault tolerance, etc.) properties to enable automatic design analysis and performance evaluation of software systems.
- (U) $100 Continue to demonstrate open-systems technology to reduce life cycle costs of Air Force software intensive systems.
- (U) $340 Total

(U) FY 2001 ($ in Thousands):

- (U) $481 Complete demonstration of technology for the capture and exploitation of design information for building systems that readily and economically evolve. Complete demonstration of technologies for packaging diverse software capabilities such as visualization, hyper-programming, dynamic testing, and object-oriented languages to reduce life cycle costs of Air Force software intensive systems.
- (U) $200 Complete development and demonstration of the ability to mathematically represent architectural, functional, and Quality of Service (safety, performance, reliability, security, fault tolerance, etc.) properties to enable automatic design analysis and performance evaluation of software systems.
- (U) $108 Apply advanced evolution-based system/software life cycle technologies and evaluate effects on productivity, product quality, and cost.
- (U) $789 Total

(U) B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0604740F, Computer Resource Management.
- (U) PE 0701112F, Inventory Control Point Operation.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603728F Advanced Computing Technology

PROJECT: 2530

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2530 Distributed Systems Reliability and Survivability	2,302	2,382	1,798	2,219	2,484	2,546	2,599	2,654	Continuing	Continuing

(U) A. Mission Description: This project develops software technology to provide distributed computer information handling for future Command, Control, Communications, and Computer (C4) systems. These technologies integrate numerous heterogeneous processing networks and provide secure, seamless access to information. Future C4 systems must be reconfigurable, operate in real-time, and be survivable, as well as capable of integrating the full spectrum of multimedia data. These systems will operate in an "information pull" mode where the users' requests for information are filled without explicit action on the part of the user to locate, retrieve, or merge data. An object-oriented architecture provides a common perspective which integrates the communications control system and the distributed computing environment.

(U) FY 1998 ($ in Thousands):

- (U) $1,533 Tested the design of mobile computing nodes in a heterogeneous distributed computing environment and demonstrated the utility of security mechanisms.
- (U) $327 Tested the design of techniques for managing multimedia data in distributed information systems.
- (U) $442 Tested adaptive, reconfigurable distributed computing environments across heterogeneous networks to support crisis management and survivability.
- (U) $2,302 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,179 Integrate information warfare technologies into multi-networked distributed computing environments. Demonstrate the ability to adapt to a limited bandwidth (low-speed) interconnection and to reconfigure the network in a distributed computing environment.
- (U) $525 Demonstrate the utility of artificial intelligent agents for the retrieval of multimedia data across a wide area network.
- (U) $611 Demonstrate adaptive, reconfigurable distributed computing environments across heterogeneous networks to support crisis management and survivability.
- (U) $67 Identified as a source for SBIR.
- (U) $2,382 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology
	PROJECT 2530

(U) FY 2000 ($ in Thousands):

- (U) $836 Develop resource management techniques, quality-of-service metrics, and system-level modeling and simulation capability to provide survivability, timeliness, and mobility for applications by dynamically interacting with the global information grid.
- (U) $500 Develop technology that integrates offensive, defensive, and support forces into a cohesive model for planning, execution, and assessment in order to provide dynamic functional and scaleable reconfiguration for mobile aerospace command centers.
- (U) $462 Develop multi-user collaborative interaction technology for adaptive visualization and presentation within distributed air and space Command and Control environments to integrate joint force battle plan simulation, assessment, and implementation.
- (U) $1,798 Total

(U) FY 2001 ($ in Thousands):

- (U) $847 Continue to develop resource management techniques, quality-of-service metrics, and system-level modeling and simulation capability to provide survivability, timeliness, and mobility for applications by dynamically interacting with the global information grid.
- (U) $700 Continue to develop technology that integrates offensive, defensive, and support forces into a cohesive model for planning, execution, and assessment in order to provide dynamic functional and scaleable reconfiguration for mobile aerospace command centers.
- (U) $672 Apply interactive wall technology for multi-user access and continue to refine and implement visual force extractions for joint force battle plan simulation, assessment, and implementation
- (U) $2,219 Total

(U)B. Project Change Summary - Description of Significant Changes: Changes to this program since the previous President's Budget are due to higher priorities within the S&T Program.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0604740F, Computer Resource Management.
- (U) PE 0701112F, Inventory Control Point Operation.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

	DATE **February 1999**
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603728F Advanced Computing Technology**

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology
	PROJECT 2532

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2532 Knowledge-Based Systems	3,000	3,099	2,369	2,924	3,317	3,391	3,461	3,534	Continuing	Continuing

(U) A. Mission Description: Knowledge-based computer systems provide the capability to automatically solve reasoning problems. This effort develops computer technologies which automate the problem solving process associated with human thought. It has three major thrusts. The first, knowledge-based analysis, provides software tools and techniques to develop and evaluate knowledge-based intelligent information tools to support robust, real-time, large-scale information systems. The second, knowledge-based planning, applies artificial intelligence (AI) technology to provide increased cost-effectiveness in diverse planning applications such as air operations planning and execution management, employment and deployment planning, logistics planning, resource allocation, and scheduling processes. The third, knowledge-based software techniques, exploits knowledge-based methods to achieve major improvements in software development and support activities.

