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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0207423F Advanced Communications Systems

PROJECT: 5084

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5084	AJCN	0	0	12,053	12,083	972	971	0	0	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

In FY04, efforts were transferred from PE 27423F, Advanced Communciations Systems, Project 675084, AJCN to this PE, BPAC 645084, AJCN.

(U) A. Mission Description

The Adaptive Joint Command, Control, Communications and Computing, Intelligence, Surveillance and Reconnaissance (C4ISR) Node Advanced Concept Technology Demonstration (ACTD) is developing software programmable Radio Frequency (RF) payloads designed to support Information Superiority. AJCN is an open, Commercial-Off-The-Shelf (COTS) based system that can be remotely programmed on the fly to perform a variety of functions simultaneously: air-to-air assured interopreable communications, electronic warfare (EW), signals intelligence (SIGINT), and computer network operations (CNO). AJCN addresses numerous Mission Needs Statements (MNS), Operational Requirements Documents (ORD), and the Combatant Commanders Integrated Priority Lists (IPL) related to communications, intelligence and Information Operations (IO).

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$0	No Activity
(U)	$0	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$0	No Activity
(U)	$0	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$11,374	System Engineering and integration.
(U)	$586	Field evaluation/Military Utitlity Assessment
(U)	$93	Contingency Operations (CONOPS)/TTP Development and Test
(U)	$0	No Activity

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0207423F Advanced Communications Systems — PROJECT: 5084

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued
(U) $12,053 Total

(U) B. Budget Activity Justification

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies to enhance Air Force operational systems.

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	0	0	0	
(U)	Appropriated Value				
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions				
	b. Small Business Innovative Research				
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram				
	e. Rescissions				
(U)	Adjustments to Budget Years Since FY 2003 PBR			12,053	
(U)	Current Budget Submit/FY 2004 PBR			12,053	TBD

(U) Significant Program Changes:

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

(U) Army
(U) DARPA

(U) E. Acquisition Strategy

All major contracts within this Program Element and Budget Project Activity Code (BPAC) will be awarded after full and open competition.

(U) F. Schedule Profile

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0401840F AMC COMMAND & CONTROL SYSTEM

PROJECT: 5119

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5119	Agile Transportation 2001	0	0	6,046	6,054	0	0	0	0	0	0
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

In FY04, this is a new PE.

(U) A. Mission Description

Agile Transportation for the 21st Century (AT21) Advanced Concept Technology Development (ACTD) provides for a suite of decision support tools capitalizing on emerging technology to enhance command and control of the Defense Transportation System (DTS). In concert with Joint Vision 2020, AT21 will focus on identifying, exploring, and fostering advanced synergistic technologies for transportation and sustainment processes with an 'end-to-end' systems perspective. AT21 will transition both COTS and GOTS maturing database, optimization and collaboration technologies into the Defense Transportation System (DTS) to improve peacetime and wartine transportation operations for all Combatant Commanders, Services, and governmental entities. Transportation mode determination and optimization for strategic lift will be based on objective, time-sensitive delivery criteria. The United States Transportation Command (USTRANSCOM) will have the ability to provide the supported CINC with modal alternatives to meet such deployment requirements as required delivery date in theater. Assignment to sealift of collaboratively selected, sealift-qualified, movement requirements will automatically increase availability of scarce airlift assets for assignment to true mission critical requirements. AT21 will produce a software toolsuite for synchronizing and optimizing all DTS operations through unit level execution. This effort will produce an immediate return on investment through better lift aggregation, cost avoidance by increased lift optimization and quality of life of the service members, due to better scheduling. Additionally, this effort will support the Combatant Commanders with improved, rapid, and collaborative transportation planning to support any force deployment.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0401840F AMC COMMAND & CONTROL SYSTEM / PROJECT: 5119

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,829	Continue development of Strategic Transportation Planner (STP) to support optimization, mode determination broker and schedular.
(U)	$1,829	Continue development of Aircrew Scheduler, Airbase Tactical Transportation Planner, and Aircraft Maintenance Schedular to support the tactical echelon for optimization of assets.
(U)	$902	Continue development of deep Collobration in phases with Air Mobility Command (AMC), Military Traffic Mobility Command (MTMC), Military Sealift Command (MSC), Joint Forces Command (JFCOM), Pacific Command (PACOM), and Central Command (CENTCOM).
(U)	$1,486	Continue development of AMC Operational Transportation Planner to support the operational echelon for optimization of assets, mode determination and schedular.
(U)	$6,046	Total

(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 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget			6,170	
(U)	Appropriated Value				
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions				
	b. Small Business Innovative Research				
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram				
	e. Rescissions				
(U)	Adjustments to Budget Years Since FY 2003 PBR			-124	
(U)	Current Budget Submit/FY 2004 PBR			6,046	

(U) Significant Program Changes:
Reduction IAW PBD 604.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
03 - Advanced Technology Development (ATD)	0401840F AMC COMMAND & CONTROL SYSTEM	5119

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

(U) PE 063750D8Z, DUSD (AS & C)
(U) PE 0603728D8Z, DUSD (S&T)
(U) PE 0604764K, DISA (AITS/JPO)
(U) PE 41119F, USAF
(U) PE 41115F, USAF
(U) PE 0603772A, USA

(U) E. Acquisition Strategy

SPO plans to use sprial development, using Indefinate Delivery and Indefinate Quantity contracts.

(U) F. Schedule Profile

(U) Not Applicable

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

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

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	42,310	41,159	33,079	34,374	39,922	46,613	41,409	41,990	Continuing	TBD
2100	Laser Hardened Materials	20,978	13,774	15,457	22,610	28,004	35,527	30,152	30,574	Continuing	TBD
3153	Non-Destructive Inspection Development	6,299	8,359	5,742	4,080	4,114	4,187	4,251	4,311	Continuing	TBD
3946	Materials Transition	13,784	15,174	9,981	5,312	5,412	4,465	4,535	4,599	Continuing	TBD
4918	Deployed Air Base Demonstrations	1,249	3,852	1,899	2,372	2,392	2,434	2,471	2,506	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2002, Project 4918, Deployed Air Base Demonstration, efforts were transferred from PE 0603205F, Project 4398, and PE 0603112F, Project 3946. In FY 2003, the space unique tasks in Projects 2100 and 3946 were transferred to PE 0603500F, Project 5032, Advanced Space Materials, as a result of the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This program develops and demonstrates materials technology for transition into Air Force systems. The program has four projects which develop: (1) laser hardened materials technologies for the broadband laser protection of aircrews and sensors; (2) non-destructive inspection and evaluation technologies; (3) transition data on structural and non-structural materials for aerospace applications; and (4) airbase operations technologies including power generators, deployable shelters, and fire fighting capabilities. Note: In FY 2003, Congress added $1.7 million for an advanced laser program for plasma enhanced chemical vapor deposition techniques for laser protection coatings, $2.5 million for quantitative inspection techniques for assessing aging of military aircraft, $1.4 million for assessing aging of military aircraft, $1.1 million for handheld holographic radar gun, $4.0 million for powdered programmable process, $3.5 million for ceramic matrix composites for engines, $1.4 million for low bandwidth medical collaboration, $1.2 million for hybrid bearing, $1.1 million for vapor grown carbon fiber, $1.0 million for advanced material corrosion research for liquid metal alloys, and $1.8 million for Tyndall Air Force Research Laboratory, which explains the perceived decrease in FY 2004.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems

(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 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	45,801	21,138	41,486	
(U)	Appropriated Value	46,248	41,838		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-447	-442		
	b. Small Business Innovative Research	-1,138			
	c. Omnibus or Other Above Threshold Reprogram		-237		
	d. Below Threshold Reprogram	-2,146			
	e. Rescissions	-207			
(U)	Adjustments to Budget Years Since FY 2003 PBR			-8,407	
(U)	Current Budget Submit/FY 2004 PBR	42,310	41,159	33,079	TBD

(U) Significant Program Changes:

In FY 2003, the space unique tasks in Projects 2100 and 3946 were transferred to PE 0603500F, Project 5032, as a result of the Space Commission recommendation to consolidate all space unique activities. This explains the perceived decrease in FY 2003. The decreases since the FY 2003 PBR are the result of realignment due to higher Air Force priorities. In addition, in FY 2003, this program received Congressional Adds, which explains the overall decrease in FY 2004.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

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

PROJECT: 2100

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
2100 Laser Hardened Materials	20,978	13,774	15,457	22,610	28,004	35,527	30,152	30,574	Continuing	TBD

Note: In FY 2003, space unique tasks in Project 2100 were transferred to PE 0603500F, Project 5032, as a result of the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

Develops enabling materials and concepts for protecting Air Force assets such as aircrews, munitions, and aerospace sensors against laser and high-power microwave directed energy threats. Concepts are demonstrated to provide hardening options for transition to Air Force systems. The goal is to ensure mission capability before, during, and after threat exposure. Current protection schemes are activated by intensity or wavelength and are only capable of countering a specific portion of the laser threat. Recent laser technology developments have increased laser wavelength agility. To harden systems against all potential lasers, the development of a combination of approaches is required. Note: In FY 2003, Congress added $1.7 million for advanced laser program for plasma enhanced chemical vapor deposition techniques for laser protection coatings, which explains the perceived decrease in FY 2004.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $5,059 Developed and demonstrated advanced materials technologies that enhance laser hardening of Air Force spacecraft sensors to ensure safety, survivability, and operability in a laser threat environment. Designed and fabricated optical limiters for the protection of mid-wave infrared staring focal plane arrays. Tested and updated the hardened coating process for rugate fixed-wavelength filters and optical switches for mid-wave infared space systems. Fabricated hardening solutions for critical space sensor designs and environments based on successful approaches employed in tactical sensors.

(U) $8,011 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. Fabricated and validated flexible filter technology (rugate and enhanced thin films) in prescription capable spectacles. Demonstrated first generation tristimulus filter technology (enhanced thin films combined with absorbing dyes) for daytime missions. Completed and transitioned both flexible filters and tristimulus filters in wraparound spectacles for human factors evaluations. Demonstrated laser protective fixed filters for the panaromic night vision goggle (PNVG) program. Began development of tunable liquid-crystal filter technology for the PNVG program.

(U) $7,908 Developed and demonstrated advanced materials technologies that enhance laser hardening for sensors, avionics, and components to increase survivability and mission effectiveness of areospace systems. Developed damage resistant image intensifier tubes. Developed laser damage resistant image intensifiers, charge couple devices, and architectures for fielded television targeting systems. Evaluated laser hardening materials

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT 2100

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

for mid-wave infrared targeting systems and precision-guided munitions.

(U) $20,978 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $7,698 Develop and demonstrate advanced materials technologies that enhance laser protection for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in a laser threat environment. Transition flexible filter technology in the form of spectacles for human factors evaluations and design refinement. Transition first generation tristimulus filter technology for daytime missions to the Life Support Systems Program Office. Fabricate refined tristimulus filter eyewear based on results from human factors study. Transition fixed wavelength filter technology to the panoramic night vision goggle (PNVG) program for flight tests. Continue the development of tunable filter technology for PNVGs. Identify and evaluate hardening technologies for use in protecting eyes from agile laser threats.

(U) $6,076 Develop and demonstrate advanced materials technologies that enhance laser hardening for sensors, avionics, and components to increase survivability and mission effectiveness of aerospace systems. Demonstrate complete hardening for a fielded electro-optical sensor system. Develop hardening solutions for Charge Coupled Device (CCD) imaging systems. Initiate hardening development for multispectral and hyperspectral sensor systems.

(U) $13,774 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $11,030 Develop and demonstrate advanced materials technologies that enhance laser protection for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in a laser threat environment. Identify next generation technology advancements to improve performance of tristimulus filter technology. Characterize tunable filter technology in a representative PNVG prototype system. Develop optical limiter devices to protect eyes from agile laser threats.

(U) $4,427 Develop and demonstrate advanced materials technologies that enhance laser hardening for sensors, avionics, and components to increase survivability and mission effectiveness of aerospace systems. Demonstrate image intensifier tube hardening. Develop hardening solutions for replacement sensors selected for the electro-optical sensor system. Evaluate hardening solutions for CCD imaging systems.

(U) $15,457 Total

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems — PROJECT: 2100

(U) B. Project Change Summary

Not Applicable.

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

(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 0603500F, Multi-Disciplinary Advanced Development Space Technology.
(U) PE 0604706F, Life Support Systems.
(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

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

PROJECT: 3153

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
3153	Non-Destructive Inspection Development	6,299	8,359	5,742	4,080	4,114	4,187	4,251	4,311	Continuing	TBD

(U) A. Mission Description

Develops and demonstrates advanced Non-Destructive Inspection/Evaluation (NDI/E) technologies 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 design, 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/E more rapidly than is currently possible. This project provides technology to satisfy Air Force requirements to extend the lifetime of current systems through increased reliability and cost-effectiveness at field and depot maintenance levels. Equally important is assuring manufacturing quality, integrity, and safety requirements. Note: In FY 2003, Congress added $2.5 million for quantitative inspection techniques for assessing aging of military aircraft, $1.4 million for assessing aging of military aircraft, and $1.1 million for handheld holographic radar gun, which explains the perceived decrease in FY 2004 and out.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$3,099	Developed and demonstrated advanced technologies for improved capabilities in materials corrosion, fatigue monitoring, and testing of aging aircraft to reduce operations and maintenance costs. These technologies will guarantee full operability and safety of the aircraft fleet. Developed and demonstrated advanced technologies for improved capabilities in detection and characterization of corrosion in aging aircraft while emphasing improvement in the probability of detecting serviceable cracks. Developed advanced methods to detect cracks in multiple layers to meet aging aircraft life extension requirements.
(U)	$1,321	Developed and demonstrated advanced technologies for improved capabilities to assess high cycle fatigue and engine life prediction practices to extend the total safe life of turbine engines. Transitioned Non-Destructive Evaluation (NDE) benchmarks and continued development of an automated inspection capability for engine rotary components for increased rotor life extension. Investigated candidate NDE techniques to extend the life of fracture-critical gas turbine engine components and to develop techniques for subsurface component evaluations. Developed an advanced X-ray robotic brassboard to measure surface residual stress on full-scale turbine engine components.
(U)	$1,879	Developed and demonstrated advanced inspection technologies supporting low-observable (LO) systems to enhance affordability and to ensure full performance and survivability. Demonstrated an advanced multispectral LO NDE tool for assessing radio frequency signature (zone versus whole aircraft) that is real-time, lightweight, portable, user friendly, and covers multiple frequency bands. Completed and transitioned to the field an advanced hand-held directional reflectometer for field level infrared signature NDE.
(U)	$6,299	Total

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems
PROJECT 3153	

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,501	Develop and demonstrate advanced technologies for improved capabilities in materials corrosion, fatigue monitoring, and testing of aging aircraft to reduce operations and maintenance costs. These technologies will guarantee full operability and safety of the aircraft fleet. Develop and demonstrate advanced technologies for improved capabilities in detection and characterization of corrosion of joints in aging aircraft. Develop and demonstrate advanced methods to detect cracks in multiple layers in order to meet aging aircraft life extension requirements.
(U)	$3,851	Develop and demonstrate advanced technologies for improved capabilities to assess high cycle fatigue and engine life prediction practices to extend the total safe life of turbine engines. Continue transition of Non-Destructive Evaluation (NDE) benchmarks. Test an automated inspection capability that will inspect engine rotary components for planned life extension of engine rotors. Downselect optimal NDE approaches to extend the life of fracture-critical gas turbine engine components and establish protocols for component inspections. Develop residual stress gradient measurement technologies to increase measurement on shot peened surfaces.
(U)	$2,007	Develop and demonstrate advanced inspection technologies supporting low-observable systems to enhance affordability and ensure full performance and survivability. Transition to the field an advanced multispectral low-observable NDE tool for assessing radio frequency signature (zone versus whole aircraft) that is real-time, small, lightweight, portable, user friendly, and covers multiple frequency bands.
(U)	$8,359	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,747	Develop and demonstrate advanced technologies for improved capabilities in materials corrosion, fatigue monitoring, and testing of aging aircraft to reduce operations and maintenance costs. These technologies will guarantee full operability and safety of the aircraft fleet. Demonstrate and validate pulsed eddy current automated scanner technology for improved capabilities in detection and characterization of corrosion of joints in aging aircraft. Validate low-frequency electromagnetic probe methods to detect cracks in multiple layers in order to meet aging aircraft life extension requirements.
(U)	$2,020	Develop and demonstrate advanced technologies for improved capabilities to assess high cycle fatigue and engine life prediction practices to extend the total safe life of turbine engines. Fabricate and demonstrate an automated inspection capability for engine rotary components for planned life extension of engine rotors. Characterize optimal NDE approaches to extend the life of fracture-critical gas turbine engine components and establish protocols for component inspections.
(U)	$1,975	Develop and demonstrate advanced systems health monitoring technologies to provide on-board and embedded sensing to gain continuous awareness of the state of key subsystems. Develop optimal approaches and methodologies to address the continuous monitoring of materials

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems — PROJECT: 3153

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

integrity and status for critical elements of structures/airframes, propulsion systems, thermal protection, tankage, and wiring.

(U) $5,742 Total

(U) B. Project Change Summary

Not Applicable.

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

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

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

PROJECT: 3946

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
3946 Materials Transition	13,784	15,174	9,981	5,312	5,412	4,465	4,535	4,599	Continuing	TBD

Note: In FY 2002, the Deployed Air Base Demonstration efforts in this PE were transferred from Project 3946 to Project 4918. In FY 2003, space unique tasks in Project 3946 were transferred to PE 0603500F, Project 5032, as a result of the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

Develops and demonstrates advanced materials and processing technologies for fielded and planned Air Force weapon, airframe, and engine applications. Advanced materials and processes that have matured beyond applied research are characterized, critical data are collected, and critical evaluations in the proposed operating environment are performed. This design and scale-up data enhances overall affordability of promising materials and processing technologies, providing needed initial incentives for their industrial development. Note: In FY 2003, Congress added $4.0 million for powdered programmable process, $3.5 million for ceramic matrix composites for engines, $1.4 million for low bandwidth medical collaboration, $1.2 million for hybrid bearing, $1.1 million for vapor grown carbon fiber, and $1.0 million for advanced material corrosion research for liquid metal alloys, which explains the perceived decrease in FY 2004.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $8,147 Developed and demonstrated advanced materials and processing technologies for air vehicles and subsystems to enhance the lift, propulsion, low-observable performance, and overall affordability of air vehicles. Fabricated and characterized integrated composite structure assemblies for aircraft with reduced part count and assembly costs. Completed demonstration of advanced aircraft brake materials with improved braking capacity, increased life, and better environmental stability. Characterized advanced non-linear optical materials for aircraft infrared countermeasures against far-infrared laser sources.

(U) $1,525 Developed and demonstrated advanced materials and processing technologies for space vehicles and subsystems to provide enhanced surveillance capabilities, improved access to space, and improved overall affordability of space vehicles. Characterized improved material processes with increased yields for robust, high performance, and producible infrared detector materials. Continued efforts to validate and demonstrate materials and materials processing technologies to improve performance, reliability, and affordability of spacecraft components and subsystems. Characterized effects of space exposure on advanced material systems.