(U) FY 1998 ($ in Thousands):
- (U) $441 Tested systematic tools and evaluation methodology for collaborative intelligent information systems capable of coordination, cooperation, and negotiation.
- (U) $1,898 Tested artificial intelligence planning and scheduling tools for imprecise environments. Tested strategies for efficient planning scenario generation in various military domains.
- (U) $661 Tested knowledge-based evolutionary design tools and developed capabilities to monitor and evaluate the satisfaction and capture of requirements and rationale for software systems.
- (U) $3,000 Total

(U) FY 1999 ($ in Thousands):
- (U) $492 Develop dynamic data mining techniques and collaborative decision-based and knowledge-based agents for large-scale information systems.
- (U) $1,750 Demonstrate artificial intelligence planning and scheduling tools for imprecise environments and develop agents for adaptive replanning. Demonstrate strategies for efficient planning scenario generation in various military domains.
- (U) $781 Demonstrate knowledge-based evolutionary design tools and test capabilities to monitor and evaluate the satisfaction and capture of requirements and rationale for software systems.
- (U) $76 Identified as a source for SBIR.
- (U) $3,099 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728F Advanced Computing Technology
	PROJECT 2532

(U) FY 2000 ($ in Thousands):

- (U) $829 Test dynamic data mining techniques and collaborative decision-based and knowledge-based agents for large-scale information systems.
- (U) $1,153 Extend and evaluate knowledge-based technologies in continuous planning. Test planning and information-based agents for adaptive replanning, and integrate next-generation Command and Control technology into aerospace and Unmanned Combat Aerial Vehicle (UCAV) environments.
- (U) $387 Extend knowledge-based evolutionary design tools and demonstrate capabilities to monitor and evaluate the satisfaction and capture of requirements and rationale for software systems.
- (U) $2369 Total

(U) FY 2001 ($ in Thousands):

- (U) $826 Evaluate dynamic data mining techniques and collaborative decision-based and knowledge-based agents for large-scale information systems.
- (U) $1,645 Demonstrate knowledge-based technologies in continuous planning. Integrate and evaluate planning and information-based agents for adaptive replanning, and demonstrate next-generation Command and Control technology for aerospace and UCAV environments.
- (U) $453 Test knowledge-based evolutionary design tools and test capabilities to monitor and evaluate the satisfaction and capture of requirements and rationale for software systems.
- (U) $2924 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0604740F, Computer Resource Management.
- (U) PE 0701112F, Inventory Control Point Operation.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603789F C3 Advanced Development

	COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	12,288	13,179	17,402	14,985	16,300	15,541	15,865	16,195	Continuing	Continuing
2335	Advanced C3 Technology	4,710	4,021	4,093	2,557	5,087	5,198	5,306	5,416	Continuing	Continuing
4072	Correlation and Fusion	6,258	6,775	10,851	9,788	8,526	7,591	7,750	7,911	Continuing	Continuing
4216	Warfighter Information Usage, Management, and Integration Technologies	1,320	2,383	2,458	2,640	2,687	2,752	2,809	2,868	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, PE 0603238F, Global Surveillance and Communications, has been incorporated as Project 4216, Warfighter Information Usage, Management, and Integration Technologies, within this PE.

(U) A. Mission Description: This Advanced Technology Development program develops and demonstrates ground and aerospace Command, Control, and Communications (C3) technology required to maintain Air Force capabilities in a fast-paced, sophisticated, high threat, and intense jamming environment. Enhanced surveillance and communications technology must be developed to counteract an enemy's jamming and to restore critical communications links to the warfighter. The technologies developed in this program include detection, identification, and tracking of hostile targets at long ranges on Command and Control (C2) and Intelligence platforms under combat conditions. Additionally, this project develops reliable, secure, jam-resistant communications and battle management technology that supports the military leader's combat decisions in response to the changing dynamics of the battlespace.

(U) B. Budget Activity Justification: This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development

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

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget/FY 1999 PB	12,865	13,235	13,645	15,651	Cont
(U) Appropriated Value	13,647	13,235			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-483	-56			
b. SBIR	-301				
c. Omnibus/Other Above Threshold Reprogrammings	-87				
d. Below Threshold Reprogrammings	-488				
e. Rescissions					
(U) Other Adjustments to Budget Years Since FY 1999 PB			+3,757	-666	
(U) Current Budget Submit/FY 2000 PB	12,288	13,179	17,402	14,985	Cont

(U) Significant Program Changes: Not Applicable.

FY 1999: $373 identified as a source for SBIR.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 2335

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
2335 Advanced C3 Technology	4,710	4,021	4,093	2,557	5,087	5,198	5,306	5,416	Continuing	Continuing

(U) A. Mission Description: This project develops Command, Control, and Communications (C3) technology for contingency and joint operations focusing on the concepts of force deployment, sustainment, and employment. Dynamic, hostile battlefield environments demand near instantaneous transmission and processing of vast amounts of C3 information for real-time decision making. This project develops and integrates technologies for: low probability of intercept/anti-jam transmission; modular, programmable, multi-level secure communications; secure survivable networks; advanced displays and interfaces; and battle management decision support capabilities for survivable, distributed Command and Control (C2) facilities. Multiband/multimode programmable radios will be enhanced to address the transmission link requirements of joint combat theater communications. Note: During FY 1997, the Defensive Planning and Execution (DPE) program was renamed the Joint Defensive Planner (JDP) per the Joint Standards Air Operations Software Configuration Control Board. The board designated DPE as the joint-Services' software application for theater air and missile defensive planning and monitoring.