(U) $4,112 Developed and demonstrated advanced materials and processing technologies to enhance the sustainability of Air Force aerospace systems by lowering operations and maintenance costs while ensuring the full operability and safety of systems and personnel. Completed the characterization of a large-aperture Aluminum Oxynitride window material with high optical quality, durability, and strength. Evaluated the effectiveness of corrosion abatement treatments and transitioned the results.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT 3946

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

(U)	$13,784	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$12,005	Develop and demonstrate advanced materials and processing technologies for air vehicles and subsystems to enhance the lift, propulsion, low-observable performance, and overall affordability of air vehicles. Continue to fabricate and characterize integrated composite structure assemblies for aircraft with reduced part count and assembly costs. Complete the demonstration of advanced non-linear optical materials for aircraft infrared countermeasures against far-infrared laser sources and then transition results. Conduct characterization of materials and processes for enhancing the reliability and maintainability of low-observable systems. Accelerate the development of advanced bearing materials for gas turbine engines.
(U)	$3,169	Develop and demonstrate advanced materials and processing technologies to enhance the sustainability of Air Force aerospace systems by lowering operations and maintenance costs and ensuring the full operability and safety of systems and personnel. Initiate efforts to develop and characterize corrosion resistant coatings and corrosion prevention compounds for aging aircraft structures applications.
(U)	$15,174	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$8,268	Develop and demonstrate advanced materials and processing technologies for air vehicles and subsystems to enhance the lift, propulsion, low-observable performance, and overall affordability of air vehicles. Demonstrate improved materials and inspection tools/processes to enhance reliability and maintainability of low-observable platforms. Demonstrate fabrication processes and properties of ceramic composite materials for turbine engine exhaust components. Develop an affordable high-temperature composite process that enables the fabrication of turbine engine components for future air vehicles to meet cost and performance criteria. Identify materials and their properties for a mid-infrared laser source enabling aircraft infrared countermeasures. Develop, demonstrate, and evaluate materials and processes for high-speed lift and aerospace vehicles. Evaluate characterization techniques and critical data for processing and fabrication of thermal protection components, high temperature structural elements, and fuel systems. Develop and assess metallic, ceramic, and carbon-based composite materials and processing technologies for application to ramjet, scramjet, cryogenic, and combined-cycle engines and structures.
(U)	$1,713	Develop and demonstrate advanced materials and processing technologies to enhance the sustainability of Air Force aerospace systems by lowering operations and maintenance costs and ensuring full operability and safety of systems and personnel. Evaluate corrosion resistant coatings and corrosion prevention compounds for aging aircraft structures applications. Initiate effort to determine durability and failure

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems
PROJECT 3946	

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

mechanisms of hybrid structures in Unmanned Air Vehicles.

(U) $9,981 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0603211F, Aerospace Technology Dev/Demo.

(U) PE 0603202F, Aerospace Propulsion Subsystems Integration.

(U) PE 0603203F, Advanced Aerospace Sensors.

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

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

PROJECT: 4918

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4918	Deployed Air Base Demonstrations	1,249	3,852	1,899	2,372	2,392	2,434	2,471	2,506	Continuing	TBD

Note: In FY 2003, Project 4918, Deployed Air Base Demonstration, efforts were transferred from PE 0603205F, Project 4398, and PE 0603112F, Project 3946.

(U) A. Mission Description

Supports the Aerospace Expeditionary Forces (AEF) through development and demonstration of advanced, rapidly deployable airbase technologies that reduce airlift and manpower requirements, setup times, and sustainment costs. Develops and demonstrates efficient and cost-effective technologies to provide physical protection and fire fighting for deployed AEF warfighters and infrastructure. Develops and demonstrates affordable rapidly deployed technologies that ensure military readiness, support advanced weapon systems, and enable enhanced peacetime training operations. Note: In FY 2003, Congress added $1.8 million for Tyndall Air Force Research Laboratory, which explains the perceived decrease in FY 2004.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$501	Demonstrated and transitioned advanced rapid deployment airbase technologies that reduce airlift, setup times, manpower requirements, and sustainment costs in support of AEF technologies. Developed deployable shelters/heat pump, power, and rapid airfield assessment technologies that improve air mobile systems performance and reduce airlift requirements in support of AEF. Developed advanced aircraft fire fighting agents and equipment. Demonstrated highly effective, deployable crash/rescue technologies based on three-dimensional foam technology to support AEF operations.
(U)	$101	Demonstrated and transitioned affordable, rapid deployment technologies that ensure military readiness, maintain aerospace missions, support advanced weapon systems, and enable peacetime training operations. Developed advanced waste reactor technologies to support deployed waste management systems. Developed a full-scale design for a rapidly deployable mixed-base hydrogen peroxide production plant for airborne laser operations.
(U)	$647	Demonstrated and transitioned efficient and cost-effective technologies to provide physical protection technologies to AEF deployed warfighters and infrastructure. Developed deployable protective and reactive blast suppression technologies to protect deployed warfighters. Developed autonomous ground vehicles to support Air Force operational requirements for unexploded ordnance clearance and active range operations.
(U)	$1,249	Total

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT 4918

(U) A. Mission Description Continued

(U)	FY 2003 ($ in Thousands)	
(U)	$0	Accomplishments/Planned Program
(U)	$2,259	Demonstrate and transition advanced rapid deployment airbase technologies that reduce airlift and manpower requirements, setup times, and sustainment costs in support of Aerospace Expeditionary Force (AEF) operations. Continue development of shelters, power, and rapid airfield assessment technologies that improve system performance and reduce airlift requirements in support of AEF operations. Develop advanced aircraft fire fighting technologies such as fire fighting agents and equipment. Transition a highly effective, deployable crash/rescue system based on three-dimensional foam technology to support AEF operations.
(U)	$101	Demonstrate and transition affordable, rapid deployment technologies that ensure military readiness, maintain aerospace missions, support advanced weapon systems, and enable peacetime training operations. Continue development of advanced waste reactor technologies to support emerging weapons. Demonstrate rapidly deployable full-scale mixed-base hydrogen peroxide production plant that reduces the airborne laser logistics burdens by thirty percent.
(U)	$1,492	Demonstrate and transition efficient and cost-effective technologies to provide physical protection to deployed AEF warfighters and infrastructure. Develop deployable protective and advanced blast suppression technologies to protect deployed warfighters. Continue development of autonomous vehicles to support Air Force operational requirements for unexploded ordnance clearance and active range operations.
(U)	$3,852	Total
(U)	FY 2004 ($ in Thousands)	
(U)	$0	Accomplishments/Planned Program
(U)	$1,776	Demonstrate and transition advanced, rapidly deployable airbase technologies that reduce airlift and manpower requirements, setup time, and sustainment costs in support of AEF operations. Transition air-inflatable shelter technology to support logistics footprint reduction in AEF operations. Demonstrate 10KW fuel cell power system that improves deployable power system performance and reduces airlift requirements for AEF operations. Demonstrate rapid airfield assessment technologies that improve performance and enhance AEF operations support. Identify and integrate advanced shelter technologies to increase energy efficiency and provide protection against chemical, biological, and directed energy weapons.
(U)	$123	Demonstrate and transition efficient and cost-effective technologies to provide physical protection to deployed AEF warfighters and infrastructure. Demonstrate deployable protective and advanced blast suppression technologies to protect deployed warfighters. Continue development of autonomous vehicles to support Air Force operational requirements for unexploded ordnance clearance and active range operations.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603112F Advanced Materials for Weapon Systems — PROJECT: 4918

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued
(U) $1,899 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602102F, Materials.
(U) PE 0604617F, Agile Combat Support.
(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	57,625	52,482	36,550	30,714	34,102	43,035	39,621	39,365	Continuing	TBD
5019	Advanced RF Technology for ISR Sensors	0	4,622	4,946	3,586	4,398	4,596	5,451	5,527	Continuing	TBD
665A	Advanced Aerospace Sensors Technology	16,382	11,985	14,953	10,782	9,643	10,740	10,902	11,055	Continuing	TBD
69DF	Target Attack and Recognition Technology	41,243	35,875	16,651	16,346	20,061	27,699	23,268	22,783	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2002, work performed under PE 0603253F, Projects 2735 and 666A, moved to this PE, Project 665A. Apparent project ramps due to realignment of the projects and higher priorities within the Science and Technology program. In FY 2003, efforts in advanced radio frequency (RF) technologies for intelligence, surveillance, and reconnaissance (ISR) sensors previously performed in this PE, Project 665A, transferred to Project 5019. Also in FY 2003, space unique tasks in this PE, Project 665A, transferred to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

Divided into three broad project areas, this program develops technologies to enable the continued superiority of sensors from aerospace platforms. The first project develops and demonstrates advanced technologies for RF sensors for aerospace ISR systems. The second project develops and demonstrates advanced technologies for electro-optical (EO) sensors, radar sensors and electronic counter-countermeasures, and components and algorithms. The third project develops and demonstrates RF and EO sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. Together, the projects in this program develop the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. Note: In FY 2003, Congress added $1.0 million for Advanced Physical Vapor Transport and $2.1 million for the National Operational Signature Production and Research Capability

(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.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	60,914	50,589	42,072	
(U)	Appropriated Value	61,509	53,689		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-595	-639		
	b. Small Business Innovative Research	-1,474			
	c. Omnibus or Other Above Threshold Reprogram		-568		
	d. Below Threshold Reprogram	-1,534			
	e. Rescissions	-281			
(U)	Adjustments to Budget Years Since FY 2003 PBR			-5,522	
(U)	Current Budget Submit/FY 2004 PBR	57,625	52,482	36,550	TBD

(U) Significant Program Changes:

Funding decrease in FY 2004 due to higher priorities within the Science and Technology program.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors

PROJECT: 5019

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5019 Advanced RF Technology for ISR Sensors	0	4,622	4,946	3,586	4,398	4,596	5,451	5,527	Continuing	TBD

Note: In FY 2003, efforts in advanced radio frequency (RF) technologies for intelligence, surveillance, and reconnaissance (ISR) sensors previously performed in this PE, Project 665A, transferred to this project.

(U) A. Mission Description

This project develops and demonstrates RF aerospace surveillance sensors and signal processing for ISR sensors capable of operating in adverse clutter and jamming environments. This project provides the warfighter with sensors capable of detecting and tracking both airborne (conventional and low radar cross section) and ground-based, high-value, time-critical targets. Work includes developing aerospace environmentally-qualified (vibration, shock, temperature, and radiation-hardened) sensor capabilities (including integrated electro-optical mixed signal), as well as advanced component and subsystem technologies.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $882 Configure data collection opportunities using existing assets for validation of techniques generated for advanced air moving target indication, ground moving target indication (GMTI), and foliage penetrating ground target indication. Initiate an effort to design a flexible testbed using a manned test aircraft to demonstrate multi-intelligence surveillance.

(U) $1,451 Conduct in-house development of a multi-intelligence sensor design, utilizing technologies developed in aperture development, signal processing, and radar design. Develop techniques for discriminating ground from air targets under conditions of common pulse repetition frequencies, waveforms, and receiver systems.

(U) $1,406 Develop advanced radar signal processing techniques to mitigate clutter and jamming interference, and improve detection and tracking of difficult targets in hostile environments. Develop knowledge-aided radar signal processing techniques for improved detection and false alarm control performance in GMTI sensors. Implement multi-dimensional adaptive processing techniques and knowledge-aided radar signal processing techniques on selected advanced computing architectures, and demonstrate these techniques for multi-mission aerospace radar applications.

(U) $883 Develop and demonstrate photonic digital and analog mixed signal multi-gigahertz component architectures. Develop and integrate chip-scale

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT 5019

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

photonic and hybrid mixed signal components for radio frequency (RF) signal generation, phased array antenna beam formation, and beam control. Develop and demonstrate high-resolution wide bandwidth photonic wavelength division multiplexing and signal processing technology. Provide performance modeling, verification, and analysis of photonic and hybrid mixed signal devices for military unique applications.

(U) $4,622 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,081 Collect data for multi-intelligence air moving target indication, ground moving target indication (GMTI), and foliage-obscured ground target indication. Mature the design for a flexible testbed demonstrating multi-intelligence surveillance to the critical design review level.

(U) $1,271 Complete the design of a multi-intelligence surveillance system and model it in mission area simulations. Validate the system through computer simulation and emulation techniques for discerning ground and air targets under multi-intelligence waveform, pulse repetition frequency, and signal processing scenarios. Initiate plans for an experiment that will validate electronic protection signal processing techniques for multi-intelligence data collection systems.

(U) $1,246 Begin developing techniques to surveil venues denied to standoff intelligence, surveillance, and reconnaissance platforms. The emphasis is on denied access areas, such as urban canyons, inner areas of buildings, and heavily concealed targets that use advanced camoflauge, concealment, and deception techniques. Specifically, the effort will concentrate on short-range, low-cost, expendable sensors that can exploit multiple phenomenologies.

(U) $1,049 Demonstrate and evaluate advanced radar signal processing techniques to mitigate clutter and jamming interference, and improve the detection and tracking of difficult targets in hostile environments. Demonstrate and evaluate knowledge-aided radar signal processing techniques for improved detection and false alarm control performance in GMTI sensors. Continue implementing adaptive processing techniques for multi-mission conformal arrays and wideband and polarization adaptive processing techniques for multi-function radar on selected advanced computing architectures, and continue demonstrating these techniques for multi-mission aerospace radar applications.

(U) $299 Continue providing impartial performance modeling, verification, and analyses of photonic and hybrid mixed signal devices for RF signal generation, phased array antenna beam formation, and beam control, in support of government-sponsored and independent research.

(U) $4,946 Total

(U) B. Project Change Summary

Not Applicable.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors / PROJECT: 5019

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

(U) Related Activities:

(U) PE 0602204F, Aerospace Sensors.

(U) PE 0603270F, Electronic Combat Technology.

(U) PE 0603500F, Multi-disciplinary Advanced Space Technology.

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors

PROJECT: 665A

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
665A Advanced Aerospace Sensors Technology	16,382	11,985	14,953	10,782	9,643	10,740	10,902	11,055	Continuing	TBD

Note: In FY 2003, space unique tasks in this project transferred to PE 0603500F, Project 5034, in conjunction with the Space Commission recommedation to consolidate all space unique activities. Also in FY 2003, efforts in advanced radio frequency (RF) technologies for intelligence, surveillance, and reconnaissance (ISR) sensors previously performed in this project transferred to this PE, Project 5019.

(U) A. Mission Description

This project develops and demonstrates aerospace sensor technologies for manned and unmanned platforms, including electro-optical (EO) sensors, targeting and attack radar sensors, and electronic counter-countermeasures for radars. It provides aerospace platforms with the capability to precisely detect, track, and target both airborne (conventional and low radar cross section) and ground-based, high-value, time-critical targets. Project activities include developing multi-function radar and electronic combat technology. Desired warfighting capabilities include the ability to detect concealed targets in difficult background conditions.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,619 Developed integrated EO sensor technology to search, detect, locate, and identify air and ground targets at ranges significantly longer than currently achievable, including targets that are camouflaged, low-observable, or employ other means of deception. Designed and began demonstrating active and passive sensor components of an affordable, integrated targeting capability.

(U) $3,557 Developed EO sensor technologies to detect and locate camouflaged and concealed targets for aerospace ISR applications. Continued fabricating a demonstration sensor for high altitude reconnaissance aircraft. Performed initial system utility demonstrations, and developed signature-based data processing techniques.

(U) $942 Develop advanced radar signal processing techniques to mitigate clutter and jamming interference and improve detection and tracking of difficult targets. Design processing architecture for evaluating multi-dimensional adaptive processing techniques. Demonstrate these techniques for multi-mission aerospace radar applications.

(U) $3,070 Developed, tested, evaluated, and demonstrated the RF sensor techniques required to detect, track, and target high-value, time-critical targets that are concealed through stealth or deceptive techniques. Demonstrated technologies to increase detection range for low-observable targets. Initiated concept design study for a 'mini' unmanned aerial vehicle RF sensor to detect, track, and target high-value, time-critical targets that are difficult to detect through either stealth or concealment.

(U) $818 Developed advanced EO sensor technology for non-cooperative target identification. Completed design and began developing a multi-function laser for air and ground target identification.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors / PROJECT: 665A

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

(U)	$1,009	Developed advanced multi-function sensor component technologies for radar, electronic warfare, navigation, and communications applications. Initiated evaluating very high density two-dimensional and three-dimensional interconnects for phased array transmit/receive modules on manned and unmanned platforms. Completed testing a multi-chip module version of a monobit receiver for electronic warfare applications. Developed advanced radio frequency (RF) photonic signal control and distribution technologies for phased array apertures.
(U)	$1,894	Develop and demonstrate advanced modular, sharable, digital RF sensor technologies for aerospace sensor suites performing intelligence, surveillance, and reconnaissance (ISR) applications. Demonstrate a multi-channel radar digital receiver with channel match greater than 60dB and jammer cancellation.
(U)	$1,569	Developed technologies to maximize Global Positioning System (GPS) jam resistance, positional accuracy, and exploitation techniques to improve offensive and defensive combat capabilities. Designed advanced GPS M-Code technology. Developed geo-registration and precise target location technology supporting multi-sensor and distributed sensor integration.
(U)	$904	Developed deposition techniques for high growth rate, high quality silicon carbide semiconductor substrates to enable advanced physical vapor transport techniques.
(U)	$16,382	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$3,166	Develop integrated electro-optical (EO) sensor technology to search, detect, locate, and identify air and ground targets at ranges significantly longer than currently achievable, including targets that are camouflaged, low-observable, or employ other means of deception. Complete fabricating and testing a ground demonstration sensor and aircraft integration design. Assess real-time data processing performance.
(U)	$3,260	Develop EO sensor technologies to detect and locate camouflaged and concealed targets for aerospace ISR applications. Complete fabricating and testing a demonstration sensor for high altitude reconnaissance aircraft. Perform flight characterization. Assess signature-based data processing performance.
(U)	$1,325	Develop advanced EO sensor technology for non-cooperative target identification. Complete design and begin developing a multi-function laser for air and ground target identification.
(U)	$1,210	Develop technologies to maximize GPS jam resistance, positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities. Develop advanced GPS M-Code technologies. Develop reference technologies to adaptively operate GPS in buildings, underground, and in air and space to provide precise time, position, and velocity for multiple platforms. Develop virtual flight test technology for improved assessment of GPS anti-jam technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors	PROJECT: 665A

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

(U)	$1,828	Develop, test, evaluate, and demonstrate the radio frequency (RF) sensor techniques required to detect, track, and target high-value, time-critical targets that are difficult to detect through either stealth or concealment. Evaluate 'mini' unmanned aerial vehicle concept of operation and RF sensor performance improvements in the detection, tracking, and targeting of high-value, time-critical targets.
(U)	$233	Provide concept definition and system analysis of a fire control radar system for airborne applications.
(U)	$963	Demonstrate deposition techniques for high growth rate, high quality silicon carbide semiconductor substrates to enable advanced physical vapor transport techniques.
(U)	$11,985	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$4,583	Continue developing integrated electro-optical (EO) sensor technology to search, detect, locate, and identify air and ground targets at ranges significantly longer than currently achievable, including targets that are camouflaged, low-observable, or employ other means of deception. Extend performance of ground demonstration sensor to flying test-bed configuration. Ground test aircraft integration components. Extend design to integrate key subsystems for modular testing.
(U)	$4,956	Continue developing EO sensor technologies to detect and locate camouflaged and concealed targets for aerospace intelligence, surveillance, and reconnaissance applications. Extend performance of a demonstration sensor for high altitude reconnaissance aircraft to incorporate an emissive spectral sensing capability. Fabricate, laboratory integrate, and test emissive spectrometer components.
(U)	$2,159	Continue developing advanced EO sensor technology for non-cooperative target identification. Complete developing a multi-function laser for air and ground target identification based on target geometry and vibration.
(U)	$1,240	Demonstrate precise reference aerospace sensing technologies to adaptively operate undergound and in buildings. Design geo-registration technologies to maximize navigation warfare exploitation techniques for enhanced offensive and defensive combat capabilities. Develop virtual flight test simulation technology to assess advanced Global Positioning System anti-jam techniques.
(U)	$1,519	Continue developing, testing, evaluating, and demonstrating the RF sensor techniques required to detect, track, and target high-value, time-critical targets that are difficult to detect through either stealth or concealment. Test 'mini' unmanned aerial vehicle concept of operation and RF sensor performance improvements in the detection, tracking, and targeting of high-value, time-critical targets.
(U)	$496	Develop advanced radar techniques, sub-systems, and methods to establish and maintain track radar performance of weapons-guidance quality in advanced jamming environments. Devise integrated high-fidelity fire control radar and weapon system simulation model to evaluate system and sub-system requirements and performance.