(U) FY 1998 ($ in Thousands):

- (U) $2,070 Developed and demonstrated critical ground and aerospace communications technology advances in programmable devices and monolithic microwave integrated circuits to provide survivable radios and transceivers.
- (U) $1,630 Demonstrated advanced networking technologies to provide efficient, secure, interoperable, and deployable communications systems, including network management capability for survivable Asynchronous Transfer Mode (ATM).
- (U) $610 Demonstrated theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities, including a limited brassboard capability for JDP.
- (U) $400 Unmanned Combat Aerial Vehicle demonstration.
- (U) $4,710 Total

(U) FY 1999 ($ in Thousands):

- (U) $1,749 Develop and demonstrate programmable devices and monolithic microwave integrated circuit technology in survivable radios and transceivers for critical ground and aerospace communications.
- (U) $1,428 Demonstrate advanced networking technologies to provide efficient, secure, interoperable, and deployable communications systems, including dynamic, integrated, self-healing networking.
- (U) $730 Demonstrate theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities. Complete the brassboard JDP capability.
- (U) $114 Identified as a source for SBIR.
- (U) $4,021 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 2335

(U) FY 2000 ($ in Thousands):

- (U) $1,475 Develop and demonstrate user-friendly radio communications capability that can automatically sense and adapt to its environment and demand for service.
- (U) $2,018 Demonstrate integrated and distributed networking and information system technologies to provide efficient, secure, interoperable, and deployable information systems, including a Multi-level Secure Information System Manager.
- (U) $600 Demonstrate integrated theater battle management and time-critical air operations technologies, including brassboard to extend displays and contingency replanning capability to mobile Tactical Air Control Parties (TACP) and Special Operations Forces (SOF)
- (U) $4,093 Total

(U) FY 2001 ($ in Thousands):

- (U) $1,054 Continue to develop and demonstrate user-friendly radio communications capability that can automatically sense and adapt to its environment and demand for service.
- (U) $503 Continue to demonstrate integrated and distributed networking and information system technologies to provide efficient, secure, interoperable, and deployable information.
- (U) $1,000 Continue to demonstrate integrated theater battle management and time-critical air operations technologies, adding micro-miniature, large volume storage capability for large-scale geographic mapping applications.
- (U) $2,557 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603617F, C3 Applications.
- (U) PE 0603737D, Advanced Research Projects Agency.
- (U) PE 0603006A, C3 Technology.
- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0602232N, C3 Technology.
- (U) PE 0603726F, C3 Subsystem Integration.
- (U) PE 0603728F, Advanced Computing Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 2335

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603789F C3 Advanced Development

PROJECT: 4072

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4072 Correlation and Fusion	6,258	6,775	10,851	9,788	8,526	7,591	7,750	7,911	Continuing	Continuing

(U) A. Mission Description: In order to ensure maximum target engagement ranges and a first-shot, first-kill capability, the Air Force must be able to detect, positively identify, and track hostile targets. This project develops and demonstrates sensor processing techniques, track and fusion algorithms, bistatic sensor technologies, and correlation techniques in order to enhance target detection and tracking ranges. This project develops and integrates the necessary suite of complementary passive and active hostile target identification technologies for command and control platforms. These technologies will enhance the performance of identification and threat assessment systems for improved acquisition, tracking, and target engagement ranges for theater operations.

(U) FY 1998 ($ in Thousands):

- (U) $2,816 Developed and demonstrated advanced sensor technologies and concepts for assured detection and tracking of hostile airborne targets using multiple off-board sensors.
- (U) $940 Developed and demonstrated advanced passive sensor technologies and concepts for increased survivability of fielded systems and assured detection and tracking of combat threats.
- (U) $2,502 Developed and demonstrated advanced sensor correlation technologies and concepts for assured detection and tracking of hostile ground targets using multiple off-board sensors.
- (U) $6,258 Total

(U) FY 1999 ($ in Thousands):

- (U) $2,864 Develop and evaluate acoustic analysis algorithms, radar identification technologies, and intelligent technologies for assured detection, tracking, and identification of hostile airborne targets using multiple off-board sensors.
- (U) $1,011 Continue to develop a bistatic airborne testbed and refine concepts that increase the survivability of fielded systems by quietly detecting and tracking combat threats.
- (U) $2,708 Continue design of real-time airborne demonstration of all-source advanced correlation capability for time-critical targets and develop teraflop signal processor technology.
- (U) $192 Identified as a source for SBIR.
- (U) $6,775 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4072

(U) FY 2000 ($ in Thousands):

- (U) $2,930 Initiate an effort for over-the-horizon situation awareness through passive exploitation of signals emanating from weapon systems and develop an integrated approach to positive target identification utilizing advanced resource management and cueing techniques.
- (U) $1,198 Evaluate and assess bistatic airborne testbed data and continue development of integrated adaptive processing for spaceborne and airborne radar applications.
- (U) $2,847 Demonstrate an all-source advanced capability for the detection and tracking of time-critical targets and continue development of affordable teraflop signal processor technology.
- (U) $3,876 Develop advanced fusion technology to evaluate the capability of Unmanned Combat Aerial Vehicle (UCAV) to operate in a C4ISR data-rich environment as part of an integrated C3 network.
- (U)$10,851 Total

(U) FY 2001 ($ in Thousands):

- (U) $2,427 Continue development of techniques to provide over-the-horizon situation awareness through passive exploitation of signals emanating from weapon systems.
- (U) $1,559 Complete analysis of bistatic airborne testbed data and continue development of integrated adaptive processing for spaceborne and airborne radar applications.
- (U) $2,946 Evaluate the all-source capability developed for the detection and tracking of time-critical targets and demonstrate affordable teraflop signal processor technology.
- (U) $2,856 Continue to develop advanced fusion technology to evaluate the capability of UCAV to operate in a C4ISR data-rich environment as part of an integrated C3 network.
- (U) $9,788 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4072

(U) .B. Project Change Summary - Description of Significant Changes: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:
- (U) PE 0603203F, Advanced Aerospace Sensors.
- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0603742F, Combat Identification Technology.
- (U) PE 0603726F, C3 Subsystem Integration.
- (U) PE 0603728F, Advanced Computing Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development	PROJECT 4216