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors
PROJECT 665A	

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued
(U) $14,953 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602204F, Aerospace Sensors.
(U) PE 0603205F, Flight Vehicle Technology.
(U) PE 0603707F, Weather Systems Advanced Development.
(U) PE 0603500F, Multi-disciplinary Advanced Development Space Technology.
(U) PE 0602111N, Weapons Technology.
(U) PE 0602232N, 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 Air Force Research Laboratory and Defense Advanced Research Projects Agency to jointly develop the technology required to detect high-value, time-critical targets in a variety of environments.
(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

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603203F Advanced Aerospace Sensors / PROJECT: 69DF

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
69DF	Target Attack and Recognition Technology	41,243	35,875	16,651	16,346	20,061	27,699	23,268	22,783	Continuing	TBD

Note: In FY 2003, efforts in advanced radio frequency technologies for intelligence, surveillance, and reconnaissance previously performed in this project transferred to this PE, Project 5019.

(U) A. Mission Description

This project 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 and at maximum weapon launch ranges. Specific fire control technologies under development 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. This project also evaluates targeting techniques to support theater missile defense efforts in surveillance and attack. These fire control technologies will provide force multiplication and reduce warfighter exposure to hostile fire. This project also develops and demonstrates target identification and recognition technologies for positive, high confidence cueing, recognition, and identification of airborne and ground-based, high-value, time-critical targets at longer ranges than are currently possible. The goal is to apply these technologies to tactical air-to-air and air-to-surface weapon systems so they are able to operate in all weather conditions, during day or night, and in high-threat, multiple target environments. Model-based vision algorithms and target signature development techniques are the key to target identification and recognition. This project is maturing these technologies in partnership with the Defense Advanced Research Projects Agency, and evaluating the techniques to support theater missile defense efforts in surveillance and attack. Fire control and recognition technologies developed and demonstrated in this project are high leverage efforts, providing for significant advancements in operational capabilities largely through software improvements readily transitionable to new and existing weapon systems.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,043 Developed advanced global awareness and precision engagement automated targeting technologies for rapid detection, location, and attack of time-critical targets. Integrated modeling, simulation, and analysis testbed to determine automatic target recognition (ATR) and information fusion algorithms for time-critical targeting, emphasizing the difficult targeting missions where weather, terrain, foliage, camoflauge, or deception techniques obscure or conceal the targets of interest during most of their deployment cycles.

(U) $3,080 Developed common, open system technologies for integrating real-time information in- and out-of-the-cockpit to improve aircrew situational awareness, target nomination, and target engagement capabilities. Demonstrated a capability to fuse all-source threat, target, and survivor location data for use on special operations forces aircraft.

(U) $2,568 Developed and evaluated radar ATR algorithms for tracking and identifying moving and stationary ground targets. Continued demonstrating

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT 69DF

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

affordable risk reduction for transition via planned sensor upgrades to strike and reconnaissance platforms. These algorithms will significantly impact the capability to find, fix, track, target, engage, and assess time-critical targets in all phases of deployments, including active and passive communication and emission states; during hide in foliage; and either moving or stationary.

(U) $873 Developed automatic target recognition (ATR) solutions using hyperspectral imaging data and other candidate sensor inputs. Developed target and background phenomenology technology to recognize and identify targets using hyperspectral imaging data. Conducted performance analyses on candidate algorithms using hyperspectral imaging data.

(U) $2,646 Continued testing and integrating 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, strike, and weapon systems. Demonstrated impact to image analysts and Air Operation Center decision makers of automated multi-sensor ATR and fusion capability on sensor-to-shooter timeline reductions for time-critical targeting.

(U) $23,854 Developed technology to detect and identify targets under trees. Designed and fabricate a very high frequency (VHF) foliage penetration radar. Developed and implemented VHF radar change detection algorithms for robust target detection with a low false alarm rate. Performed VHF radar data collections for algorithm development and foliage penetration characterization. Developed imagery exploitation algorithms for target identification sensor fusing techniques. Performed high fidelity modeling of the VHF radar, change detection capability, data fusion process, and weapon effectiveness. Developed integration plans for a warfighter-selected operational platform. Developed and demonstrated air-to-ground radar imaging technology and reliable combat identification technology to enable capability to detect and target difficult, concealed, and non-cooperative targets.

(U) $7,179 Continued developing a National Radar Signature Production and Research Capability. Developed, validated, and began integrating data libraries discriminating friend, foe, and neutral targets into aircraft radar signature computer modeling and simulation tools.

(U) $41,243 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,006 Develop modeling and simulation to show enhanced global awareness and precision engagement capability for warfighters, as enabled by automated targeting technologies for rapid detection, location, and prosecution of time-critical targets. Employ the modeling, simulation, and analysis testbed to analyze and demonstrate ATR and information fusion algorithms for time-critical targeting, emphasizing the difficult targeting missions where weather, terrain, foliage, camouflage, and deception techniques obscure or conceal the targets of interest. Develop and employ air and ground target signature generation models to support automated target signature exploitation in automatic target recognizer and

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

multi-sensor fusion algorithms. Generate synthetic target signatures for automated signature exploitation of radio frequency and electro-optical (EO) sensor data.

(U) $1,818 Continue common open system technology integration for real-time information in- and out-of-the-cockpit to improve aircrew combat and joint battlespace situational awareness, target nomination, and target engagement capabilities. Demonstrate initial capability to fuse all-source threat, imagery, target, and survivor location data using an airborne platform digitally linked to airborne combat search and rescue assets.

(U) $5,160 Continue developing and testing an automatic target recognition (ATR) system for tracking and identifying moving and stationary ground targets for use in strike and reconnaissance platforms. Integrate advanced stationary target identification techniques and algorithms with synthetic aperture radar processing. Advance the state-of-the-art for moving target identification techniques and algorithms by providing technology maturation and risk reduction. Continue analysis of requirements and affordable risk reduction for transition via planned sensor upgrades to strike and reconnaissance platforms.

(U) $3,766 Test and integrate Air Force and 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, reconnaissance, strike, and weapon systems. Characterize single and multi-sensor contributions from radar and EO (including hyperspectral imaging) sensors with automated exploitation. Continue demonstrating, to image analysts and Air Operation Centers decision makers, the impact of automated multi-sensor ATR and fusion capability on timeline reductions for time-critical targeting.

(U) $12,201 Develop technology to detect, identify, and engage targets under trees (TUT). Characterize performance of foliage penetration radar sensors and algorithms for robust target detection and tracking with low probability of false alarms. Develop TUT-specific intelligence preparation of the battlefield tools for improved tracking, detection, sensor management, and target identification and location. Develop tools for multi-intelligence georegistration. Perform end-to-end modeling for the TUT family of systems, providing measures of effectiveness that encompass the entire kill chain cycle. Perform virtual simulations to identify system integration issues, human decision functions, and system processes. Develop integration plans with warfighter-selected operational systems. Test system functionality, including fusion and georegistration, and concepts of employment.

(U) $8,900 Continue developing and demonstrating a moderate confidence automatic target recognition and advanced cueing (ATR/C) capability for stationary and moving targets under the Air-to-Ground Radar Imaging effort. Continue developing a follow-on, high confidence combat identification capability under the Reliable Combat Identification for Surface Targeting effort. Characterize advanced stationary and moving target radar data to determine its utility for ATR/C and combat identification. Develop tools to support sensor system, sensor management, and system performance analyses. Characterize the performance of identification techniques for multiple moving targets. Perform advanced multi-sensor data collection on stationary and moving targets. Determine which combination of sensors, modes, and fusion processing

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

techniques would provide combat identification of the highest confidence.

(U) $2,024 Continue developing a National Operational Signature Production and Research Capability. Continue expanding the database and begin creating the signature modeling and simulation capability to consistently and expediently expand database production support for critical combat identification systems.

(U) $35,875 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $943 Continue developing modeling and simulation to show enhanced global awareness and precision engagement capabilities for warfighters as enabled by automated targeting technologies for rapid detection, location, and prosecution of time-critical targets. Employ the modeling, simulation, and analysis testbed to analyze and demonstrate automatic target recognition (ATR) and information fusion algorithms for time-critical targeting, emphasizing the difficult targeting missions where weather, terrain, foliage, camouflage, and deception techniques obscure or conceal the targets of interest during their deployment cycles. Emphasize analysis testbed demonstrations in operationally realistic environments, using operationally realistic data and processes. Continue to develop and employ air and ground target signature generation models that support automated target signature exploitation in automatic target recognizer and multi-sensor fusion algorithms. Generate synthetic target signatures for automated signature exploitation of radio frequency and electro-optical sensor data.

(U) $1,386 Incrementally upgrade common situational awareness open system technologies to integrate special threat awareness receiver system that provides aircrew with integrated air defense system threat intent data for enhancing in-flight threat response options and aircraft self-protection capabilities. Demonstrate a laboratory capability to fuse all-source threat, target, survivor location, and threat intent data for use across special operations and other tactical aviation platforms. Conduct limited flight evaluations of key system components to assess system performance capabilities in low-altitude, terrain-masked threat environments.

(U) $2,832 Finalize developing and integrating advanced stationary target identification techniques and algorithms with synthetic aperture radar processing. Demonstrate a stationary ground target classification/identification capability using these advanced techniques in real-time in a laboratory setting using operational computer hardware devices. Develop transition plans and perform transition risk reduction tasks for integrating this capability into operational strike and reconnaissance platforms. Develop advanced moving target classification/identification techniques and algorithms for integration with high range resolution radar and other moving target indication processing techniques.

(U) $3,510 Assess the performance of Air Force and Defense Advanced Research Projects Agency multi-sensor ATR fusion algorithms using the Air Force ATR evaluation test facility. Continue characterizing both single and multiple sensor contributions from radar and electro-optical (including

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
03 - Advanced Technology Development (ATD)	0603203F Advanced Aerospace Sensors	69DF

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

		hyperspectral imaging) sensors with automated exploitation. Initiate developing tools to automate data collection planning for transition of algorithms. Improve automatic target recognition (ATR) research and development computer and networking infrastructure via software, hardware, and network integration enhancements. Improve processing capabilities and expand DoD-wide repository of Research and Development (R&D) sensor data. Develop an integrated computational and collaborative environment to accelerate the transition of ATR and sensor fusion technologies. Utilize synthetic data generation capability to augment and enhance existing R&D and operational data sets. Continue to show timeline reduction for time-critical targeting impact of automated multi-sensor ATR and fusion capability to image analysts and decision-makers in the experimental Air Operations Centers.
(U)	$4,831	Continue developing and demonstrate technology to detect and identify targets under trees (TUT). Characterize performance of foliage penetration radar sensors and algorithms for robust target detection and tracking with low probability of false alarm. Develop and demonstrate TUT-specific intelligence preparation of the battlefield tools for improved tracking, detection, sensor management, and target identification and location. Develop and integrate tools for multi-intelligence georegistration with fusion architecture. Perform end-to-end modeling for TUT family of systems, providing measures of effectiveness that encompass the entire kill chain cycle. Perform virtual simulation of the TUT family of systems in an operationally realistic environment. Finish system functionality test, including fusion and georegistration tests, and study of possible trades in concepts of employment.
(U)	$811	Continue mission-level and system-of-systems studies and analyses to determine which combination of sensors, modes, and fusion processing techniques would provide a high confidence combat identification capability for stationary and moving ground targets.
(U)	$2,338	Develop and demonstrate ATR capability integrated with advanced geo-registration techniques and innovative change detection algorithms. Initiate a spiral development activity focused on time-critical targeting. Develop initial capability for an advanced real-time contingency cell in support of initial experiments for the Combined Air Operations Center.
(U)	$16,651	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602204F, Aerospace Sensors.

(U) PE 0603253F, Advanced Sensor Integration.

(U) PE 0603500F, Multi-disciplinary Advanced Space Technology.

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

(U) PE 0603762E, Sensor and Guidance Technology.
(U) PE 0603270F, Electronic Combat 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603205F Flight Vehicle Technology

PROJECT: 4398

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4398	Air Base Technology	4,418	3,463	0	0	0	0	0	0	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2003, remaining efforts transferred to PE 0603112F, Project 4918. However, Congress added $3.5 million for environmental sensing and monitoring system (E-SMART™) Chemical and Biological Sensors in FY 2003.

(U) A. Mission Description

Prior to FY 2003, this project developed technologies for fixed and bare base operations, including airfield pavements, energy systems, air base survivability, air base recovery, protective systems, airfield fire protection, and crash rescue.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,737 Continued Congressionally-directed effort related to providing increased explosion mitigation, increased ability to conduct rapid airfield assessment, improved lightweight airfield matting, and more efficient deployable utility systems.

(U) $2,681 Continued Congressionally-directed effort to develop and integrate additional chemical and biological sensor and monitoring technologies into the E-SMART™ system.

(U) $4,418 Total

(U) FY 2003 ($ in Thousands)

(U) $3,463 Continue Congressionally-directed effort to develop and integrate additional chemical and biological sensor and monitoring technologies into the E-SMART™ system.

(U) $3,463 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603205F Flight Vehicle Technology	PROJECT: 4398

(U) B. Budget Activity Justification

This program is in the Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for exhibiting new systems development that have military utility and address warfighter needs.

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	4,556	0	0	
(U)	Appropriated Value	4,600	3,500		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-44	-37		
	b. Small Business Innovative Research	-117			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram				
	e. Rescissions	-21			
(U)	Adjustments to Budget Years Since FY 2003 PBR			0	
(U)	Current Budget Submit/FY 2004 PBR	4,418	3,463	0	TBD

(U) Significant Program Changes:

In FY 2003, remaining efforts transferred to PE 0603112F, Project 4918. However, Congress added $3.5 million for environmental sensing and monitoring system (E-SMART™) Chemical and Biological Sensors in FY 2003.

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

(U) Related Activities:

(U) PE 0603112F, Advanced Materials for Weapon Systems.

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

(U) E. Acquisition Strategy

Not Applicable.

(U) F. Schedule Profile

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603211F Aerospace Technology Dev/Demo

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	22,214	29,002	73,416	31,427	28,176	28,678	229,113	629,521	Continuing	TBD
486U	Advanced Aerospace Structures	6,330	9,034	5,368	5,897	5,863	5,976	6,067	6,152	Continuing	TBD
4920	Flight Vehicle Tech Integration	15,884	19,968	25,750	25,530	22,313	22,702	223,046	623,369	Continuing	TBD
5099	National Aerospace Initiative	0	0	42,298	0	0	0	0	0	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 2002, Project 4920 contains the ongoing technical efforts from PE 0603205F, Project 2978, and PE 0603245F, Project 2568, in order to align projects with the Air Force Research Laboratory organization. In FY 2004, Project 5099 is a new project, but not a New Start. This effort supports increased emphasis being placed on the National Aerospace Initiative and ongoing hypersonics efforts. Outyear funding for the hypersonic activity will be addressed in the FY05 President's Budget Development.

(U) A. Mission Description

The demonstration and transition of advanced aerospace vehicle technologies are accomplished in this program. The three project areas are advanced aerospace structures, flight vehicle technology integration, and the National Aerospace Initiative. Advanced aerospace structures are demonstrated to sustain and enhance the capability of current and future aerospace vehicles. Flight vehicle technology integration is accomplished through system level integration of various technologies to include avionics, advanced propulsion, and weapon systems for demonstration in near-realistic operational environments. Note: In FY 2003, Congress added $3.7 million for advanced aluminum aerostructures, $0.5 million for ultra-lightweight composites, and $3.0 million for sensorcraft unmanned aerial vehicle.

(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.

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	22,945	22,315	25,455	
(U)	Appropriated Value	23,169	29,565		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-224	-313		
	b. Small Business Innovative Research	-622			
	c. Omnibus or Other Above Threshold Reprogram		-250		
	d. Below Threshold Reprogram				
	e. Rescissions	-109			
(U)	Adjustments to Budget Years Since FY 2003 PBR			47,961	
(U)	Current Budget Submit/FY 2004 PBR	22,214	29,002	73,416	TBD

(U) Significant Program Changes:

Changes to this program since the previous President's Budget are due to increased funding for technologies supporting the National Aerospace Initiative. Outyear funding for the hypersonic activity will be addressed in the FY 2005 President's Budget Development.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603211F Aerospace Technology Dev/Demo

PROJECT: 486U

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
486U	Advanced Aerospace Structures	6,330	9,034	5,368	5,897	5,863	5,976	6,067	6,152	Continuing	TBD

(U) A. Mission Description

This project develops and demonstrates affordable aerospace vehicle technologies to sustain the existing fleet, reduce the cost of aircraft ownership, and enhance the capability of current and future aerospace vehicles. Sustainment of the existing fleet through their extended operational service life with innovative technology application will lead to reduced operations and support costs, and increased operational readiness. Analytical certification will reduce the cost associated with component replacement by allowing and certifying new designs under reduced test requirements. Development of capability enhancing technologies will expand the operational envelope and increase survivability in high threat environments. Demonstration of these technologies will restore structural integrity, extend structural life, enhance the capability, and reduce the life cycle costs of fielded aircraft.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,243	Completed the development of analysis methods to accurately predict the impact of corrosion on the onset of cracking, crack progression, and structural failure. Improved the ability to predict the effect of corrosion and corrosion treatments on structural integrity to greatly reduce instances and levels of repair/replacement.
(U)	$2,106	Continued improvement in durability and affordability of existing aging aircraft and future aerospace vehicle structures for reduced operations and support costs and to extend usable structural lives. Continued the development of technology required for full implementation of bonded repair technology.
(U)	$1,017	Developed technologies that will extend aircraft life, increase aircraft availability, and reduce operations and support costs. Concepts and methods were developed to reduce dynamic loads. This will result in the capability to cost-effectively and safely utilize aircraft longer than originally intended. It will also result in decreased maintenance actions due to damage in dynamically loaded structures.
(U)	$964	Continued Congressionally-directed efforts to accelerate development of three-dimensional woven preform composite technology to produce low weight, non-corroding structural components.
(U)	$6,330	Total

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo	PROJECT 486U

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,165	Continue improvements in sustainment technologies for existing aging aircraft and future aerospace vehicle structures for reduced operations and support costs and to extend usable structural lives. Continue the development of technology required for full implementation of bonded composite repair of thick and complex structures. Continue development of new analytical methods and techniques to expand bonded composite repair capabilities to thick and complex geometry structures enabling repair in lieu of replacement of primary load carrying structural components.
(U)	$2,665	Develop innovative and new non-traditional sustainment technologies that will extend aircraft life, increase aircraft availability, and reduce operational and support costs. Continue development of unitized composite structures to replace mechanically fastened built up components that are highly susceptible to damage from dynamic in-service usage resulting in elimination of maintenance actions due to loose fasteners and fastener hole damage.
(U)	$3,710	Initiate Congressionally-directed effort for advanced aluminum aerostructures.
(U)	$494	Initiate Congressionally-directed effort for ultra-lightweight composites.
(U)	$9,034	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,111	Develop improvements in sustainment technologies for existing aging aircraft and future air vehicle structures for reduced operations and support costs and to extend the usable structural lives. Continue the development of new analytical methods and techniques to expand bonded composite repair capability to thick and complex geometry structures enabling repair in lieu of replacement of the primary load carrying structural components.
(U)	$3,257	Develop innovative and new non-traditional sustainment technologies that will extend aircraft life, increase aircraft availability, and reduce operations and support costs. Complete development of unitized composite structure concepts for repair or replacement of mechanically fastened built up components that are highly susceptible to loose fasteners and fastener hole damage from dynamic in-service usage, thereby providing a significant reduction in maintenance actions.
(U)	$5,368	Total

(U) B. Project Change Summary

Not Applicable.

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PROJECT: 486U	

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

(U) Related Activities:

(U) PE 0602201F, Aerospace Vehicle Technologies.

(U) PE 0603333F, Unmanned Air Vehicle Dev/Demo.

(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

(U) Not Applicable.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603211F Aerospace Technology Dev/Demo

PROJECT: 4920

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4920 Flight Vehicle Tech Integration	15,884	19,968	25,750	25,530	22,313	22,702	223,046	623,369	Continuing	TBD

Note: Beginning in FY 2002, this project contains the ongoing technical efforts from PE 0603205F, Project 2978, and PE 0603245F, Project 2568, in order to align projects with the Air Force Research Laboratory organization.

(U) A. Mission Description

This project 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 for demonstration in a near-realistic operational environment. Integration and technology demonstrations reduce the risk and time required to transition technologies into operational aircraft. This program provides proven aerospace vehicle technologies for all-weather, day/night operations with significantly improved performance and affordability.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $3,901 Developed and validated novel control automation techniques and algorithms to enable the safe and interoperable application of unmanned vehicle systems while providing mission responsiveness and adaptability for improved operational effectiveness of manned and unmanned systems. Completed the simulation assessment of intelligent-agent-based algorithms and modular software system architecture for cooperative control of unmanned vehicles. Integrated unmanned vehicle software with photonic vehicle management system hardware.

(U) $803 Demonstrated and validated advanced control mechanization technologies to provide highly reliable operation for manned and unmanned systems at significantly reduced size, weight, and cost. Completed advanced development and demonstration of direct optical control and interfacing of vehicle management and more-electric subsystems. Transferred technology to unmanned air vehicle control integration efforts. Assessed benefits of applying photonic technologies to vehicle and health management for military space access systems.

(U) $1,439 Developed multi-functional integrated structures to reduce acquisition and support costs, weight, and volume. Developed concepts for embedding high frequency multi-element antenna arrays in load bearing structures for antenna performance improvement. Matured concepts with advanced aerodynamic technologies that enable structurally integrated highly survivable and maintainable inlet and exhaust systems.

(U) $1,600 Demonstrated new analysis methods and design criteria for advanced composite structures to reduce life cycle costs of current and future aerospace vehicles by maximizing the use of composite structures. Developed design concepts and methods to allow a more widespread use of low-cost bonded structures with particular attention to verification of analysis methods through test articles.

(U) $416 Developed advanced structural concepts and design methods for future aerospace vehicles for enhanced affordability and higher performance.

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

Completed flight test demonstration of the increased control authority of an active aeroelastic wing, and transitional technology to reduce airframe cost and weight for future air vehicles.

(U) $1,387 Initiated Congressionally-directed efforts to establish an Access-to-Space Joint System Program Office.

(U) $4,853 Initiated Congressionally-directed efforts with Aeronautical Systems Center.

(U) $1,485 Initiated Congressionally-directed efforts for affordable combat avionics initiatives.

(U) $15,884 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $4,942 Develop and demonstrate key control automation techniques and algorithms to enable the safe and interoperable application of unmanned aerial vehicle systems. Continue to develop and demonstrate hardware and algorithms for automated air collision avoidance. Flight demonstrate intelligent agent-based algorithms and modular software system architecture for cooperative control of unmanned aerospace vehicles systems.

(U) $4,193 Develop an integrated control technology suite to provide significantly increased reliability and mission effectiveness for air vehicle systems. Complete baseline systems architecture by combining compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control. Develop, test, and verify component technologies for systems integration.

(U) $362 Demonstrate and validate advanced control mechanization technologies to provide highly reliable operations for manned and unmanned systems at a significantly reduced size, weight, and cost. Complete advanced development and demonstration of direct optical control and interfacing of vehicle management and more-electric subsystems.

(U) $1,886 Develop multi-functional integrated structures to reduce acquisition costs, support costs, weight, and volume while increasing the performance of air vehicles. Continue development of concepts with embedded high frequency multi-element antenna arrays in load bearing structures to enable increased antenna performance and new capabilities at reduced cost, weight, and volume. Develop highly efficient and durable multifunction structures with embedded electrical conductors and data cabling, health monitoring networks, fuel handling and sensing, and thermal management in order to minimize vehicle weight, volume, and acquisition and support costs.

(U) $1,997 Develop integral airframe technologies to enable increased propulsion system performance. Complete demonstration of inlet duct concepts with advanced aerodynamic technologies that enable structural integration, enhanced performance, survivability, and increased propulsion system performance. Develop conformal inlet concepts with advanced aerodynamic technologies that enable higher efficiency propulsion systems.

(U) $2,106 Develop advanced structural concepts and design methods to significantly enhance the affordability and increase the performance of current and future aerospace vehicles. Continue development of new analysis methods, design concepts, and design criteria to enable low-cost unitized

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo	PROJECT 4920

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

composite structures. Continue development of demonstration articles for test verification of analyses methods, design concepts, and design criteria.

(U) $1,514 Develop affordable advanced aero-structural concepts and design methods to enable new performance capabilities for future aerospace vehicles. Continue flight test demonstration of the increased high-speed control authority of an active aeroelastic wing. Develop concepts applying continuous moldline technologies to reduce aerodynamic drag and electromagnetic signature for reconfigurable structures to enable maximum warfighting capability and versatility in a single platform. Develop highly efficient wing concepts integrating active aeroelastic design concepts, adaptive structures, and aerodynamic flow control technologies to enable new capabilities for long-range air vehicles and long endurance vehicles.

(U) $2,968 Initiate Congressionally-directed effort for sensorcraft unmanned aerial vehicle.

(U) $19,968 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $13,116 Develop and demonstrate key automation techniques and flight control algorithms to enable the safe and interoperable application of unmanned and manned air vehicle systems. Continue development of an integrated flight control technology suite that combines compact, low-cost hardware with adaptive, fault tolerant inner-loop control and autonomous, trajectory-generating outer-loop control to provide significantly increased reliability and mission effectiveness for unmanned air vehicle systems. Develop and demonstrate control component technologies for systems integration. Develop automated aerial refueling algorithms and system design concepts for manned and unmanned air vehicle refueling in flight.

(U) $2,474 Develop advanced aerodynamic/structural integration concepts that enable increased system performance at a reduced cost. Continue development and demonstration of system hardware for an actively controlled conformal inlet system, enabling increased installed propulsion system performance at a reduced weight and size. Develop and demonstrate active flow control devices to significantly increase and enhance the separation envelope for small diameter munitions and to reduce weapon bay acoustics to minimize damage susceptibility of sensitive subsystem electronics.

(U) $2,360 Develop advanced structural concepts and design methods for future air vehicle airframes for enhanced affordability and higher performance. Complete demonstration of advanced low-cost bonded composite structure concepts enabled by new analysis, manufacturing, and assembly processes which will reduce life cycle costs of current and future air vehicles by maximizing the use of composite structures. Develop approaches to reliably use virtual and analytical methods to reduce the need for physical testing in the certification of structural components.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo
PROJECT 4920	

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

(U)	$3,368	Develop multi-functional integrated structures to reduce acquisition costs, support costs, weight, and volume, and to increase performance of air vehicles. Continue development of concepts with embedded high and low frequency multi-element antenna arrays in loadbearing structures for antenna performance improvement and reduced air vehicle weight and volume. Develop highly efficient and durable structures with embedded electrical conductors and data cabling, health monitoring networks, fuel handling and sensing, and thermal management.
(U)	$4,432	Develop advanced aero-structural concepts and design methods for enhanced affordability, higher performance, and survivability for future air vehicles. Complete flight test that demonstrates increased high-speed control authority enabled by an active aeroelastic wing. Complete demonstration of reconfigurable continuous moldline structure concepts to reduce aerodynamic drag and electromagnetic signature to enable platform adaptation as mission requirements change and thus maximize its versatility. Continue development of highly efficient wing concepts integrating active aeroelastic design concepts, adaptive structures, and aerodynamic flow control technologies for long-range and long endurance air vehicle concepts.
(U)	$25,750	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602201F, Aerospace Vehicle Technologies.
(U) PE 0603333F, Unmanned Air Vehicle Dev/Demo.
(U) PE 0604731F, Unmanned Combat Air Vehicle.
(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603211F Aerospace Technology Dev/Demo

PROJECT: 5099

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5099 National Aerospace Initiative	0	0	42,298	0	0	0	0	0	Continuing	TBD

Note: In FY 2004, Project 5099 is a new project, but not a New Start. This effort supports increased emphasis being placed on the National Aerospace Initiative and ongoing hypersonics efforts. Outyear funding for the hypersonic activity will be addressed in the FY05 President's Budget Development.

(U) A. Mission Description

This project develops, integrates, and demonstrates flight capbilities from Mn 0 - 7 as identified in the National Aerospace Initiative (NAI). Enabling technologies include thermal protection, structures, air vehicle subsystems, flight controls, advanced propulsion systems, configurations aero-thermo dynamics, and wind tunnel testing. These and other critical technologies will be integrated into ground and flight demonstration vehicles that will validate the technologies or operation concepts, such as responsive, reliable, and cost effective 'aircraft-like' operability. Key payoffs include global reach, global strike, and space access.

(U) FY 2002 ($ in Thousands)

(U) $0 No Activity

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 No Activity

(U) $0 Total

(U) FY 2004 ($ in Thousands)

(U) $17,333 Working with NASA under the NAI, jointly develop advanced aerospace vehicle concepts and design methods focused on a flight demonstration of Mn 0.7-7 capability that permits global reach and space access for enhanced affordability and operability, higher performance, and survivability. Develop concepts for integration of low-speed and advanced propulsion systems. Develop and characterize critical aerothermodynamic environments and flight trajectories. Develop approaches for high-speed vehicle and payload separation. Develop approaches to integrate aero sciences technologies with structures, flight controls and advanced propulsion systems to ensure successful demonstrations of supersonic/hypersonic air platforms.

(U) $11,985 Develop concepts for multifunctional integrated thermal structures and advanced thermal protection systems to reduce acquisition and support costs, weight, and volume and to increase performance of supersonic/hypersonic air vehicles. Develop lightweight long life tanks and efficient vehicle integration concepts for increased performance. Demonstrate advanced, low-cost structure concepts enabled by new analysis, manufacturing, and assembly processes, which will reduce life cycle costs of future supersonic/hypersonic air vehicles. Develop approaches

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo
PROJECT 5099	

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

required to integrate structure technologies with aero-sciences, flight controls, and advanced propulsion systems.

(U) $12,980 Develop key guidance, navigation, and control automation techniques and algorithms as well as vehicle management systems that will enable the safe and interoperable application of supersonic/hypersonic air vehicles. Develop an integrated control technology suite combining compact, low cost hardware with adaptive, fault tolerant controls. Develop an integrated vehicle management and health/maintenance management system to reduce life cycle costs and increase reliability. Develop vehicle subsystems, flight controls, and power systems component technologies for systems integration. Develop approaches to integrate flight controls technologies with aero-sciences, structures and advanced propulsion to ensure successful demonstrations.

(U) $42,298 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602201F, Aerospace Vehicle Technologies.

(U) PE 0602203F, Aerospace Propulsion.

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	112,738	88,236	114,726	62,578	67,710	72,298	82,408	82,878	Continuing	TBD
2480	Aerospace Fuels and Atmospheric Propulsion	11,456	10,971	3,128	3,182	7,076	15,783	18,872	18,491	Continuing	TBD
3035	Aerospace Power Technology	4,254	6,104	4,221	4,308	4,344	4,421	4,489	4,553	Continuing	TBD
4921	Aircraft Propulsion Subsystems Int	34,672	35,991	26,345	22,779	22,709	20,077	26,545	26,878	Continuing	TBD
4922	Space & Missile Rocket Propulsion	28,546	1,433	12,848	6,055	7,084	5,048	5,125	5,196	Continuing	TBD
5098	Advanced Aerospace Propulsion	0	0	38,885	0	0	0	0	0	Continuing	TBD
681B	Advanced Turbine Engine Gas Generator	33,810	33,737	29,299	26,254	26,497	26,969	27,377	27,760	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2002, all turbine engine technology efforts performed in PE 0603202F, Project 668A, were transferred to PE 0603216F, Project 4921. Also in FY 2002, all rocket propulsion technology efforts performed in PE 0603302F, Projects 4373 and 6340, were transferred to PE 0603216F, Project 4922, in order to align projects with the Air Force Research Laboratory organization. In FY 2003, space unique tasks in Project 4922 were transferred to PE 0603500F, Project 5033, in conjunction with the Space Commission recommendation to consolidate all space unique activities. In Project 4922, space unique includes all Integrated High Payoff Rocket Propulsion Technology activities except Technology for the Sustainment of Strategic Systems and tactical missiles. In FY 2004, Project 5098 is a new project, but not a New Start. This effort supports increased emphasis being placed on the National Aerospace Initiative and ongoing hypersonics effort.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

(U) A. Mission Description

This program develops and demonstrates technologies to achieve enabling and revolutionary advances in turbine, advanced cycle, and rocket propulsion, as well as power generation and storage, and fuels. The program has five projects, each focusing on technologies with a high potential to enhance the performance of existing and future Air Force weapons systems. The Advanced Turbine Engine Gas Generator (ATEGG) project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. The Aerospace Propulsion Subsystem Integration project integrates the engine cores demonstrated in the ATEGG project with low-pressure components into demonstrator engines. The Aerospace Power Technologies project develops and demonstrates power technologies for weapons and aircraft. The Space and Missile Rocket Technology project develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. Finally, the Aerospace Fuels and Atmospheric Propulsion project develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems for high-speed/hypersonic flight. Turbine engine propulsion projects within this program are part of the Integrated High Performance Turbine Engine Technology and the Versatile Affordable Advanced Turbine Engine programs. Rocket propulsion projects within this program are part of the Integrated High Payoff Rocket Propulsion Technology program, which includes the area of Technology for the Sustainment of Strategic Systems. In FY 2003, Congress added $3.5 million for the Variable Flow Ducted Rocket Propulsion System and $1.0 million for the Joint Expendable Turbine Engine Concept Phase III.

(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 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	121,548	85,650	72,863	
(U)	Appropriated Value	122,735	90,150		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-1,187	-953		
	b. Small Business Innovative Research	-3,566			
	c. Omnibus or Other Above Threshold Reprogram		-961		
	d. Below Threshold Reprogram	-4,684			
	e. Rescissions	-560			
(U)	Adjustments to Budget Years Since FY 2003 PBR			41,863	
(U)	Current Budget Submit/FY 2004 PBR	112,738	88,236	114,726	TBD

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

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

(U) Significant Program Changes:

Changes to this program since the previous President' Budget are due to increased funding for technologies supporting the National Aerospace Initiative. Outyear funding for the hypersonic activity will be addressed in the FY 2005 President's Budget development.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology / PROJECT: 2480

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
2480	Aerospace Fuels and Atmospheric Propulsion	11,456	10,971	3,128	3,182	7,076	15,783	18,872	18,491	Continuing	TBD

(U) A. Mission Description

This project develops and demonstrates improved hydrocarbon fuels and advanced, novel aerospace propulsion systems, including systems for high-speed/hypersonic flight and access to space. The advanced fuel emphasis is on developing and demonstrating new thermally stable, high-heat sink, and controlled chemically reacting fuels for a conventional turbine engine and other advanced propulsion systems. The project also develops and demonstrates fuel system components that minimize cost, reduce maintenance, and improve performance of future aerospace systems. The advanced propulsion emphasis is on demonstrating concepts for combined cycle, ramjet, and scramjet engines.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $3,650 Developed techniques for merging the scramjet with other engine cycles such as, rockets and gas turbine engines to enable responsive, reliable, operable, and affordable access to space. Evaluated options to enable variable geometry scramjet technologies. Initiated development of a variable geometry scramjet flow path. Developed an inlet system for airbreathing space access vehicles requiring multiple scramjet engine modules to enable fuller dominance of space. Designed, fabricated, and initiated wind tunnel testing of a sub-scale multiple scramjet engine inlet system. Quantified scramjet inlet mass capture and boundary layer characteristics of each module resulting from multi-engine interactions.

(U) $3,059 Developed high fidelity analytical tools to evaluate combined cycle engine options (e.g., gas turbine and ramjet/scramjet combinations) for next generation aerospace vehicles and their weapons for long-range strike. Identified key combined/combination cycle engine technologies to maximize the use of vehicle speed in force miniaturization and platform survivability for a capability beyond low-observables. Conducted analyses to identify an optimum transition Mach number between gas turbine engine and ramjet/scramjet engine cycles and the maximum cruise speed of the ramjet/scramjet engine. Conducted a pre-design study to evaluate force-multiplier and bomber survivability as a function of a maximum sustainable flight Mach number achievable with select gas turbine-based combined/combination cycle engine options.

(U) $1,000 Developed an enhanced high-heat sink endothermic fuel system cooling technology to enable responsive, reliable, operable, and affordable access to space. Determined optimum operating conditions to ensure low catalyst coking and high efficiency cooling. Began evaluation of advanced fuel/additive combinations to improve ignition and aerospace vehicle operational characteristics. Designed and fabricated subscale hardware to assess component operability and durability in small scale simulators.

(U) $1,000 Evaluated advanced high-heat sink fuels and advanced fuel cooling technologies for next generation aerospace vehicles for long-range strike.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology / PROJECT: 2480

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

Determined requirements for fuel/fuel additive combinations to improve component life and durability, improve fuel efficiency, reduce weight, and enable operation of advanced propulsion cycles. Developed a comprehensive test and qualification strategy for advanced high-heat sink fuels. Initiated design and fabrication of reduced scale fuel system simulation components unique to next generation bombers.

(U) $20 Demonstrated thermally stable fuels to enhance cooling capacity (performance) and reduce fuel system maintenance. Demonstrated advanced high-heat sink fuels to increase fuel delivery system durability at high temperatures and to reduce maintenance due to fuel degradation in a sub-scale integrated fuel/air heat exchanger.

(U) $400 Determined fuel cooling requirements for advanced aircraft sensors and directed energy weapons to meet the needs of evolving manned and unmanned aerospace systems. Determined properties for low temperature additives to prevent fuel from freezing and to allow advanced unmanned and manned systems to sustain high altitude loiter for extended periods.

(U) $797 Developed low-cost fuel additives for Air Force applications. Evaluated and demonstrated optimum low-cost fuel additives to reduce particulate emissions from gas turbine engines by 50 percent. Evaluated and demonstrated low-cost fuel additives to improve ignition characteristics and combustion in current, advanced, and combined cycle engines.

(U) $800 Developed fuel system technology. Designed and developed fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles. The focus will be on aerospace vehicles with advanced and combined cycle engines that require high levels of fuel cooling. Identified fuel concepts to maximize performance of advanced and combined cycle engines and minimize logistics costs.

(U) $730 Identified and developed low-cost approaches to reducing the fuel logistics footprint for the Expeditionary Air Force. Determined benefits of advanced additive packages to improve any commercially available jet fuel to meet military standards. Developed novel methods to inject additives to improve fuels and advanced field diagnostic techniques, such as smart nozzles, to assess fuel quality, additive injection requirements, and to aid in mission planning by monitoring mission limiting fuel properties.

(U) $11,456 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $4,473 Continue development of high fidelity analytical tools to evaluate combined cycle engine options, such as gas turbine and ramjet/scramjet combinations, for next generation aerospace vehicles and their weapons for long-range strike. Continue evaluation of advanced (ramjet/scramjet) and combined cycle engine options for next generation aerospace vehicles and their weapons for long-range strike. Develop key engine technologies to maximize the use of vehicle speed in force miniaturization and platform survivability for a capability beyond low-observables.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology / PROJECT: 2480

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

Continue to conduct analyses and experiments to optimize component technologies for transition between gas turbine engine and ramjet/scramjet engine cycles, and to optimize the cruise speed of ramjet/scramjet engines. Continue to conduct a pre-design study to evaluate force-multiplier and bomber survivability as a function of a flight Mach number achievable for next generation aerospace vehicles and their weapons.

(U) $672 Demonstrate thermally stable fuels that will enhance cooling capacity (performance) and reduce fuel system maintenance. Continue to study, test, and demonstrate advanced high-heat sink fuels that can increase fuel delivery system durability at high temperatures and reduce maintenance due to fuel degradation in a sub-scale integrated fuel/air heat exchanger. Demonstrate long-term JP-8+225 performance in a fuel system simulator.

(U) $384 Continue determination of fuel cooling requirements for advanced aircraft sensors and directed energy weapons that will meet the needs of evolving manned and unmanned aerospace systems. Develop requirements for low temperature additives to prevent fuel from freezing to allow advanced manned and unmanned systems sustain high altitude loiter for extended periods. Refine design and build an Unmanned Aerial Vehicle fuel system/tank simulator to study high and low temperature fuel behavior.

(U) $769 Develop low-cost fuel additives for Air Force applications. Continue to perform demonstration testing with low-cost fuel additives to reduce particulate emissions from gas turbine engines by 50 percent and to improve ignition characteristics and combustion in current and advanced propulsion concepts, including combined cycle engines. Demonstrate effectiveness of particulate mitigation additives in a full-scale engine test.