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4216 Warfighter Information Usage, Management, and Integration Technologies	1,320	2,383	2,458	2,640	2,687	2,752	2,809	2,868	Continuing	Continuing

(U) A. Mission Description: This project will develop and demonstrate the advanced technologies required to implement an interoperable, worldwide Information For The Warrior (IFTW) construct capable of supporting near-real-time multimedia (i.e., voice, data, video, and imagery) information exchange between ground and airborne platforms. The IFTW technology will provide "reachback" (i.e., updating information and mission changes to enroute aircraft and "in-transit visibility" of the aircraft and cargo status at Command and Control centers.) The IFTW capabilities will be enhanced through the incremental development, demonstration, and integration of advanced information management, network management, and communications transmission technologies. It will address interoperation across echelon, Service, and multi-national force boundaries, as well as provide support for mobile command and control, and sensor-to-shooter operations. This program directly responds to user deficiencies as expressed by the Joint Staff (Command, Control, Communications, Computers, and Intelligence for the Warrior), the Air Force (Theater Deployable Communications), Air Mobility Command (Air Mobility Master Plan and Airborne Situational Awareness), and the Defense Information Systems Agency (Far-Term Defense Information Systems Network).

(U) FY 1998 ($ in Thousands):
- (U) $543 Designed, developed, demonstrated, and integrated IFTW advanced information management technologies for data retrieval, transfer, and presentation.
- (U) $383 Designed, developed, demonstrated, and integrated advanced airborne, high-speed super-high frequency communications technologies for global broadcast service and IFTW.
- (U) $394 Designed, developed, demonstrated, and integrated advanced network module and bandwidth management and communications protocol technologies into the IFTW effort. Conducted studies on Asynchronous Transfer Mode (ATM) technologies for the IFTW environment.
- (U) $1,320 Total

(U) FY 1999 ($ in Thousands):
- (U) $726 Design, develop, demonstrate, and integrate advanced information communication mediation management technologies for IFTW joint task force and international operations.
- (U) $794 Design, develop, demonstrate, and integrate advanced airborne, super-high frequency communications and low-cost, phased array antenna technologies.
- (U) $796 Design, develop, demonstrate, and integrate advanced network and bandwidth management and technologies, including agents and routers, for IFTW in joint and international environments.
- (U) $67 Identified as a source for SBIR.
- (U) $2,383 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603789F C3 Advanced Development
	PROJECT 4216

(U) FY 2000 ($ in Thousands):

- (U) $830 Design, develop, integrate, and demonstrate advanced expert system decision algorithms and software to prioritize and control resources for global reach in a mobility environment.
- (U) $865 Design, develop, integrate, and demonstrate modular, reprogrammable radio communications technologies for commercial and military global reach in an airborne mobility environment.
- (U) $763 Design, develop, integrate, and demonstrate advanced protocol network and commercial management technologies to validate communications between air platforms and Command and Control centers at Scott Air Force Base for global reach in a mobility environment. Develop autonomous network setup and control for a global reach capability.
- (U) $2,458 Total

(U) FY 2001 ($ in Thousands):

- (U) $880 Design, develop, integrate, and demonstrate advanced intelligent agents and information structure management technologies for global reach in a mobility environment.
- (U) $909 Design, develop, integrate, and demonstrate advanced reprogrammable radio communication and media control reach and awareness in a mobility environment.
- (U) $851 Design, develop, integrate, and demonstrate advanced global intranet technologies for global reach in a mobility environment.
- (U) $2,640 Total

(U) B. Project Change Summary - Description of Significant Changes: Not Applicable.

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

(U) Related Activities:

- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0603726F, C3 Subsystem Integration.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy: Not Applicable.

(U) E. Schedule Profile: Not Applicable.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603876F Space Based Laser (SBL) (Space)

PROJECT: 4779

COST *($ In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4779 Space Based Laser	0*	34,884	63,840	63,779	63,674	63,565	64,244	64,938	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

* No FY98 Air Force funding, program funded by BMDO (PE0603173C).

(U) A. Mission Description

The Space Based Laser (SBL) program was created to provide the nation with a highly effective, continuous, global boost phase intercept option for both theater and national missile defense. An SBL system could defend against missiles without putting the lives of US military personnel at risk. The possible speed of light defense allows for boost phase intercept at the earliest possible moment, offering the highest probability that intercepted missile fragments (possibly containing active chemical/biological or nuclear materials) will fall within the attacker's territory, rather than defended territory. The SBL system could also provide many ancillary mission capabilities, including air defense, global surveillance, and target detection and designation.

The SBL program is structured to research the feasibility and operational contribution of performing boost phase missile defense from space. BMDO's directed energy program (PE0603173C, Project 1360) has been addressing several key critical technology issues, such as the Hydrogen Fluoride laser performance and modeling; optics experiments; laser and optics integration; and acquisition, tracking, pointing, and fire control (ATP/FC) tests. The Air Force began contributing to the SBL program in FY99. The combined AF/BMDO budget funds further technology development and risk reduction efforts leading to an Integrated Flight Experiment (IFX) that will provide opportunities for more complete ground and space flight testing. The IFX is a critical step in proving the feasibility of destroying ballistic missiles in their boost phase from space.

The Air Force program funding increase in FY2000 and beyond will aid the intense efforts planned for technology risk reduction, integrated system testing, and development of an IFX. The technology risk reduction activities include uncooled laser resonator optics, phase conjugation beam clean-up, and ATP demonstration. Potential ground experiments will demonstrate major risk area engineering design units (gain generator, resonator, beam control). Technology risk reduction and component demonstration prior to flight hardware development is an important part of the IFX program. The IFX will culminate in integration, performance of a series of on-orbit experiments, and demonstration of SBL boost phase intercept feasibility.