(U) $384 Develop fuel system technology. Continue to design and develop fuel system simulators that will evaluate key high temperature fuel system components of reusable aerospace vehicles. The focus will be on aerospace vehicles with advanced and combined cycle engines that require high levels of fuel cooling. Continue to investigate fuel concepts that will maximize the performance of advanced or combined cycle engines and minimize logistic costs. Complete characterization of hydrocarbon fuel candidates for combined cycle engines.

(U) $841 Identify and develop low-cost approaches to reducing the fuel logistics footprint for the Expeditionary Air Force. Determine the benefits of advanced additive packages to improve any commercially available jet fuel that can meet military standards. Develop novel methods to inject additives packages to improve fuels and advanced field diagnostic techniques, such as smart nozzles, to assess fuel quality, additive injection requirements, and aid in mission planning by monitoring mission limiting fuel properties. Demonstrate a field-capable concept for fuel identification and characterization.

(U) $3,448 Develop a preliminary design for an integrated tactical missile technology demonstrator using a Variable Flow Ducted Rocket (VFDR). Develop conceptual designs for VFDR tactical missiles that are compatible with the internal carriage in the F/A-22. Define a preliminary flight test plan. Develop high-fidelity models and simulations for engineering, engagement, and mission analysis. Perform critical experiments to reduce the risk of key component technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology / PROJECT: 2480

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

(U) $10,971 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $829 Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance. Continue to study, test, and demonstrate advanced high-heat sink fuels and hardware concepts that can increase fuel delivery system durability and performance at high temperatures and can reduce maintenance due to fuel degradation in aircraft fuel systems and engine control hardware. Demonstrate long-term JP-8+225 performance in bench and full-scale fuel systems. Demonstrate performance of fuel developed from alternative (non-petroleum) sources in reduced scale fuel system simulators and engine tests.

(U) $415 Continue determination of fuel requirements to meet the needs of evolving manned and unmanned aerospace systems. Demonstrate low temperature additives for use in jet fuel to allow advanced manned and unmanned systems to sustain high altitude loiter for extended periods. Refine design and build an Unmanned Aerial Vehicle fuel system/tank simulator to study low temperature fuel behavior. Demonstrate the use of low temperature additives in Unmanned Aerial Vehicle engine components and engine.

(U) $802 Develop and demonstrate efficacy of low-cost, environmentally friendly fuel additives to reduce soot particulate emissions from gas turbine engines using advanced research combustors and small turbine engines. Demonstrate additives that reduce soot emissions by at least 50 percent. Develop additives to improve ignition and combustion characteristics in current and advanced propulsion concepts, including combined cycle engines. Qualify additives through material compatibility, toxicology, and hot section tests, and demonstrate additive effectiveness in engine component tests.

(U) $682 Demonstrate enhancements to fuel system technology. Continue to design and develop concept hardware and fuel system simulators to evaluate key high temperature fuel system components of reusable aerospace vehicles, focusing on aerospace vehicles with advanced and combined cycle engines that require high levels of fuel cooling. Complete characterization of hydrocarbon fuel candidates and enhanced hardware concepts for combined cycle engines.

(U) $400 Continue developing low-cost methods to reduce the fuel logistics footprint for the Expeditionary Air Force and to support Global Reach. Continue to develop novel methods for fuel analysis and additization in order to extend the usable temperature range of commercially available aviation fuel through application of smart nozzle technologies, including biologically related approaches. Demonstrate applicability of rapid fuel screening and identification using chromatography-based statistical analysis methods and commercially available fuel vapor analyzers.

(U) $3,128 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology
	PROJECT: 2480

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602102F, Materials.

(U) PE 0602204F, Aerospace Sensors.

(U) PE 0603112F, Advanced Materials for Weapons 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT: 3035

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
3035	Aerospace Power Technology	4,254	6,104	4,221	4,308	4,344	4,421	4,489	4,553	Continuing	TBD

(U) A. Mission Description

This project develops and demonstrates electrical power generation, energy storage, thermal management, and distribution systems for aerospace applications. This technology enhances reliability and survivability, and reduces vulnerability, weight, and life cycle costs for manned and unmanned aerospace vehicles. The electrical power system components developed are projected to provide a two to five fold improvement in aircraft reliability and maintainability, and a 20 percent reduction in power system weight. This project also develops and demonstrates high power generation, energy storage, and thermal management technologies to enable high power density sources for directed energy weapons.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Programs
(U)	$1,887	Developed a high-density secondary power system and advanced weapons power technologies for a next generation aerospace vehicle for long-range strike. Initiated trade studies, detailed design, and critical technology development to optimize secondary power system size, weight, and efficiency. Evaluated electric power technology options for advanced weapon systems.
(U)	$236	Developed cryogenic power generation, high rate batteries, energy storage and power conditioning components, and system technologies with low volume displacement for delivery of high power to operate directed energy weapons. Fabricated lengths of Yttrium Barium Copper Oxide sufficient to fabricate test coils for cryogenic generators.
(U)	$777	Developed power generation/conditioning/distribution, energy storage, and thermal management components and subsystem technologies for manned and unmanned aircraft systems. Demonstrated technologies for an integrated power unit for advanced fighter aircraft and unmanned vehicles.
(U)	$1,354	Defined requirements for high power generation systems for directed energy weapons. Evaluated trade offs and defined approaches for superconducting and conventional generators for weapons power systems.
(U)	$4,254	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology / PROJECT: 3035

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Programs
(U)	$1,921	Continue to develop and demonstrate high-density secondary power systems and advanced weapons power technologies for a next generation aerospace vehicle for long-range strike. Conduct trade studies, detailed design, and critical technology development to optimize secondary power system size, weight, and efficiency. Continue to evaluate electric power technology options for advanced weapon systems.
(U)	$896	Develop power generation and conditioning, high rate batteries, and energy storage component and subsystem technologies for integration of high power subsystems with directed energy weapons. Develop a high power, low duty cycle generator for pulsed directed energy weapons. Continue to fabricate lengths of Yttrium Barium Copper Oxide sufficient to fabricate coated conductors for cryogenic generators.
(U)	$1,109	Develop power generation/conditioning/distribution component, energy storage, and thermal management components and subsystem technologies for manned and unmanned aircraft systems. These technologies will improve aircraft self-sufficiency, reliability, maintainability, and supportability while reducing life cycle costs and enabling new capabilities. Develop a power generator system that is closely coupled with the propulsion system.
(U)	$2,178	Develop power generation/conditioning/distribution, energy storage, and thermal management components and subsystem technologies that are synergistic with air, space, and weapons platforms. Demonstrate advanced power conditioning technologies with motor drives and lithium-ion batteries to provide reductions in both volume and weight.
(U)	$6,104	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Programs
(U)	$1,200	Develop power generation/conditioning, high rate batteries, and energy storage component and subsystem technologies for integration of high power subsystems. These technologies will enable the delivery of high power for operation of directed energy weapon. Fabricate high power, low duty cycle generator systems for pulsed directed energy weapon.
(U)	$2,061	Develop power generation/conditioning/distribution component, energy storage, and thermal management components and subsystem technologies for manned and unmanned aircraft systems. These technologies improve aircraft self-sufficiency, reliability, maintainability, and supportability while reducing life cycle costs and enabling new capabilities. Initiate design of the demonstration generator for integration into mid-thrust class engines. Fabricate and test large amp-hour (200) cells and batteries.
(U)	$960	Develop power generation/conditioning/distribution, energy storage, and thermal management components and subsystem technologies that are synergistic with aerospace and weapons platforms. Fabricate low volume/low weight high temperature motor drive.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology
	PROJECT: 3035

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued
(U) $4,221 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602203F, Aerospace Propulsion.
(U) PE 0602201F, Aerospace Flight Dynamics.
(U) PE 0602605F, Directed Energy 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology

PROJECT: 4921

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4921	Aircraft Propulsion Subsystems Int	34,672	35,991	26,345	22,779	22,709	20,077	26,545	26,878	Continuing	TBD

Note: In FY 2002, all turbine engine technology efforts performed in PE 0603202F, Project 668A, were transferred into this project.

(U) A. Mission Description

This project develops and demonstrates gas turbine propulsion system technologies applicable to aircraft. The Aerospace Propulsion Subsystems Integration (APSI) project includes demonstrator engines such as the Joint Technology Demonstrator Engine for manned systems and the Joint Expendable Turbine Engine Concept for unmanned air vehicle and cruise missile applications. The demonstrator engines integrate the core (high-pressure spool) technology developed under the Advanced Turbine Engine Gas Generator project with the engine (low-pressure spool) technology such as fans, turbines, engine controls, and exhaust nozzles. Additionally, these efforts include activities under the national High Cycle Fatigue program. This project also focuses on system integration of inlets, nozzles, engine/airframe compatibility, and low-observable technologies. APSI provides aircraft with potential for longer range and higher cruise speeds 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 project supports the goals of the national Integrated High Performance Turbine Engine Technology program, which is focused on doubling turbine engine propulsion capabilities while reducing cost of ownership. Anticipated technology advances include turbine engine improvements providing an approximate 30 percent reduction in tactical fighter aircraft takeoff gross weight and 100 percent increase in aircraft range/loiter. The Integrated High Performance Turbine Engine Technology program provides continuous technology transition for military turbine engine upgrades and derivatives, and has the added dual-use benefit of enhancing the United States turbine engine industry's international competitiveness. APSI is also fully integrated into the Versatile Affordable Advanced Turbine Engine program.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Programs

(U) $5,736 Designed, fabricated, and demonstrated durability and integration technologies for turbofan/turbojet engines. These technologies will improve durability, supportability, and affordability of current and future Air Force aircraft. Completed engine testing in support of the national High Cycle Fatigue program including forward swept fan blade damage tolerance, advanced instrumentation, model validation, and improved test protocol.

(U) $17,835 Designed, fabricated, and demonstrated advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines for fighters, bombers, and transports. Completed demonstrator engine test of fixed inlet guide vanes and Moderate Aspect Ratio rotor, Integrally Bladed Rotor repair, fan rim damper, High Cycle Fatigue mistuning technologies, vaneless counter-rotating high/low pressure turbine,

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	PROJECT: 4921

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

probabilistic rotor system design, gamma titanium aluminide Low Pressure Turbine coverplate, sprayform cast hardware, and Ceramic Matrix Composite technologies. Continued advanced engine designs for High Cycle Fatigue robust front frame, two-stage forward swept fan, tiled low pressure turbine blade, uncooled Ceramic Matrix Composite low pressure turbine blade, and model-based control with diagnostics.

(U) $6,120 Designed, fabricated, and demonstrated advanced component technologies for limited life engines. These technologies improve performance, durability, and affordability of engines for missile and unmanned air vehicle applications. Completed design and fabricated Organic Matrix Composite fan, high stage loading splittered fan, uncooled ceramic high/low pressure turbine, slinger and low volume combustors. Completed engine testing the high stage loading splittered fan and uncooled ceramic low pressure turbine in a demonstrator engine.

(U) $3,000 Developed high-speed turbine engine technology for next generation aerospace vehicles for long-range strike. Initiated a study to evaluate gas turbine technologies for long-range strike vehicles (e.g., gas turbine and ramjet/scramjet combined/combination cycle engines). Initiated an integrated design of turbine engine controls, exhaust nozzles, high temperature material components, and mechanical systems for capability beyond low-observables.

(U) $1,981 Developed turbine engines that reduce fuel consumption, increase thrust/airflow ratio, and reduce production costs for supersonic expendable and limited life unmanned vehicle turbine engines. This is the goal of the Joint Expendable Turbine Engine Concept demonstrator, an important demonstrator in the Integrated High Performance Turbine Engine Technology program. Performed design, fabrication, assembly, and test of materials and high pressure ratio technologies. These technologies include single crystal Lamilloy blades and advanced thermal barrier coated cast cool vanes.

(U) $34,672 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Programs

(U) $5,934 Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines. These technologies will improve durability, supportability, and affordability of current and future Air Force aircraft. Complete engine structural durability testing of fixed inlet guide vanes and Moderate Aspect Ratio rotor, Integrally Bladed Rotor repair, fan rim damper, High Cycle Fatigue mistuning and damping technologies, vaneless counter-rotating high/low pressure turbine, probabilistic rotor system design, gamma titanium aluminide low pressure turbine coverplate, sprayform cast hardware, and Ceramic Matrix Composite technologies.

(U) $20,637 Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines for fighters, bombers, and transports. Complete advanced engine designs and initiate fabrication of High Cycle Fatigue robust front frame,

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

affordable Organic Matrix Composite fan frame, two-stage forward swept fan, tiled low pressure turbine blade, uncooled Ceramic Matrix Composite low pressure turbine blade, Metal Matrix Composite shaft and model-based flexible control with diagnostics. Initiate advanced engine designs for tandem fan with Organic Matrix Composite tip shroud, carbon counter-rotating intershaft seal, and active augmenter screech control. Each of these component technology innovations can be applied to a significant part of the Air Force's engine inventory and offer potentially significant performance enhancements to future aircraft engines.

(U) $5,097 Design, fabricate, and test advanced component technologies for limited life engines. These technologies improve the performance, durability, and affordability of engines for missile and unmanned air vehicle applications. Complete fabrication and conduct testing on an Organic Matrix Composite fan, uncooled ceramic high pressure turbine, and slinger combustor. Complete fabrication of a low volume combustor. Complete engine structural durability testing of a high stage loading splittered fan and uncooled ceramic low pressure turbine.

(U) $3,362 Develop high-speed turbine engine technology for next generation aerospace vehicles for long-range strike. Complete study to evaluate gas turbine technologies for long-range strike vehicles (e.g., gas turbine and ramjet/scramjet combined/combination cycle engines). Continue to integrate design and initiate long lead hardware for turbine engine controls, exhaust nozzles, high temperature material components, and mechanical systems for capability beyond low-observables.

(U) $961 Design and fabricate a fixed composite nozzle and add instrumentation to the combustor for the Joint Expendable Turbine Engine Concept Phase III demonstrator engine test, an important demonstrator in the Integrated High Performance Turbine Engine Technology program. The Joint Expendable Turbine Engine Concept goal is to develop turbine engines that reduce fuel consumption, increase thrust/airflow ratio, and reduce production costs for supersonic expendable and limited life unmanned vehicle turbine engines. These efforts will contribute to the continued detailed design, fabrication, assembly, and test of materials and high pressure ratio technologies. Technologies include single crystal Lamilloy blades and advanced thermal barrier coated cast cool vanes.

(U) $35,991 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Programs

(U) $5,807 Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines. These technologies will improve durability, supportability, and affordability of current and future Air Force aircraft. Complete design, analysis, and fabrication of advanced engine components/instrumentation for structural durability testing.

(U) $16,182 Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan/turbojet engines for

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

fighters, bombers, and transports. Continue fabrication of High Cycle Fatigue robust front frame, affordable Organic Matrix Composite fan frame, two-stage forward swept fan, tiled low pressure turbine blade, uncooled Ceramic Matrix Composite low pressure turbine blade, Titanium Matrix Composite shaft and model-based flexible control with diagnostics. Complete advanced engine designs for a tandem fan with Organic Matrix Composite tip shroud, carbon counter-rotating intershaft seal, and active augmentor screech control. Each of these component technology innovations can be applied to a significant part of the Air Force's engine inventory and offer potentially significant performance enhancements to future aircraft engineers.

(U) $4,356 Design, fabricate, and test advanced component technologies for limited life engines. These technologies improve performance, durability, and affordability of engines for missile and unmanned air vehicle applications. Complete testing of an Organic Matrix Composite fan, an uncooled ceramic high pressure turbine, and slinger combustor. Complete fabrication and conduct durability testing on an uncooled Ceramic Matrix Composite turbine blisk/nozzle, and a Carbon/Carbon exhaust nozzle. Complete testing of low volume combustor. Initiate designs of advanced component technologies for intelligent and durability engine testing.

(U) $26,345 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities

(U) PE 0602201F, Aerospace Flight Dynamics.

(U) PE 0602203F, Aerospace 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

(U) Not Applicable.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology / PROJECT: 4922

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4922	Space & Missile Rocket Propulsion	28,546	1,433	12,848	6,055	7,084	5,048	5,125	5,196	Continuing	TBD

Note: In FY 2002, all rocket propulsion technology efforts performed in PE 0603302F, Projects 4373 and 6340, were transferred into this project, in order to align projects with the Air Force Research Laboratory organization. In FY 2003, space unique technology efforts in this project were transferred to PE 0603500F, Project 5033, in conjunction with the Space Commission recommendation to consolidate all space unique activities. In this project, space unique includes all Integrated High Payoff Rocket Propulsion Technology activities except Technology for the Sustainment of Strategic Systems and tactical missiles.

(U) A. Mission Description

This project develops advanced and innovative low-cost rocket turbomachinery and components, low-cost space and missile launch propulsion system technologies, demonstrates advanced propellants for launch and orbit transfer propulsion, demonstrates technologies for sustainment of strategic systems, and demonstrates technologies for tactical rockets. Characteristics such as environmental acceptability, affordability, reliability, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. This project also develops chemical, electrical, and solar rocket propulsion system technologies for station keeping and on-orbit maneuvering applications. 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 propellants. Technological advances developed in this program will improve the performance of expendable systems' payload capabilities by approximately 20 percent and reduce the launch and operations and support costs by approximately 30 percent. Technology advances will also lead to a seven year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload. The projects in this program are part of the Integrated High Payoff Rocket Propulsion Technology program, a joint DoD, NASA, and industry effort to focus rocket propulsion technology on national needs.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$10,213	Developed propulsion technology for current and future space launch vehicles. Continued to develop turbomachinery components for integration into an advanced liquid test bed demonstrator. Completed fabrication and assembly of a combustion chamber and injector for a liquid engine booster. Continued fabrication of an oxygen turbopump for integration into an advanced liquid booster engine. Completed testing of oxygen and hydrogen preburner components for integration into an advanced liquid booster engine. Completed the design of an advanced hydrocarbon test bed engine and began fabrication of hardware.
(U)	$4,047	Conducted a detailed design of hydrocarbon rocket engine test bed to enable responsive, reliable, operable, and affordable access to space.

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

		Conducted analyses to determine the optimum operating conditions and cooling requirements for a hydrocarbon rocket engine. Developed a rocket engine test bed component design to include turbopumps, boost pumps, and thrust chambers. Conducted an initial demonstration using hydrocarbon fuels and additives to cool engine without causing coking or stability problems.
(U)	$3,612	Developed propulsion technologies for current and future upper stage and orbit transfer vehicles. Continued to demonstrate solar thermal propulsion technologies, such as strut development, pointing, and tracking, for orbit transfer and maneuvering propulsion. Continued program to develop electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of low-earth orbit-geosynchronous earth orbit.
(U)	$3,827	Developed technologies for the sustainment of strategic systems. Continued the Post Boost Control System program to demonstrate component technologies with readily available materials to reduce hardware costs, achieve a 90 percent reduction in hydrazine leakage, and increase in service life for ballistic missiles by a factor of 5. Began evaluating the Strategic Sustainment Demonstration program hardware that integrates advanced propellant, case, and nozzle technologies.
(U)	$2,679	Developed electric propulsion technologies for satellite formation flying, station keeping, and repositioning. Continued development of mathematical models to address different propulsion technologies that could be used for small satellite formation flying. Continued brass board level testing of a pulsed plasma thruster. Continued development of propulsion systems for Air Force small satellites (<100 kg) required for key Air Force Space Command concepts. Completed design of flight hardware and began technology transition of selected propulsion concepts. Completed the fabrication of engine hardware for the TechSat 21 spacecraft.
(U)	$4,168	Continued to develop turbomachinery components for integration into an advanced liquid propellant test bed demonstration. Completed fabrication and assembly of the combustion chamber and injector for a liquid engine booster. Continued fabrication of an oxygen turbopump for integration into an advanced liquid booster engine. Completed testing of oxygen and hydrogen preburner components for integration into an advanced liquid booster engine.
(U)	$28,546	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,433	This project previously included space unique funding which has been transferred to PE 0603500F, Project 5033. These funds represent the civilian salaries for the work effort transferred and will be transferred at a later date.
(U)	$1,433	Total

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	PROJECT 4922

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$6,619	Develop technologies for the sustainment of strategic systems in support of FY 2003 work being conducted in 63500F, BPAC 5033. This work is part of the Technology for the Sustainment of Strategic Systems Phase I. Continue the Post Boost Control System program to demonstrate component technologies with readily available materials to reduce hardware costs with increased performance. Continue hardware development for the Missile Propulsion Demo integrating case, nozzle, insulation and propellant.
(U)	$6,229	Develop Technology for Sustainment of Strategic Systems Phase II. Continue evaluation and scale-up of technologies for demonstration. Integrate case, propellant, insulation, and nozzle technologies into an integrated demonstration. Continue integration, scale-up, and demonstration of advanced aging and surveillance codes, analysis tools, and inspection techniques and tools.
(U)	$12,848	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602102F, Materials.
(U) PE 0602601F, Spacecraft Technology.
(U) PE 0603401F, Advanced Spacecraft Technology.
(U) PE 0603853F, Evolved Expendable Launch Vehicle Program.
(U) PE 0603114N, Power Projection 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

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology / PROJECT: 5098

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5098 Advanced Aerospace Propulsion	0	0	38,885	0	0	0	0	0	Continuing	TBD

Note: In FY 2004, this Project is a new project, but not a New Start. This effort supports increased emphasis being placed on the National Aerospace Initiative and ongoing hypersonics effort.