(U) FY 1998 ($ in Thousands):
Not Applicable

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603876F Space Based Laser (SBL) (Space)
	PROJECT 4779

(U) FY 1999 ($ in Thousands):

- (U) $4,418 Alpha LAMP Integration (ALI) risk reduction efforts and system definition
- (U) $2,500 Concept Definition Study Extension (LMA)
- (U) $2,971 Alpha Laser Optimization (ALO) risk reduction efforts and system definition
- (U) $2,500 Concept Definition Study Extension (TRW)
- (U) $6,389 Advanced Phase-conjugation Experiment (APEX) risk reduction efforts
- (U) $1,500 Advanced Mirror System Development (NASA) and joint efforts
- (U) $3,550 Modeling, Simulation (XR), and SBL lethality studies (AFRL)
- (U) $4,257 AFSPC support efforts and AFRL technology investment
- (U) $4,020 FFRDC and SETA support
- (U) $1,648 Program Support
- (U) $1,131 Identified as a source for SBIR
- (U) $34,884 Total

(U) FY 2000 ($ in Thousands):

- (U) $55,415 Integrated Flight Experiment (IFX) Contract
- (U) $1,500 Advanced Mirror System Development (NASA) and joint efforts
- (U) $3,257 AFSPC support efforts and AFRL technology investment
- (U) $2,020 FFRDC and SETA support
- (U) $1,648 Program Support
- (U) $63,840 Total

(U) FY 2001 ($ in Thousands):

- (U) $56,624 Integrated Flight Experiment (IFX) Contract
- (U) $250 Advanced Mirror System Development (NASA) and joint efforts
- (U) $3,257 AFSPC support efforts and AFRL technology investment
- (U) $2,000 FFRDC and SETA support
- (U) $1,648 Program Support
- (U) $63,779 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603876F Space Based Laser (SBL) (Space) / PROJECT: 4779

(U) B. Budget Activity Justification:

This PE is in Budget Activity 3 (Advanced Technology Development) because it is performing technology development and risk reduction activities in support of IFX development.

(U) C. Program Change Summary ($ in Thousands)

	FY 1998	FY 1999	FY 2000	FY 2001	Total Cost
(U) Previous President's Budget (FY 1999 PB)	0	35,000	35,002	34,994	Continuing
(U) Appropriated Value		35,000			
(U) Adjustments to Appropriated Value					
a. Cong Reductions		-116			
b. SBIR					
c. Omnibus or Other Above Threshold Reprogram					
d. Below Threshold Reprogramming					
(U) Adjustments to Budget Years Since FY 1999 PB			28,838	28,785	
(U) Current Budget Submit/FY 2000 PB	0	34,884	63,840	63,779	Continuing

(U) Significant Program Changes: More aggressive SBL risk reduction plan briefed to DDR&E and USD(A&T). Both concurred on AF/BMDO plan to add additional funds to the program and increase the intense efforts for technology risk reduction, integrated system testing, and development of an IFX.

FY99: $1,131 identified as a source for SBIR

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603876F Space Based Laser (SBL) (Space)
	PROJECT 4779

(U) D. Other Program Funding Summary ($ in Thousands)

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	To Compl	Total Cost
(U) RDT&E, BMDO, R-29, Support Technologies-Adv Tech Dev	118,323	126,388	75,000	75,000	75,000	75,000	75,000	75,000	Cont	Cont

(U) E. Acquisition Strategy: BMDO and the Air Force are jointly funding the SBL risk reduction activities. BMDO is the program lead, and the Air Force is the integrating executing agent for BMDO. The IFX contract award is planned to occur by 3QFY99. The IFX contract plans to bring together the three major contractors under a joint venture agreement to accomplish the IFX. The contract will be structured under a Total System Authority (TSA) arrangement allowing the contractor broad authority and responsibility for program success (planning, baselining, resource management, etc.).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603876F Space Based Laser (SBL) (Space)
	PROJECT 4779

(U) F. Schedule Profile*

	FY 1998				FY 1999				FY 2000				FY 2001			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(U) Concept Definition Studies Awarded		X														
(U) Integrated Flight Experiment (IFX) Contract Award							X									
(U) Component Development/Risk Reduction Efforts on laser and optics components (under IFX contract)							X									
(U) High Altitude Flight Test of Component Technology									X							

* Schedule profile reflects AF and BMDO funding.

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603876F Space Based Laser (SBL) (Space)
	PROJECT 4779

(U) A. Project Cost Breakdown ($ in Thousands)

	FY 1998	FY 1999	FY 2000	FY 2001
(U) Alpha LAMP Integration (ALI) risk reduction efforts	0	4,418		
(U) Concept Definition Study Extension (LMA)	0	2,500		
(U) Alpha Laser Optimization (ALO) risk reduction efforts	0	2,971		
(U) Concept Definition Study Extension (LMA)	0	2,500		
(U) Integrated Flight Experiment (IFX) Contract	0	0	55,415	56,624
(U) Advanced Phase-conjugation Experiment (APEX) risk reduction efforts	0	6,389	0	0
(U) Advanced Mirror System Development (AMSD) and joint efforts	0	1,500	1,500	250
(U) Modeling, Simulation (XR), and Lethality (AFRL) studies	0	3,550	0	0
(U) AFSPC support efforts and AFRL technology investment	0	4,257	3,257	3,257
(U) FFRDC and SETA support	0	4,020	2,020	2,000
(U) Program Support	0	1,648	1,648	1,648
(U) Identified as a source for SBIR	0	1,131	0	0
(U) Total	0	34,884	63,840	63,779