(U) A. Mission Description

This project develops the scramjet propulsion cycle to a technology readiness level appropriate for in-flight demonstration and for full integration with other engine cycles (including turbine and rocket based) to provide revolutionary propulsion options for the Air Force. The primary focus is on the hydrocarbon-fueled, scramjet engine. Multi-cycle engines will provide the propulsion systems necessary to support aircraft and weapon platforms operating over the range of Mach 0 to 8+. Efforts include scramjet flow-path optimization to enable operation over the widest possible range of Mach numbers, active combustion control to assure continuous positive thrust (even during mode transition), robust flame-holding to maintain stability through flow distortions, and maximized volume-to-surface area to minimize the thermal load imposed by the high-speed engine. Thermal management plays a vital role in scramjet and combined cycle engines, including considerations for protecting potential low speed propulsion systems during hypersonic flight.

(U) FY 2002 ($ in Thousands)
(U) $0 No Activity; activities previously part of other projects in this PE .
(U) $0 Total

(U) FY 2003 ($ in Thousands)
(U) $0 No Activity; activities previously part of other projects in this PE .
(U) $0 Total

(U) FY 2004 ($ in Thousands)
(U) $38,885 Design, fabricate, and initiate testing of a near-fixed geometry flow-path for a hydrocarbon-fueled scramjet with robust operation over a range of Mach 4 to 8. This effort includes optimization of the flow-path cross-section and the flame-holding/fuel-mixing geometry. Develop a robust engine start system to achieve full engine light after boost to Mach 4. Initiate design of an active engine sense-control system to manage start transient and engine mode changes during acceleration. Initiate vehicle design capable of rocket-boost to Mach 4, full integration with scramjet engine and hydrocarbon fuel system, and acceleration from Mach 4 to 8. Initiate selection of rocket boosters.
(U) $38,885 Total

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology	PROJECT: 5098

(U) B. Project Change Summary

Not Applicable

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

(U) Related Activities:

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

(U) D. Acquisition Strategy

Not Applicable

(U) E. Schedule Profile

(U) Not Applicable

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology / PROJECT: 681B

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
681B	Advanced Turbine Engine Gas Generator	33,810	33,737	29,299	26,254	26,497	26,969	27,377	27,760	0	0

(U) A. Mission Description

This project develops turbine engine gas generator technologies for 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, reparability, and maintainability 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. Component technologies are demonstrated in a core (sub-engine) test. The core performances of this project are proven in demonstrator engines in Project 4921 of this PE. Efforts are part of the Integrated High Performance Turbine Engine Technology and the Versatile Affordable Advanced Turbine Engine programs.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $26,410 Designed, fabricated, and tested performance of technology demonstrator core engines to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Completed design and continued fabrication of hardware for core engine testing of a load decoupler fan frame, a ceramic matrix composite combustor liner, a ceramic bearing, and advanced turbine vane, blade, and disk materials. Designed advanced hardware for core engine testing of a high pressure ratio four stage compressor with stability enhancing control, an integrated lightweight combustor with ceramic matrix composite panels, a microplasma ignitor, revolutionary turbine blade material, and an endothermic fuel/air heat exchanger.

(U) $2,270 Designed, fabricated, and tested durability of technology demonstration core engines to provide increased life and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Designed turbine engine advanced hardware for core engine evaluation in the national durability program.

(U) $3,149 Designed, fabricated, and evaluated 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 unmanned air vehicles. Continued evaluation of a core engine forward swept splittered compressor rotor, a high temperature rise combustor, a counter rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings.

(U) $1,981 Developed turboprop/turboshaft engine technologies that are applicable to military helicopter applications such as combat search and rescue.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603216F Aerospace Propulsion and Power Technology / PROJECT: 681B

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued
(U) $33,810 Total

(U) FY 2003 ($ in Thousands)
(U) $0 Accomplishments/Planned Program
(U) $28,298 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. Complete design and continue hardware fabrication of a core engine test article with a load decoupler fan frame, a trapped vortex combustor, ceramic matrix composite combustor liner, a ceramic bearing, and advanced turbine blisk and vane materials. Complete design and continue fabrication of hardware for core engine testing of a high-pressure ratio four stage compressor with an integrated lightweight combustor with ceramic matrix composite panels, microcircuit cooling, revolutionary hot section material, and an endothermic fuel/air heat exchanger. Each of these technology innovations can be applied to a significant part of the Air Force's engine inventory and offer potentially significant performance enhancements to future aircraft engines.
(U) $1,944 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. Continue to design and initiate fabrication of long lead hardware for turbine engine advanced hardware for core engine evaluations in the national durability programs.
(U) $3,495 Design, fabricate, and evaluate 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. Complete core engine testing of a forward swept splittered compressor rotor, a high temperature rise combustor, a counter rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings.
(U) $33,737 Total

(U) FY 2004 ($ in Thousands)
(U) $0 Accomplishments/Planned Program
(U) $24,390 Design, fabricate, and test performance demonstration core engines, using advanced materials including Titanium Matrix Composites, to provide improved performance and fuel consumption for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Continue hardware fabrication of a core engine test article with a load decoupler fan frame, a trapped vortex combustor, a ceramic matrix composite combustor liner, ceramic bearings, and advanced turbine blisk and vane materials. Continue fabrication of hardware for core engine testing of a high-pressure ratio four-stage compressor with an integrated lightweight combustor with ceramic matrix composite panels, microcircuit cooling, revolutionary hot section material, and an endothermic fuel/air heat exchanger. Each of these technology innovations can be applied to a

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

significant part of the Air Force's engine inventory and offer potentially significant performance enhancements to future aircraft engines.

(U) $1,755 Design, fabricate, and durability test demonstration core engines to provide increased durability and affordability for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports. Complete design and continue fabrication of long lead hardware for turbine engine advanced core evaluations in the national durability programs.

(U) $3,154 Design, fabricate, and evaluate 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. Continue core engine testing of forward swept splittered compressor rotor, a high temperature rise combustor, a counter-rotating vaneless turbine, ceramic matrix composite turbine blades and vanes, and magnetic bearings. Initiate design of small versatile affordable core engine technologies.

(U) $29,299 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602201F, Aerospace Flight Dynamics.

(U) PE 0602203F, Aerospace 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603231F Crew Systems and Personnel Protection Technology

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	32,115	39,235	34,487	32,881	32,614	33,197	33,700	34,171	Continuing	TBD
2830	Decision Support and Cognitive Systems	7,454	7,883	7,541	6,386	6,253	6,200	6,294	6,383	Continuing	TBD
3257	Helmet-Mounted Sensory Technologies	9,787	6,798	6,001	4,801	5,342	5,432	5,514	5,590	Continuing	TBD
4923	Logistics Readiness and Sustainment	9,124	8,170	11,569	10,560	10,877	11,227	11,398	11,557	Continuing	TBD
4924	Distributed Mission Training Technology	5,750	7,369	6,530	7,239	7,179	7,176	7,284	7,386	Continuing	TBD
5020	Directed Energy Protective Systems	0	9,015	2,846	3,895	2,963	3,162	3,210	3,255	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2002, all activity previously reported in PE 0603106F will be reported in Project 4923 and all activity previously reported in PE 0603227F will be reported in Project 4924. In FY 2003, the Directed Energy Protective Systems program at Brooks City-Base, TX, will move from Project 3257 to Project 5020 to align resources with the Air Force Research Laboratory organization.

(U) A. Mission Description

This program develops and demonstrates technologies to enhance human performance and effectiveness and to enable the aerospace force. State-of-the-art advances are made to train personnel, protect and sustain warfighters, and improve human interfaces with weapon systems. The Decision Support and Cognitive Systems project develops and demonstrates crew system interface technologies and information operations technologies that promote effective decision-making, control, and execution in operational environments. The Helmet-Mounted Sensory Technologies project develops and demonstrates advanced operator interface technologies for multi-functional helmet-mounted displays and night vision devices, and laser eye protection. The Logistics Readiness and Sustainment project develops and demonstrates technologies that will protect the force, enhance logistics, and improve the design, deployability, performance, and support of current and future weapon systems. The Distributed Mission Training Technology project develops and demonstrates advanced training, simulation, and mission rehearsal technologies. The Directed Energy Protective Technologies project develops and demonstrates advanced technologies for laser eye protection and for assuring safety of personnel involved

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603231F Crew Systems and Personnel Protection Technology

(U) A. Mission Description Continued

with test, deployment, and operation of high-energy laser weapons and systems. Note: In FY 2003, Congress added $1.0 million for Battlespace Logistics Readiness and Sustainment, $3.5 million for Total Atmospheric Liquefaction System (TALON), $1.8 million for Combat Automation Requirement Testbed, $2.1 million for Special Operations Crew Research at Brooks AFB, $0.9 million for Laser Eye Protection Research, and $1.0 million for Helmet Cueing System 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 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	34,023	29,690	35,193	TBD
(U)	Appropriated Value	34,356	39,990		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-333	-423		
	b. Small Business Innovative Research				
	c. Omnibus or Other Above Threshold Reprogram		-332		
	d. Below Threshold Reprogram	-1,751			
	e. Rescissions	-157			
(U)	Adjustments to Budget Years Since FY 2003 PBR			-706	
(U)	Current Budget Submit/FY 2004 PBR	32,115	39,235	34,487	TBD

(U) Significant Program Changes:

Decrease in FY 2004 is to fund higher priority Air Force programs.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603231F Crew Systems and Personnel Protection Technology

PROJECT: 2830

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
2830	Decision Support and Cognitive Systems	7,454	7,883	7,541	6,386	6,253	6,200	6,294	6,383	Continuing	TBD

(U) A. Mission Description

This project provides technology to improve human combat performance, combat support performance, and aerospace safety through better information delivery and crew station integration, which are achievable through effective decision support and cognitive systems engineering. Crew stations represent the fundamental interface between the warfighter and equipment across the gamut of aerospace operations. To cope with the recognized data overload in command centers and weapon platforms, this project develops technologies to quantify requirements, develop information interfaces, and evaluate crew performance in selected operational environments. This project includes bioacoustic technologies to complement decision support and visual information technologies as part of an integrated solution to negate information overload in the Air Expeditionary Force environment, while improving sound cueing, voice communications, and hearing protection for weapon systems operators, command centers, and security forces.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,250 Developed and demonstrated human modeling technologies and simulation tools to verify crew performance requirements, reduce the cost and time for system developers to isolate and analyze critical operator tactics in simulated operational exercises, and support clear accountability in design. Completed feasibility demonstration for integrating human modeling technology in a simulation-based testbed to establish performance-based crew system requirements. Developed plan to extend human modeling and simulation technologies to make effective trade off assessments of crew system concepts to quantify impact on performance, mission effectiveness, and affordability. Demonstrated feasibility of modeling teamwork, intra-team communications, and air center operations in support of effectiveness trades used during acquisition.

(U) $3,475 Developed and demonstrated aircrew escape subsystems to protect the aircrew member during emergency ejection in current and future high performance fighter aircraft. Developed head/neck protection systems and Helmet-Mounted Displays (HMD) that will provide a decrease in head and neck injuries for crewmembers wearing HMDs during high-speed emergency ejections. Conducted windblast testing to verify head, neck, and eye protection are provided to 600 Knots Equivalent Air Speed.

(U) $993 Developed and demonstrated user-tailored information management and portrayal technologies that enhance battlespace situational awareness for global- and MAJCOM-level information operations centers to reduce decision-making bottlenecks. Continued to develop user-tailored visualizations promoting battlespace situational awareness. Developed and demonstrated tools to improve information operations planning, execution, and combat assessment within the information warfare flights of the numbered air forces. Performed cross-cultural analysis as a first

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

step in developing a tool to support understanding of adversarial decision-making. Demonstrated the effectiveness of combat assessment tools in joint or Air Force specific exercises.

(U) $744 Developed high performance bioacoustic hearing protection technologies to achieve 40-45 dB noise attenuation for personnel working in and around aircraft. Demonstrated improved noise attenuation performance metrics in laboratory and field environments. Integrated deep insert earplug technology to achieve 35-40 dB field attenuation.

(U) $992 Developed and demonstrated technologies to enhance security force situational awareness and threat response time using acoustic sensors. Demonstrated that using an eight microphone array can increase signal-to-noise ratio for a given look angle, provide three-dimensional (3-D) sound localization, and provide a limited remote detection capability for security forces. Developed and evaluated acoustic algorithms for locating, tracking, and detecting threats. Began to develop an information management concept for deployed security forces to improve situational awareness by using intelligent algorithms, 3-D audio, and audio symbology to code the detected threats and assist in threat intervention.

(U) $7,454 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,982 Develop and demonstrate human modeling technologies and simulation tools to justify crew performance requirements, reduce the cost and time for system developers to isolate and analyze critical operator tactics in simulated operational exercises, and support analysis of alternatives. Continue to extend human modeling and simulation technologies to make effective trade offs between crew system concepts and mission effectiveness. Begin to analyze and develop integrated crew system concepts to reduce manning within air operations centers, showing contribution of human modeling to substantiate time-critical targeting effectiveness and affordability. Begin development of extensions to the simulation testbed that will provide the capability to objectively and systematically assess the overall sensor-to-shooter process for time-critical targets.

(U) $2,708 Develop and demonstrate user-tailored information management and portrayal technologies that enhance battlespace situational awareness for global- and MAJCOM-level information warfare and air operations centers to reduce decision-making bottlenecks. Transition and integrate initial version of combat assessment tools into joint and/or Air Force weapon systems. Develop effects-based adversarial decision-making process and model to characterize different types of adversary systems and assess alternative ways they may be favorably influenced by allied force actions. Develop speech recognition front-end and advanced visualization for operations centers' information management tool. Improve

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

flow of time-critical targeting information into strike aircraft to enhance pilot situational awareness, exploiting capabilities inherent with helmet-mounted display technology.

(U) $893 Develop advanced high performance bioacoustic hearing protection technologies to achieve 40-45 dB noise attenuation for personnel working in and around fighter aircraft. Demonstrate communication capability in 150 dB noise fields. Integrate deep insert earplug technology with active noise reduction to achieve 45 dB field attenuation. Demonstrate improved attenuation and user acceptability in laboratory and field environments.

(U) $980 Develop and demonstrate advanced technologies to enhance security force situational awareness and threat response time using acoustic sensors. Demonstrate to deployed security forces an information management concept that can improve situational awareness by using intelligent algorithms, three-dimensional (3-D) audio, and audio symbology to code the detected threats and assist in threat intervention. Demonstrate at a military exercise the operational payoff from using 3-D audio radios and helmets in a mobile patrol squadron. Develop an automated threat assessment system to evaluate the severity and importance of detected noise.

(U) $1,320 Develop and demonstrate human-centered science and technology for the Air Force Information Warfare (IW) community. This research will provide the IW warrior with tailored decision support systems, guidelines for effective selection of information warriors, information operations simulators and training systems, improved operational shift schedules to increase personnel efficiency and effectiveness, enhanced decision-making tools, and automated tools to reduce operator task load. Tools will be developed to influence human senses to enable perception management and deception, model and simulate human behavior, develop adversary cultural and decision models, enhance predictive battlespace awareness, and improve interaction and monitoring capability by determining effectiveness of automated tools in support of intelligence and information warfare units.

(U) $7,883 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,077 Develop and demonstrate human modeling technologies and simulation tools to justify crew performance requirements, reduce the cost and time for system developers to isolate and analyze critical operator tactics in simulated operational exercises, and support analysis of alternatives. Integrate human modeling and simulation technologies into distributed simulation exercises to reduce manning within air operations centers and to shorten time-critical targeting cycle times.

(U) $3,250 Develop and demonstrate user-tailored information management and portrayal technologies that enhance battlespace situational awareness for

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

		global- and MAJCOM-level information warfare and air operations centers to reduce decision-making bottlenecks. Develop effects-based adversarial decision-making modeling, simulation, and analysis tool to evaluate different types of adversary systems and to assess alternative ways they may be favorably influenced by allied force actions. Integrate this tool into next-generation planning and combat assessment tools to demonstrate enhanced information warfare planning. Develop dynamic user tailoring for operation centers' information management tool.
(U)	$955	Develop and demonstrate advanced audio technologies to enhance security force situational awareness and threat response time using acoustic sensors. Demonstrate a user-centered interface to improve threat level and location awareness for security force command, as well as automated acoustic threat detection, localization and classification of foot traffic, land vehicles, air vehicles, and munitions firing. Demonstrate during a military exercise the operational payoff from using the combination of acoustic sensors, multimedia displays at the command center, and three-dimensional audio radios to assist mobile patrol squads.
(U)	$910	Develop and demonstrate human-centered science and technology for the Air Force Information Warfare (IW) community. Develop technologies to provide human-centered alternatives to current IW architectures, systems, processes, and operations. These technologies will focus on predictive battlespace awareness and tailored decision support systems and tools to augment human operators' performance. Analysis of alternatives will lead to a modernization plan for IW as well as a detailed plan to support future demonstrations of Information Warfare tools, training, and requirements.
(U)	$1,349	Develop and demonstrate a combined aerospace information system that provides combat effectiveness reporting, situation assessment updates, and decision support for Combined Air Operations Centers (CAOC). Perform work-centered analysis of key CAOC positions and develop measures of performance and effectiveness. Begin to develop visualizations promoting battlespace situational awareness.
(U)	$7,541	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602202F, Human Effectiveness Applied Research.

(U) PE 0604706F, Life Support Systems.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

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(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603231F Crew Systems and Personnel Protection Technology

PROJECT: 3257

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
3257	Helmet-Mounted Sensory Technologies	9,787	6,798	6,001	4,801	5,342	5,432	5,514	5,590	Continuing	TBD

Note: In FY 2003, the Directed Energy Protective Systems program at Brooks City-Base, TX, will move from Project 3257 to Project 5020 to align resources with the Air Force Research Laboratory organization.

(U) A. Mission Description

This project develops and demonstrates advanced technologies for ejection-safe, multi-functional Helmet-Mounted Displays and night vision devices. Development of helmet-mounted tracker and display (HMT/D) technologies will enable pilots to detect, identify, target, and launch weapons faster and more accurately. Development of improved aircrew Night Vision Goggle (NVG) technologies will enhance aerial combat capabilities at night.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $4,830 Developed and demonstrated advanced HMT/D and subsystem technologies to improve mission effectiveness and pilot situational awareness during day and night missions in all-weather conditions. Demonstrated advanced symbology and video insertion on HMT/D for air-to-ground strike missions. Demonstrated inertial head tracker on HMT/D for air-to-ground strike missions. Developed and demonstrated high-brightness, high resolution, miniature flat-panel display and assessed utility of the new flat-panel display as a replacement for cathode ray tubes on daytime HMT/Ds.