(U) B. Budget Acquisition History and Planning Information ($ in Thousands)

Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
Identified as a source for SBIR							1,131				

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)											DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development					PE NUMBER AND TITLE 0603876F Space Based Laser (SBL) (Space)						PROJECT 4779
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1998	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget FY 2001	Budget to Complete	Total Program
Product Development Organizations											
Lockheed Martin	C/CPFF	1Q89			0	0	4,418	0	0	0	4,418
Lockheed Martin	FFP	2Q98			0	0	2,500	0	0	0	2,500
TRW	C/CPFF	4Q92			0	0	2,971	0	0	0	2,971
TRW	FFP	2Q98			0	0	2,500	0	0	0	2,500
TRW	C/CPFF	4QFY89			0	0	6,389	0	0	0	6,389
NASA (AFRL)	MIPR	N/A			0	0	1,500	1,500	250	TBD	TBD
TBD	C/CPAF	3Q99			0	0	0	55,415	56,624	TBD	TBD
Support and Management Organizations											
Misc	Misc				0	0	13,475	6,925	6,905	TBD	TBD
Test and Evaluation Organizations											
N/A	N/A										
Identified as a source for SBIR							1,131				
Subtotal Product Development					0	0	20,278	56,915	56,874	TBD	TBD
Subtotal Support and Management							13,475	6,925	6,905		
Subtotal Test and Evaluation											
Total Project					0	0	34,884	63,840	63,779	TBD	TBD

(U) B. Budget Acquisition History and Planning Information Continued ($ in Thousands)

Government Furnished Property:
None.

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DEPARTMENT OF THE AIR FORCE

HEADQUARTERS AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE OHIO

19 JAN 1999

MEMORANDUM FOR SAF/FMBIM

FROM: HQ AFMC/CEP
4225 Logistics Avenue, Room A-127
Wright-Patterson AFB OH 45433-5745

SUBJECT: Update to the FY 2000-2001 RDT&E Construction Program Budget Estimate (BES) Submission

1. We reviewed our initial FY 2000-2001 BES, 8 Sep 98, and have no changes to our previous submittal.

2. In accordance with Air Force Instruction (AFI) 65-601, Volume 1, Chapter 13, we are resubmitting for your review, Air Staff coordination, and congressional notification the AFMC FY 2000-2001 RDT&E Construction Program and changes to the FY99 President's Budget Investment Call.

FY	Project #	Title	PE	($000)	Remarks
1999	FSPM981305	Airborne Laser Complex Upgrade	6.33.19F	6,845	Moved from FY98
1999		Minor Construction	6.58.07F	350	New Start

FY	Project #	Title	PE	($000)	Remarks
2000		Minor Construction	6.27.02F	636	
2000		Minor Construction	6.58.07F	525.5	

FY	Project #	Title	PE	($000)	Remarks
2001		Minor Construction	6.27.02F	350	
2001		Minor Construction	6.58.07F	820	

Each of the projects has been reviewed and we find that they meet the RDT&E funding criteria as outlined in AFI 65-601. The RDT&E (Appn 3600) Minor Construction (MC) requirements are listed by Program Element (PE) but are line item listed by base on the attached DD Form 1391s.

2. Our point of contact for this effort is Mr. Art Rosenfelder, HQ AFMC/CEPD, DSN 787-7610.

/ signed

THOMAS M. GRIFFITH, Colonel, USAF
Chief, Programs and Operations Division
Directorate of the Command Civil Engineer

Attachments:
1. DD Form 1391, FSPM981305
2. DD Forms 1391, Misc Minor Construction

cc:
HQ USAF/ILEC
HQ AFMC/FMA/DRS/DOR
HQ AFRL/DS

1. COMPONENT	FY 1999 RDT&E FACILITY PROJECT DATA (computer generated)	2. DATE
AIR FORCE		

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
EDWARDS AIR FORCE BASE, CALIFORNIA	AIRBORNE LASER COMPLEX UPGRADE

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST($000)
6.33.19F	311-114	FSPM981305	6,845.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
AIRBORNE LASER COMPLEX UPGRADE				5,123.8
CONSTRUCT PAD PRESSURE RECOVERY SYSTEM	LS			(1,537.1)
INTERIOR SUPPORT AREA	LS			(768.6)
UPGRADE SYSTEM INTEGRATION LAB	LS			(2,818.1)
SUPPORTING FACILITIES				748.0
CONSTRUCT FUEL FARM	LS			(107.0)
CONSTRUCT NEUTRALIZATION SUBSYSTEMS	LS			(641.0)
SUBTOTAL				5,871.8
CONTINGENCY (10%)				587.2
TOTAL CONTRACT COST				6,459.0
SUPERVISION, INSPECTION AND OVERHEAD (6%)				387.5
TOTAL FUNDED COST				6,845.0

10. Description of Proposed Construction: Modify existing Birk Flight Test Facility (Bldg 151 and associated areas) and install necessary R&D equipment. Modifications include constructing concrete pad for pressure recovery system, upgrade Bldg 151 for installion of a system integration laboratory, other Bldg. 151 mods, construct a laser fuel farm, and a neutralization subsystem. All work required for a complete facility.