(U) $2,216 Developed and demonstrated technologies for improved aircrew NVGs to increase mission effectiveness and enhance air operations by allowing the pilot to perform daytime tactics at night. Demonstrated miniature image sources and smaller format filmless image intensifier tubes to provide aircrew members a wider field-of-view, improved low-light level resolution, and reduced halo effects. Demonstrated Integrated Panoramic Night Vision Goggles (IPNVG) technologies integrated with Laser Eye Protection (LEP) technologies. Continued flight evaluation of IPNVG and demonstrated imagery insertion in flight.

(U) $2,741 Developed and demonstrated technologies that counter the multiple wavelength and agile laser threat and permit safe testing, deployment, and use of high-energy laser weapons. Continued evaluation of the biological effects of non-lethal laser weapons and high-energy laser systems. Finished aircrew evaluation of dye/dielectric stack combination LEP. Completed performance evaluation of vision-corrective prescription capability and airborne LEP of dielectric stack-based technologies, and began aircrew evaluations of these devices. Demonstrated next generation rugate technology for visible wavelength protection. Continued assessment of laser glare effects on visual performance of human subjects wearing reflective laser eye protection compared to combined dye/dielectric stack technologies.

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued
(U) $9,787 Total

(U) FY 2003 ($ in Thousands)
(U) $0 Accomplishments/Planned Program
(U) $3,378 Develop and demonstrate advanced Helmet-Mounted Tracker and Display (HMT/D) and subsystem technologies to improve mission effectiveness and pilot situational awareness during day and night missions in all-weather conditions. These technologies help pilots to detect, identify, target, and engage with weapons faster and more accurately. Investigate and develop advanced symbology sets for tactical HMT/Ds to improve targeting, increase situational awareness, and reduce spatial disorientation. Integrate ultrasonic transducers with inertial head tracker to improve tracker accuracy. Investigate utility of advanced daytime HMT/D incorporating miniature color display for future simulations and flight evaluations.
(U) $979 Develop and demonstrate advanced head tracker technologies to improve helmet cueing capabilities for onboard weapons and sensors.
(U) $1,504 Develop and demonstrate technologies for improved aircrew night vision goggles to increase mission effectiveness and enhance air operations by allowing the pilot to perform daytime tactics at night. Incorporate and evaluate laser hardening technologies for image intensifier tube. Integrate Integrated Panoramic Night Vision Goggles with an HMT/D.
(U) $937 Develop and demonstrate subsystems to protect the aircrew member wearing Helmet-Mounted Displays (HMDs) during emergency ejection in current and future high-performance fighter aircraft. Advanced head/neck protection systems will provide a decrease in head and neck injuries for crewmembers wearing HMDs during high-speed emergency ejections. Conduct tests to verify head, neck, and eye protection are provided to 600 Knots Equivalent Air Speed (KEAS) threshold, 700 KEAS objective.
(U) $6,798 Total

(U) FY 2004 ($ in Thousands)
(U) $0 Accomplishments/Planned Program
(U) $2,333 Develop and demonstrate advanced HMT/D and subsystem technologies to improve mission effectiveness and pilot situational awareness during day and night missions in all-weather conditions. These technologies help pilots to detect, identify, target, and engage with weapons faster and more accurately. Demonstrate advanced symbology sets for tactical HMT/Ds in an operational environment to assess improvements to targeting, to increase situational awareness, and to reduce spatial disorientation. Demonstrate and assess utility of advanced head tracker that improves tracker accuracy, reduces system latency, and reduces mobility footprint.
(U) $2,935 Develop and demonstrate advanced visual display technologies to provide integrated day/night capability for reducing pilot workload and

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

enhancing mission performance. Assess capabilities of emerging night vision devices and investigate head-mounted, multi-channel displays. Develop technologies to reduce bulk and head-supported weight required by existing cathode ray tube-based designs to improve aircrew safety and comfort.

(U) $733 Develop and demonstrate subsystems to protect the aircrew member wearing Helmet-Mounted Displays (HMD) during emergency ejection in current and future high performance fighter aircraft. Aerodynamic lift-reducing helmet concepts will provide a decrease in head and neck injuries for crewmembers wearing HMDs during high-speed emergency ejections. Identify candidate lift-reducing concepts and integrate helmet design with emerging HMD designs. Conduct impact, windblast, and ejection sled tests to verify performance under high-speed ejection conditions.

(U) $6,001 Total

(U) B. Project Change Summary

Not Applicable.

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

(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 Program.
(U) PE 0604706F, Life Support Systems.
(U) PE 0604201F, Integrated Avionics Planning 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

(U) Not Applicable.

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	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4923	Logistics Readiness and Sustainment	9,124	8,170	11,569	10,560	10,877	11,227	11,398	11,557	Continuing	TBD

(U) A. Mission Description

This project develops and demonstrates technologies that will enhance logistics and improve the design, deployability, performance, and support of current and future weapon systems. This includes technology development to model and simulate intelligent behavior; improve the accuracy of logistics process modeling; create intelligent software agents to perfect human and logistics representation in large-scale military simulations; and create more effective logistics information systems. This project also develops and demonstrates technologies to incorporate human operator, maintenance, and support considerations into the weapon systems design process, and to make related data available electronically throughout weapon systems life cycles. The resulting efforts will reduce deployment airlift and footprint requirements, improve the logistics information system, and improve the command, control, and decision-making in worldwide logistics management.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,608 Developed and demonstrated technologies that enhance and streamline aircraft maintenance processes to improve the Air Force's ability to meet Air Expeditionary Force requirements by providing faster and more accurate methods of diagnosing and predicting component failures. Continued development of diagnostics capability to provide technicians with more effective tools for isolating faults on software intensive, reconfigurable systems found on modern aircraft and advanced aircraft systems currently in development. Began development of a prognostics capability to accurately predict when a component will fail so that parts can be replaced before failure.

(U) $3,799 Developed and demonstrated intelligent software agents and realistic human behavior models. These software agents and models add realism and fidelity to large-scale synthetic environments and war games, and improve the user interaction with logistics information systems. Developed intelligent agents that extend the role player's ability to monitor events and execute missions, and better represent logistics functions in synthetic exercises. Developed software agents that anticipate problems and offer decision options to command center personnel during mobility operations.

(U) $3,717 Developed and demonstrated logistics technologies for improved deployment operations, supportability, and planning. These technologies enhance deployments and mobility operations. Continued to develop technology to provide wing commanders and senior logisticians with advanced logistics information and management capabilities, including rapid access to real-time resources status information, proactive problem identification, decision support aids, and process tracking. Focus on the information feeds required to support the wing commander and senior logisticians in effectively assessing the wing logistics support status.

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

(U) $9,124 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,591 Develop and demonstrate intelligent software agents and realistic human behavior models. These computer agents and models will add realism and fidelity to large-scale synthetic environments and war games, and improve the user interaction with logistics information systems. Develop intelligent software agents that mimic the functionality of command/control echelons and opposing forces and that better represent logistics functions in synthetic exercises.

(U) $2,991 Develop and demonstrate logistics technologies for improved deployment operations and improved system supportability. These technologies will maximize the efficiency and effectiveness of Air Force deployments and mobility operations in support of agile combat support initiatives and the emerging Air Expeditionary Force (AEF) concepts. Continue to develop technology to provide wing commanders and senior logisticians with advanced logistics information and management capabilities, including rapid access to real-time resources status information, proactive problem identification, decision support, and process tracking. Initial software tool set will be tested and transitioned to users.

(U) $1,609 Develop and demonstrate advanced user interface technologies to enhance the utility of Air Mobility Command's command and control systems. These interfaces will combine artificial intelligence software with automated, work-centered collaborative planning and decision support technologies. Command and control operators will have immediate access to integrated, decision-quality information from multiple sources, thereby enabling faster, more accurate decision-making and problem resolution during mobility operations.

(U) $979 Develop and demonstrate technologies that will enhance Air Force maintenance and supply processes and improve the design, deployability, performance, and logistics support of current and future weapon systems.

(U) $8,170 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,757 Develop and demonstrate technologies that will enhance and streamline aircraft maintenance processes to improve the Air Force's ability to meet AEF requirements by providing faster and more accurate methods of diagnosing and predicting component failures. Begin to develop cognitive decision technologies, new information fusion techniques, and algorithms to determine failure trends for improved maintenance troubleshooting. Develop revolutionary formats for presenting technical information and software tools that support collaborative problem solving during aircraft maintenance.

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

(U)	$2,814	Develop and demonstrate intelligent software agents and realistic human and organizational behavior models. These computer agents and models will add realism and fidelity to large-scale synthetic environments and war games, provide intelligence analysts a way to model collected data, and improve the user interaction with logistics information systems. Develop computer models that mimic the functionality of command and control echelons and opposing forces and that better represent logistics functions in synthetic exercises.
(U)	$4,441	Develop and demonstrate logistics technologies for improved deployment operations and improved system supportability. These technologies will maximize the efficiency and effectiveness of Air Force deployments and mobility operations in support of agile combat support initiatives and Air Expeditionary Force concepts. Complete development and transition of technology to provide wing commanders and senior logisticians with advanced logistics information and management capabilities, including rapid access to real-time resources status information, proactive problem identification, decision support, and process tracking. Begin to assess and develop technology to automatically collect and update critical information required to effectively manage logistics resources in support of combat operations.
(U)	$1,557	Develop and demonstrate advanced job performance aiding technologies to enhance the utility of Air Mobility Command's (AMC) command and control systems. These technologies will provide command and control operators with automated access to integrated, decision-quality data from multiple sources and thus support faster, more accurate decision-making and problem resolution during mobility operations. Develop artificial intelligence software, work-centered collaborative planning tools, and advanced decision support technologies to augment AMC's command and control systems.
(U)	$11,569	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602201F, Aerospace Flight Dynamics.

(U) PE 0602202F, Human Effectiveness Applied Research.

(U) PE 0603721N, Environmental Protection.

(U) PE 0604708F, Civil, Fire, Environmental, Shelter.

(U) PE 0604740F, Integrated Command and Control Applications.

(U) PE 0605801A, Programwide Activities.

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

(U) PE 0708011F, Industrial Preparedness.

(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

(U) Not Applicable.

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PROJECT: 4924

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4924	Distributed Mission Training Technology	5,750	7,369	6,530	7,239	7,179	7,176	7,284	7,386	Continuing	TBD

(U) A. Mission Description

This project develops and demonstrates advanced training, simulation, and mission rehearsal technologies that will improve warfighter capabilities and mission readiness by enhancing operator and team performance skills. This effort includes the development of technologies that enable integration of computer models, live weapon systems, and weapon system simulators to portray the global battlespace, including all-weather, day/night flight operations, command and control, force protection, and aerospace operations. This project develops and demonstrates advanced training and simulation technologies that will improve warfighter readiness by enhancing mission training and mission rehearsal capabilities. Development and effective use of this global battlespace requires advances in training systems, interconnection, information, visual, and representation technologies. The resulting mission training and rehearsal capabilities will enhance the mission essential competencies of the combat and combat support individuals and teams that comprise the aerospace force.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,728 Advanced warfighter training capabilities by developing and demonstrating representational technologies and training techniques for integrated aerospace operations training, which includes training for aerospace, command and control, force protection, and warfighters. Techniques developed will increase fidelity of mission training and rehearsal systems, reduce the learning time for new operators, sustain critical mission competencies, and ensure that deployed personnel have the knowledge and skills to accomplish their mission. Demonstrated training benefits of distributed mission training technology for fighter aircraft individual flying skills, fighter weapons school, and aircrew training program. Completed development of a tactical decision trainer for security forces. Began development of data capturing tools for crew and team performance assessment in both simulator and field environments. Designed and developed technologies for realistic databases and electronic combat simulators.

(U) $875 Developed and demonstrated the application of information and communications technologies for realistic mission training and mission rehearsal in a distributed simulation environment. These technologies will increase readiness training by enabling more realistic employment of weapon systems within a horizontally and vertically integrated system of sensors, command and control, and weapons platforms. Designed a communication bridge to enable virtual simulators, operating at different security levels, to interact with one another in a real-time simulation environment. Developed and demonstrated enhancements to the High-Level Architecture that will enable more rapid development of simulator federations and enhanced simulator performance. Developed a testbed for command and control training research with links to existing

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	PROJECT 4924

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

command and control centers. Evaluated techniques for integrating operational command and control systems into the Distributed Mission Training (DMT) environment.

(U) $1,393 Demonstrated advances in simulator visual system technologies through the development of high-fidelity image generation, display, and databases. Advanced visual systems will provide operators greater visual definition to identify other aircraft, ground vehicles, roads, and bridges at realistic tactical ranges or to properly assess their aspect angle, increasing mission rehearsal capability for the warfighter. Continued development of a PC-based, high resolution, real-time image generator. Continued development of an ultrahigh resolution laser projector for DMT simulators.

(U) $1,754 Developed and demonstrated technologies for high-fidelity Night Vision Goggle (NVG) simulation to support and increase mission training, preview, and rehearsal capabilities. This development will reduce the cost of initial NVG qualification, allow for effective advanced night operation mission pretraining prior to in-aircraft training, and increase combat training realism by adding simulated weather, seasonal, and environmental changes. Tested the use of an automated material classification toolset for rapid build of multi-spectral databases. This toolset increased the capability to rapidly respond to world changes with realistic visualization of the new or changing operating areas. Evaluated effectiveness of on-line NVG and laser courseware, and assessed impact of these technologies on mission effectiveness and risk management.

(U) $5,750 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,731 Advance warfighter training capabilities by developing and demonstrating representational technologies and simulation techniques for integrated training and rehearsal, which includes training for aerospace operations, command and control, force protection, and air base defense warfighters. Develop and validate training technologies and methods to enable deployed personnel to maintain mission essential skills. Implement and evaluate the next generation threat system in DMT testbed, while integrating with multi-hyperspectral and weather databases. Develop functional requirements for hyperspectral databases to support realistic sensor simulation.

(U) $766 Develop and demonstrate the application of information and communications technologies for realistic mission training and mission rehearsal in a distributed simulation environment. These technologies will increase readiness training by enabling more realistic employment of weapon systems within a horizontally and vertically integrated system of sensors, command and control, and weapons platforms. Demonstrate the capability to establish a High-Level Architecture (HLA) federation that provides aircrew and command and control training to geographically separate audiences. Demonstrate an HLA federation operating at multiple security levels.

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology
	PROJECT 4924

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

(U) $1,768 Demonstrate advances in simulator visual system technologies through the development of high-fidelity image generator display, components, and databases. Advanced visual systems will provide operators enhanced cueing in simulated high-definition immersive environments and greater visual detail to identify other aircraft, ground vehicles, roads, and bridges at realistic tactical ranges, thus increasing mission rehearsal capability for the warfighter. Develop and demonstrate less expensive, thin-film holographic collimating display components for the simulator. Develop and demonstrate a proof-of-concept ultrahigh resolution, color laser projector. Integrate and evaluate high bandwidth PC-based image generator with high resolution laser projector.

(U) $2,104 Develop and demonstrate technologies for night vision device training and high-fidelity Night Vision Goggle (NVG) simulation. This development will reduce the cost of initial NVG qualification and increase combat training realism. Complete generic NVG simulation and generic Forward Looking Infrared simulation using the same tools used for NVG functionality, allowing for high-fidelity, completely correlated visible and sensor simulation imagery. Develop proof-of-concept for dual mode, covert and overt, external aircraft lighting for fighter aircraft. Complete digital conversion of introductory and instructor courseware. Evaluate simulator-based training scenarios for initial qualification, spatial orientation, and advanced combat night operations.

(U) $7,369 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,277 Advance integrated warfighter training and rehearsal technologies for aerospace operations, command and control, force protection, and air base defense warfighters. Increase training effectiveness and efficiency, and decrease time to mission qualification. Develop mission essential competency analysis toolset for air superiority that identifies those critical knowledge, skills, and experiences that are important enablers of mission performance for individuals and teams. Develop specifications for virtual and live training performance assessment and measurement to enable deployed personnel to maintain mission essential skills, and develop training and simulation technologies that will enable integrated command and control training within the distributed mission training environment. Demonstrate competency-based design of a simulator performance measurement and tracking system, and develop a stand-alone performance monitoring and tracking capability for live-fly instrumented range data.

(U) $943 Develop and demonstrate the application of information and communications technologies for realistic mission training and mission rehearsal in a distributed simulation environment. These technologies will increase readiness training by enabling more realistic employment of weapon systems within a horizontally and vertically integrated system of sensors, command and control, and weapons platforms. Demonstrate a

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

near-real-time High-Level Architecture (HLA) based training environment enabling aircrew and command and control training for geographically separated training audiences. Validate performance of an HLA network guard federation operating at multiple security levels and produce documentation to support certification and accreditation.

(U) $1,800 Demonstrate advances in simulator visual system technologies through the development of ultrahigh resolution projection systems, low-cost high-fidelity image generator, and thin-film holographic collimating display technologies. Technologies will create high-definition immersive virtual environment for aircrew readiness training and mission rehearsal, increasing mission rehearsal capability for the warfighter. Fabricate and evaluate efficient, full-size, thin-film holographic collimating screen materials. Develop a 5120 x 4096 pixel low cost PC-based image generator.

(U) $1,623 Advance warfighter integrated training and rehearsal for aerospace operations, command and control, force protection, and air base defense warfighters. Technologies will increase training effectiveness and efficiency, and decrease time to mission qualification. Develop a sample database using hyperspectral imagery to test alternative data storage and real-time run formats. Model advanced radio frequency threats, infrared threats, and countermeasures and incorporate into the distributed mission training research testbed threat system. Incorporate performance characteristics of the panoramic night vision goggle (NVG) into the testbed's existing NVG simulation model.

(U) $887 Develop and demonstrate a high-fidelity distributed mission operations training and rehearsal capability for operators in an Air Operations Center (AOC). Link AOC operational mission requirements and principles of instruction to enable effective and efficient training at both the AOC Formal Training Unit and the operational units. Develop specifications, strategies, and methods for individual-, team-, and division-level training and rehearsal within an AOC. Develop preliminary guidelines and metrics for assessing mission readiness levels for AOC members.

(U) $6,530 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602202F, Human Effectiveness Applied Research.

(U) PE 0604227F, Distributed Mission Training.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

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(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603231F Crew Systems and Personnel Protection Technology

PROJECT: 5020

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5020	Directed Energy Protective Systems	0	9,015	2,846	3,895	2,963	3,162	3,210	3,255	Continuing	TBD

Note: In FY 2003, the Directed Energy Protective Systems program at Brooks City-Base, TX, will move from Project 3257 to Project 5020 to align resources with the Air Force Research Laboratory organization.

(U) A. Mission Description

This project develops and demonstrates advanced technologies for Laser Eye Protection (LEP) and for assuring safety of personnel involved with test, deployment, and operation of high-energy laser weapons and systems. The project develops technologies to provide protection against laser threats and hazards, without compromising performance, vigilance, and mission effectiveness. It also develops tools and guidelines for testing and deploying high-energy laser systems and technologies to enhance personnel safety and effectiveness in aerospace operations and increase Air Expeditionary Force deployability through innovative on-board oxygen generation capabilities for cargo aircraft.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 FY 2002 activity reported in PE 0603231F, Project 3257.

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,470 Develop and demonstrate LEP technologies in the form of spectacles and visors for aircrew and ground personnel to provide protection from lasers while minimizing negative impacts on vision. Complete evaluation of protective performance, visual acuity impacts, life support equipment compatibility, and aircrew acceptability of next-generation LEP, designed to provide acceptable visual performance while protecting against a second laser in the visible spectrum. Develop and demonstrate LEP for air-based laser platforms and for special operations teams. Demonstrate and evaluate LEP with vision corrective prescriptions. Accelerate operational utility evaluations of prescription-capable LEP and include first response capability to 'pop-up' laser threats.

(U) $1,312 Develop and demonstrate agile LEP technologies for aircrew and ground personnel that will provide a single device that can be used by all aircrew for protection against any laser hazard or threat. Continue development and demonstration of LEP with laser hardened night vision goggles. Continue design, development, and evaluation of a Laser Familiarization Program for warfighters toward integration with Distributed

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

Mission Training system. Continue supporting development and evaluation of a Laser Detector and Warning system toward integration into aircraft cockpits and with agile Laser Eye Protection (LEP).