11. REQUIREMENT: As required.
PROJECT: Modify existing Birk Flight Test Facility (BFTF) (Building 151 and associated areas) and install necessary R&D equipment to support the Program Definition Risk Reduction(PDRR)Airborne Laser (ABL) RDT&E program.
REQUIREMENT: The PDRR ABL program is designed to exploit powerful technologies which have evolved over the past 20 years and integrate them into a revolutionary airborne weapon system which is lethal to boosting enemy Theater Ballistic Missiles (TBMs) at extremely long ranges. The ABL also plays a significant role in assisting the other joint tiers in the Theater Missile Defense architecture by reducing the number of targets, providing missile trajectory information to the theater point defenses, and identifying TBM launch points for counter force strikes against mobile launchers. Test facilities must be capable of supporting a test program which integrates a multi megawatt chemical oxygen iodine laser (COIL) and beam control system with a large aperture telescope into a Boeing 747 400F aircraft. Since the PDRR ABL aircraft will be a first-of-its-kind, modifications and equipment installation will be designed and modified as the program proceeds. With the facility capabilities of BFTF, building a new temporary facility for the PDRR ABL is an unnecessary expense.
CURRENT SITUATION: Current BFTF facilities were designed to support wide body aircraft and can accommodate the Boeing 747 400F. Modifications,

1. COMPONENT	FY 1999 RDT&E FACILITY PROJECT DATA (computer generated)	2. DATE
AIR FORCE		

3. INSTALLATION AND LOCATION	
EDWARDS AIR FORCE BASE, CALIFORNIA	
4. PROJECT TITLE	5. PROJECT NUMBER
AIRBORNE LASER COMPLEX UPGRADE	FSPM981305

however, are needed to support the weapon element of the PDRR ABL. No pad exists to mount a pressure recovery system designed to simulate PDRR ABL operating altitudes. Other Building 151 facility modifications are required to accommodate the uniqueness of testing and operating a high energy laser system. As an example, minor power and HVAC upgrades may be needed to support laboratory equipment in the system integration laboratory. Not having a laser fuel farm or a neutralization subsystem, areas will be prepared to construct a fuel farm and install equipment. A neutralization pond does not exist and may be required to handle expended chemicals from laser operations.

IMPACT IF NOT PROVIDED: Significant costs and schedule delays will be incurred if the government cannot provide the facilities required by the integration contractor. Existing contractor facilities are not sufficient to support the PDRR ABL. The program is currently on track to demonstrate lethality against boosting Theater Ballistic Missiles in the year 2003.

ADDITIONAL: 10 USC 2353 authorizes the use of RDT&E funds to construct facilities necessary for the performance of a contract. This construction project supports the PDRR ABL integration contractor. There is no criteria to scope for this project in Part II of Military Handbook 1190, "Facility Planning and Design Guide" and in AFH 32-1084, "Facility Requirements."

1. COMPONENT	FY 1999 MILITARY CONSTRUCTION PROJECT DATA (computer generated)	2. DATE
AIR FORCE (AFMC)		

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
EDWARDS AIR FORCE BASE, CALIFORNIA	Minor Construction < $500,000

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F	116-665	FSPM982523	350.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Minor Construction using RDT&E funds for FY1999:				
Construct Joint Strike Force Harrier Pit	LS			350.0

10. DESCRIPTION OF PROPOSED WORK: Construct in-ground concrete test pit

11. REQUIREMENT: As required.

PROJECT: Construct Joint Strike Force Harrier Pit

REQUIREMENT: A Harrier type pit is required to allow testing of the vertical take off capability of the new Joint Strike Fighter (JSF) aircraft while providing noise and blast attenuation.

CURRENT SITUATION: There is no facility available to support this test requirement.

IMPACT IF NOT PROVIDED: Lack of this mission critical capability will impede the successful testing of this state-of-the-art aircraft.

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1. COMPONENT	FY 2000 MILITARY CONSTRUCTION PROJECT DATA (computer generated)	2. DATE
AIR FORCE (AFMC)		

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ROME LAB, NEW YORK	Minor Construction < $1,000,000

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
62702F	610-281	ULDF93002P2	636.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Minor Construction using RDT&E funds for FY2000:				
Upgrade Research Engineering Area, Bldg 106	LS			636.0

10. DESCRIPTION OF PROPOSED WORK: This is a quality of life improvement for the Sensors Directorate offices in Building 106. Improvements include: replacement of existing asbestos cement partitions with a nonasbestos wall system, replacement of obsolete building systems including electrical distribution, lighting, suspended ceilings, fire detection and protection systems.

11. REQUIREMENT:.

PROJECT:: Upgrade Research Engineering Area, Bldg 106

REQUIREMENT:.. Rome Research Site facilities require modern laboratory and professional office facilities to accomplish its mission.

CURRENT SITUATION: Building 106 was originally built in 1943 and renovated into a laboratory in 1952, virtually no changes other than painting have occurred since. Facilities are substandard, inefficient, and outmoded by today's standards, which seriously impacts on their safety, efficiency, productivity, and denies personnel the benefit of a modern quality office/lab facility which meets AF standards.

IMPACT IF NOT PROVIDED: The office power systems consist of 1950's vintage open bussways which pose a potential electrocution hazard to personnel, and are subject to frequent outages due to overloading will continue. All of the walls are constructed of asbestos cement partitions, and the areas above the ceilings contain friable asbestos material, whenever any minor work is accomplished, the area has to be evacuated causing lengthy unscheduled work stoppages in emergencies and scheduled work stoppages in non-emergencies

1. COMPONENT	FY 2000 MILITARY CONSTRUCTION PROJECT DATA (computer generated)	2. DATE
AIR FORCE (AFMC)		

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
EDWARDS AIR FORCE BASE, CALIFORNIA	Minor Construction < $500,000

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F	211-183	FSPM992502	495.5

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Multi Axis Thrust Stand (MATS) Pad 17	SF	8,000		
Supporting Facilities				423.0
Utilities	LS			(141.0)
Pavements	LS			(141.0)
Site Improvements	LS			(141.0)
Subtotal				423.0
Contingency (10%)				42.3
Total Contract Cost				465.3
Supervision, Inspection, and Overhead				30.2
Total Funded Cost				495.5

10. DESCRIPTION OF PROPOSED WORK: Unspecified Minor Construction (13.15.4). Construct a stand for the Multi Axis Thrust Stand at Pad 17. Reinforce concrete, provide utilities to support remote electrical, fueling, and monitoring while test vehicle is on a raised stand. The test stand structure will be procured from NASA AMES at Moffett Field, CA.

11. REQUIREMENT: As required.

PROJECT: Construct MATS at Pad 17

REQUIREMENT: Construct a test stand capable of hoisting a test vehicle up to 50' above ground, with a capacity of 60 tons. A new control cab made of concrete masonry units to be placed near the pad. Concrete pad must be reinforced to withstand the weight and thrust of multiple test vehicles with no restrictions. A remotely operated system will monitor the system supplying fuel, electrical, and computer modeling information as testing progresses.

CURRENT SITUATION: A MATS stand exists at NASA AMES that is not being used. The stand could be transferred to Pad 17, where Dryden Flight Research Facility (DFRF), NASA or Joint Strike Fighter Task Force could utilize the facility in testing the new composite vehicles.

IMPACT IF NOT PROVIDED: Costs incurred in research and development will continue to rise. Benefits of knowledge gained from a multi-dimensional thrust exhaust nozzle could reduce costs following information gained utilizing the MATS stand at Pad 17.

1. COMPONENT	FY 2000 MILITARY CONSTRUCTION PROJECT DATA (computer generated)	2. DATE
AIR FORCE (AFMC)		

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
EGLIN AIR FORCE BASE, FLORIDA	Minor Construction < $500,000

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F	312-477	FTFA901200	30.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Minor Construction using RDT&E funds for FY2000:				
FTFA901200 Commercial Water	LS			30.0

10. DESCRIPTION OF PROPOSED WORK: Install water line and fire hydrants

11. REQUIREMENT:

PROJECT: Commercial Water Connection

REQUIREMENT:. Provide reliable water source to test facility to support fire protection for high value equipment.

CURRENT SITUATION: Test Facility is currently fed by a small ¾ inch line from an existing well and has no fire protection.

IMPACT IF NOT PROVIDED: Potential loss of high value equipment due to fire.

1. COMPONENT	FY 2001 MILITARY CONSTRUCTION PROJECT DATA (computer generated)	2. DATE
AIR FORCE (AFMC)		

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ROME LAB, NEW YORK	Minor Construction < $1,000,000

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
62702F	610-281	ULDF950076	350.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Minor Construction using RDT&E funds for FY2001:				
Upgrade Research Engineering Area, Bldg 104	LS			350.0

10. DESCRIPTION OF PROPOSED WORK: This is a quality of life improvement for the Sensors Directorate offices of the Photonics Center. Improvements include: The demolition of existing offices in the South end of the building, the construction of new perimeter partitions, replacement of obsolete building systems including electrical distribution, lighting, suspended ceilings, fire detection, and protection systems and the incorporation of systems furniture.

11. REQUIREMENT:

PROJECT: Upgrade Research Engineering Area, Bldg 104

REQUIREMENT:.. Rome Research Site facilities require modern laboratory and professional office facilities to accomplish its mission.

CURRENT SITUATION: : This buildings facilities are outdated by today's standards. The current facility denies personnel the benefit of a modern office/lab.

IMPACT IF NOT PROVIDED: The Rome Research Site elements currently housed in Bldg 104 will continue to operate in substandard, inefficient, and outmoded facilities having impact on efficiency and productivity.

1. COMPONENT	FY 2001 MILITARY CONSTRUCTION PROJECT DATA (computer generated)	2. DATE
AIR FORCE (AFMC)		

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
EGLIN AIR FORCE BASE, FLORIDA	Minor Construction < $500,000

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F	Multi	Multi	820.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Minor Construction using RDT&E funds for FY2001:				
FTFA880252 Upgrade Test Project Building	LS			400.0
FTFA971041 Construct Munitions Test Facility	LS			420.0
Total FY2001 Minor Construction				820.0

10. DESCRIPTION OF PROPOSED WORK: Expand existing facility to accommodate test mission and construct a new facility to replace existing munitions test trailers.

11. REQUIREMENT:

PROJECT: Multiple Construction projects as described above

REQUIREMENT:. Construction to add new bay for bathrooms and office areas, a new parking lot and loading ramp to accommodate additional munitions test personnel. Construct a new facility to replace three double-wide trailers to support munitions test personnel.

CURRENT SITUATION: Existing facility cannot accommodate additional personnel and trailers are a very inefficient and costly alternative to a permanent facility.

IMPACT IF NOT PROVIDED: Test customers cannot be supported and munitions personnel will continue to operate out of inefficient trailer space.

COMBATING TERRORISM RESOURCES

Research, Development, Test and Evaluation, AF	**FY97**	**FY98**	**FY99**	**FY00**	**FY01**	**FY02**	**FY03**	**FY04**	**FY05**
BA: 5 - Engineering and Manufacturing Development PE: 0604617 Agile Combat Support	2.8	1.2	2.4	0.9	0.7	0	0	0	0
BA: 7 - Operational System Development PE: 0305128F Security & Investigative Activities	0	3.3	1.4	0.5	0.4	0.4	0.4	0.4	0.5
TOTAL COMPONENT	3.0	4.5	3.8	1.4	1.1	0.4	0.4	0.4	0.5