(U) $711 Develop and demonstrate technologies that permit safe testing, deployment, and use of high-energy laser weapons and systems. Begin integration of probabilistic risk assessment technology into laser range hazard assessment tools for use by test ranges with high-energy laser weapon systems, including airborne laser flight tests. Continue to evaluate the biological effects of high-energy laser systems. Conduct damage threshold studies on short pulse (sub-microsecond) high-energy laser pulses. Continue to evaluate the biological effects of non-lethal laser weapons.

(U) $3,451 Design, fabricate, and test a palletized advanced technology demonstrator for on-board production of oxygen and nitrogen for airlift aircraft. Technology will increase the availability of high-purity nitrogen gas for fuel tank inerting; provide high-purity oxygen for aircrew, paratrooper, and patient life support; and reduce aircraft dependency on the costly and extensive deployment footprint of liquid oxygen. Fabricate and test a cryocooler for liquefaction of nitrogen and oxygen from compressed air, and produce a detailed aircraft integration plan for the palletized system.

(U) $2,071 Develop technologies to counter warfighter fatigue, identify and neutralize biological agents, and reduce casualties and attrition in special operations training and operations.

(U) $9,015 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $370 Develop and demonstrate LEP technologies in the form of spectacles and visors for aircrew and ground personnel to provide protection from lasers while minimizing negative impacts on vision. Begin design and development of a laser protective visor compatible with Night Vision Goggles (NVG). Continue demonstration and evaluation of LEP for air-based laser platforms. Evaluate protective performance, visual acuity impacts, equipment compatibility, and user acceptability of LEP for special operations teams. Transition technology for vision corrective prescription LEP, and for wide-band, near-infrared, and two visible laser line protection.

(U) $1,600 Develop and demonstrate agile LEP technologies for aircrew. Begin evaluating and integrating optical limiters, tunable liquid crystals, photochromic and electrochromic materials, reflective technologies, and advanced dyes toward demonstration of agile LEP. Continue development, integration, and evaluation of LEP spectacles with laser hardened NVGs. Continue supporting development and evaluation of a Laser Detector and Warning system toward integration into aircraft cockpits and agile LEP. Continue development and evaluation of a Laser Familiarization Program for warfighters toward integration with Distributed Mission Training system.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
03 - Advanced Technology Development (ATD)	0603231F Crew Systems and Personnel Protection Technology	5020

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

(U)	$876	Develop and demonstrate technologies that permit safe testing, deployment, and use of high-energy laser weapons and systems. Release version 2.0 of Laser Range Safety Tool (LRST) and complete integration with laser test range personnel to permit rapid analysis of high energy laser test operations. Integrate laser bioeffects data to refine laser safety parameters for computer code supporting LRST. Refine software damage models for high-energy laser weapons based on bioeffects studies and field test measurements.
(U)	$2,846	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) PE 0602102F, Materials.
(U) PE 0602202F, Human Effectiveness Applied Research.
(U) PE 0603112F, Advanced Materials for Weapon Systems.
(U) PE 0603319F, Airborne Laser Program.
(U) PE 0604706F, Life Support Systems.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	30,582	23,828	28,496	28,356	26,628	26,372	26,771	27,146	Continuing	TBD
2432	Defensive System Fusion Technology	7,769	7,932	8,086	7,677	5,888	5,368	5,449	5,525	Continuing	TBD
431G	RF Warning & Countermeasures Tech	7,867	5,878	8,047	8,287	8,660	8,727	8,860	8,984	Continuing	TBD
691X	EO/IR Warning & Countermeasures Tech	14,946	10,018	12,363	12,392	12,080	12,277	12,462	12,637	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2003, space unique tasks in this PE, Projects 431G and 691X, transferred to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This program develops and demonstrates technologies to support Air Force electronic combat (EC) requirements. The program focuses on developing components, subsystems, and technologies with potential aerospace combat, special operations, and airlift EC applications in three project areas. The first project develops and demonstrates techniques and technologies for integrating EC sensors and systems into a fused and seamless whole. The second project develops and demonstrates advanced technologies for radio frequency EC suites. The third project develops and demonstrates advanced warning and countermeasure technologies to defeat electro-optical, infrared, and laser threats to aerospace platforms. Note: In FY 2003, Congress added $1.0 million to assess the 'see and avoid' requirement for unmanned aerial vehicles to operate in national airspace.

(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 EC system developments that have military utility and address warfighter needs.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	32,405	23,350	27,773	
(U)	Appropriated Value	32,721	24,350		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-316	-261		
	b. Small Business Innovative Research	-701			
	c. Omnibus or Other Above Threshold Reprogram		-261		
	d. Below Threshold Reprogram	-973			
	e. Rescissions	-149			
(U)	Adjustments to Budget Years Since FY 2003 PBR			723	
(U)	Current Budget Submit/FY 2004 PBR	30,582	23,828	28,496	TBD

(U) Significant Program Changes:
Not Applicable.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

PROJECT: 2432

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
2432	Defensive System Fusion Technology	7,769	7,932	8,086	7,677	5,888	5,368	5,449	5,525	Continuing	

(U) A. Mission Description

This project develops and demonstrates technologies for integrating electronic combat (EC) sensors and EC system fusion. It develops advanced algorithms and assessment techniques needed to evaluate and enable combat aircraft operations in multi-spectral threat and countermeasure environments. It also matures technologies required for command and control (C2) warfare, standoff jamming, and electronic support measures for the denial, disruption, and suppression of adversary air defense operations. Technologies included are: advanced components and techniques needed to jam enemy radars; advanced standoff jammer technologies; and electronic collection methods to inform field commanders of changes in the electronic environment.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,103 Developed and investigated offensive counter information warfare technologies to disrupt and/or deny adversarial C2 nodes and networks. Completed laboratory tests and subsequently demonstrated the advanced electronic attack (EA) techniques to counter modern digital C2 network links. Analyzed and evaluated technical data to determine technique effectiveness. Integrated hardware/software and conducted laboratory tests to evaluate EA techniques to counter adversarial communication and navigation systems. Continued the detailed planning process for ground and flight tests. Developed offensive countermeasures against high-speed, wideband data links for use by multiple ground-based and airborne platforms.

(U) $302 Developed and implemented advanced hardware-in-the-loop threat simulators in the Integrated Demonstrations and Applications Laboratory (IDAL) to conduct evaluations and risk reduction demonstrations of defensive sensors and fusion of multiple information sources for situational awareness. Developed and conducted IDAL risk reduction evaluations and demonstrations that evolve advanced sensor processing technologies for real-time threat situational awareness.

(U) $4,373 Developed affordable radar and radio frequency (RF) emitter warning concepts and techniques. Developed affordable threat alert and jamming technique generator technologies for combat aircraft to increase survivability against advanced, integrated RF, electro-optical, and infrared air defense systems. Performed trade study analyses for techniques to defeat future threat radar guided missile systems. Completed requirements study and transition analysis, began hardware and software development, and held preliminary design reviews for an advanced digital threat warning and response capability.

(U) $991 Continued integrating Coherent Command, Control, Communications, Navigation, and Identification (C3NI) signal simulation capabilities into the IDAL. Upgraded the IDAL's C3NI equipment to the standards required for a joint survivability demonstration.

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT 2432

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

(U)	$7,769	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$3,236	Develop and investigate offensive counter information warfare technologies to disrupt and deny hostile command and control nodes and networks. Complete hardware/software system integration and conduct extensive ground tests to evaluate electronic attack and electronic support measures techniques to counter adversarial communication and navigation systems. Continue detailed planning for the flight tests. Investigate and analyze various computer networks for selection of the most viable threat. Design effective countermeasure techniques against selected high-speed, wideband data link targets.
(U)	$2,398	Integrate advanced sensor receiver and processing technologies. Conduct risk reduction evaluations and demonstrations in the Integrated Demonstrations and Applications Laboratory (IDAL) that focus these technologies on mission applications. Conduct IDAL risk reduction evaluations and demonstrations to evolve advanced sensor threat identification and location algorithms for real-time threat situational awareness.
(U)	$2,298	Develop affordable radar and radio frequency (RF) emitter warning concepts and techniques. Develop affordable threat alert and jamming techniques generator technologies for combat aircraft to increase survivability against advanced, integrated RF, electro-optical, and infrared air defense systems, including trade study analyses for techniques to defeat future threat radar-guided missile systems. Continue hardware and software development through subsystem tests and early system integration for an advanced digital threat warning and response capability.
(U)	$7,932	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$3,463	Continue developing and investigating offensive counter information warfare technologies to disrupt and/or deny adversarial command and control nodes and networks. Finalize the detailed flight test plan, based on the results of the exhaustive ground tests. Flight test the Electronic Attack/Electronic Support (EA/ES) countermeasures system to counter adversary communication and navigation systems. Document system design and ground/flight test results in a final report. Design hardware and software for the EA/ES system to counter high-speed, wideband data/communication links utilized by multiple ground-based and airborne platforms. Fabricate hardware to process and attack the threat network.
(U)	$1,805	Conduct evaluations and risk reduction demonstrations of defensive sensors and the fusion of multiple information sources for situational awareness in the IDAL. Conduct IDAL laboratory risk reduction evaluations and demonstrations which evolve and optimize sensor fusion algorithms. These sensor fusion algorithms would provide real-time threat situational awareness for U.S. and coalition tactical platforms.

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

(U)	$2,818	Continue developing affordable radar and radio frequency (RF) emitter warning concepts and techniques. Continue developing affordable threat alert and jamming techniques generator technologies for combat aircraft to increase survivability against advanced, integrated RF, electro-optical, and infrared air defense systems, including trade study analyses for techniques to defeat future threat radar guided missile systems. Complete system integration, tests, and laboratory demonstrations for an advanced digital threat warning and response capability.
(U)	$8,086	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602204F, Aerospace Sensors.
(U) PE 0603203F, Advanced Aerospace Sensors.
(U) PE 0603500F, Multi-disciplinary Advanced Space Technology.
(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

PROJECT: 431G

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
431G RF Warning & Countermeasures Tech	7,867	5,878	8,047	8,287	8,660	8,727	8,860	8,984	Continuing	

Note: In FY 2003, space unique tasks in this project transferred to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This project develops and demonstrates advanced technologies for radio frequency (RF) electronic combat (EC) suites to enhance the survivability of aerospace vehicles and to provide crew situational awareness. One major area addresses technologies for missile/threat warning, RF 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 electronic countermeasures (ECM) techniques as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,252	Developed advanced tactical targeting technology in conjunction with the Defense Advanced Research Projects Agency for Suppression of Enemy Air Defenses (SEAD). Integrated and flight-tested brassboard units that triangulate threat emitter positions and provide targeting for precision-guided munitions.
(U)	$779	Developed wideband, multi-mode, multi-function apertures for electronic warfare applications (i.e., threat detection, threat avoidance, SEAD, surveillance, and reconnaissance). Fabricated and laboratory tested low-cost adaptive wideband conformal aperture sub-arrays consisting of structurally integrated, multiple polarization elements.
(U)	$5,836	Studied and initiated developing aerospace platform self-protection and support jamming technologies to counter advanced RF threats associated with current and future aerospace weapon systems. Conducted field evaluation of an advanced monopulse ECM brassboard system. Developed and tested ECM techniques for aircraft against future RF threat systems. Optimized, laboratory tested, and field tested electronic protection breadboard that will shield advanced radar systems against electronic attacks.
(U)	$7,867	Total

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603270F Electronic Combat Technology / PROJECT: 431G

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,903	Develop wideband, multi-mode, multi-function apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Demonstrate proof-of-concept for cost and weight reduction for adaptive, wideband conformal phased arrays that are integrated into potential unmanned aerospace platforms. These subarrays will have multiple polarization elements and perform over an extremely wide frequency range with an instantaneous bandwidth of between 4:1 to 10:1.
(U)	$3,975	Complete study and continue developing and demonstrating aerospace platform self-protection and support jamming technologies and techniques to counter advanced radio frequency (RF) threats associated with current and future aerospace weapon systems. Initiate developing next generation monopulse countermeasure systems. Continue developing and evaluating innovative RF countermeasure techniques for aerospace platforms against future RF threat systems. Continue developing and performing laboratory and field tests of advanced electronic protection techniques and technology to protect our aerospace radar systems.
(U)	$5,878	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,091	Continue developing wideband, multi-mode, multi-function apertures for electronic warfare applications (i.e., threat detection, threat avoidance, suppression of enemy air defenses, surveillance, and reconnaissance). Fully characterize adaptive, wideband, conformal phased arrays that have been structurally integrated into future unmanned aerial vehicle aperture and receiver concepts to assess technology readiness levels. These subarrays will have multiple polarization elements and will perform over the ultra-high frequency through Ku band with instantaneous bandwidths of 4:1 to 10:1.
(U)	$5,956	Continue developing and evaluating aerospace platform self-protection and support jamming technologies and techniques to counter advanced RF threats associated with current and future aerospace weapon systems. Continue developing, and initiate testing of, next generation monopulse countermeasure systems for Air Force aerospace platforms. Perform laboratory testing of innovative RF countermeasure techniques for aerospace platforms against future RF threat systems. Continue developing innovative electronic protection techniques in advanced radar systems. Laboratory and field test these techniques.
(U)	$8,047	Total

(U) B. Project Change Summary

Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603270F Electronic Combat Technology
	PROJECT: 431G

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

(U) Related Activities:

(U) PE 0602204F, Aerospace Sensors.

(U) PE 0604270F, Electronic Warfare (EW) Development.

(U) PE 0603500F, Multi-disciplinary Advanced Space Technology.

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603270F Electronic Combat Technology

PROJECT: 691X

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
691X EO/IR Warning & Countermeasures Tech	14,946	10,018	12,363	12,392	12,080	12,277	12,462	12,637	Continuing	

Note: In FY 2003, space unique tasks in this project transferred to PE 0603500F, Project 5034, in conjunction with the Space Commission recommendation to consolidate all space unique tasks.

(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 threats to aerospace platforms. Off-board (decoys and expendables) and on-board countermeasure technologies developed for aircraft self-protection will provide robust, affordable solutions for protection against IR missiles with autonomous seekers, multi-spectral threats, laser-guided weapons, and EO and IR tracking systems used to direct EO, IR, and radar-guided missiles.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $8,796 Developed on-board, closed-loop, laser infrared countermeasures (IRCM) for large aircraft to defeat current and future IR-guided missiles in multiple scenarios. Integrated and flight-tested closed-loop IRCM technology on large aircraft.

(U) $1,056 Conducted in-house analyses of current and future IR-guided threat missiles. Completed evaluation of novel expendable countermeasure design concepts and dispense patterns to defeat conventional IR-guided and imaging anti-aircraft IR missiles. Initiated development of expendable decoy technology suitable for peacekeeping operations which can be safely deployed at low altitudes over urban areas.

(U) $1,523 Developed aerospace laser warning sensor technologies for timely alert to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals. Continued developing laser warning sensor technology for space situational awareness. Completed design of radiometer module and initiated designing geolocation and spectrometer modules. Tested and evaluated laser warning sensor components for aircrew protection. Designed laser warning sensor to provide cueing for eye/sensor protection on airborne platforms.

(U) $1,735 Developed EO and IR missile warning technologies to alert aircrews and aircraft self-protection systems to the approach of advanced, low-signature threats. Initiated developing multi-color warning technologies that improve threat detection and reduce declaration times in heavy clutter environments.

(U) $1,836 Developed countermeasure technology to defeat passive EO/IR aircraft tracking sensors and ordnance guidance. Continued evaluating detection techniques for locating, identifying, and countering conventional and advanced EO/IR tracking sensors. Field tested the most promising techniques on a 2km range.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT 691X

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

(U)	$14,946	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$320	Develop on-board, closed-loop, laser infrared countermeasures (IRCM) for large aircraft to defeat current and future IR-guided missiles in multiple scenarios. Complete flight tests of closed-loop IRCM technology on large aircraft.
(U)	$1,577	Conduct in-house analyses of the vulnerabilities of current infrared (IR) missile systems and future imaging IR sensors. Fabricate an expendable decoy technology suitable for peacekeeping operations that can be safely deployed at low altitudes over urban areas. Acquire and assess capabilities and vulnerabilities of imaging IR sensors used for target acquisition.
(U)	$2,922	Develop aerospace laser warning sensor technologies for timely alert to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals. Initiate design of an airborne laser warning sensor which can cue agile filter protection for aircrew or sensor protection.
(U)	$4,257	Develop a countermeasure technology to defeat passive electro-optical (EO) and IR aircraft tracking sensors and ordnance guidance. Initiate an advanced technology demonstration program to detect and counter passive EO and IR tracking sensors. Complete preliminary design for a method to counter sensors beyond kinematic launch capability.
(U)	$942	Develop, demonstrate, and implement an interim 'see and avoid' system for unmanned aerial vehicles that meets with Federal Aviation Administration approval to do limited flying in national airspace without a chase aircraft.
(U)	$10,018	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,282	Continue conducting in-house analyses on vulnerabilities of current and future IR imaging sensors and missiles. Demonstrate and evaluate countermeasure techniques for countering multiple types of imaging IR sensors used for target acquisition. Initiate developing low-cost, cooperative techniques to counter imaging sensors.
(U)	$4,348	Continue developing aerospace laser warning sensor technologies for timely alert to advanced laser acquisition and tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals. Complete design of an airborne laser warning sensor which can cue agile filter protection for aircrew or sensor protection. Conduct laboratory demonstration of cueing capabilities. Test and demonstrate a multi-platform sensor capable of identifying and classifying battlefield lasers that are dangerous to eyes and sensors.
(U)	$1,110	Develop EO/IR missile warning technologies to alert aircrews and aircraft self-protection systems to the approach of advanced, low-signature

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology
PROJECT 691X	

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

threats. Establish spatial, spectral, and temporal trade space for advanced missile warning sensors optimized for detecting low contrast missile threats in high clutter backgrounds. Perform airborne experiments to quantify expected performance.

(U) $4,623 Continue developing countermeasure technology to defeat passive electro-optical/infrared aircraft tracking sensors and ordnance guidance. Finalize designing a system that can locate and counter passive threats beyond kinematic launch boundaries. Complete assessment of multiple threats and threat surrogates. Begin developing a laboratory testbed.

(U) $12,363 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602204F, Aerospace Sensors.
(U) PE 0604270F, Electronic Warfare (EW) Development.
(U) PE 0603500F, Multi-disciplinary Advanced Development Space Technology.
(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603311F Ballistic Missile Technology

PROJECT: 4091

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4091	Missile Electronics	1,146	13,159	0	0	0	0	0	0	0	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 1997, the Air Force eliminated this program. However, Congress added funds for Missile Technology Demonstration flight testing and Radiation-Hardened Electronics in FY 1998, for Ballistic Missile Technology and Range Safety in FY 1999, for Ballistic Missile Technology in FYs 2000 and 2001, for Global Positioning System Range Safety in 2002, and for Advanced Guidance Technologies for Ballistic Missiles and Range Safety Instrumentation and Common Guidance Development Program of Sensor Technologies in FY 2003.

(U) A. Mission Description

This program develops, integrates, and demonstrates advanced guidance, navigation, and control technologies for ballistic missiles, including upgrades of instrumentation for range safety instrumentation. Note: In FY 2003, Congress added $11.8 million for Advanced Guidance Technologies for Ballistic Missiles and Range Safety Instrumentation and $1.5 million for Common Guidance Development Program of Sensor Technologies.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $948 Developed technologies for the integration of advanced Global Position System-Inertial Navigation System (GPS-INS) technologies into space and missile range instrumentation and missile guidance systems to meet more stringent range safety requirements. Developed and demonstrated robust technologies for the command and control system providing non-interfering, continuous, two-way missile communication under all flight conditions.

(U) $124 Extended the acceptance and certification of qualified GPS-INS range safety technologies to meet launch-range requirements in more locations and encompassing more severe launch conditions.

(U) $74 Continued plasma technology development efforts to mitigate GPS communication loss through the reentry blackout phase of flight.

(U) $1,146 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $10,189 Develop, integrate, and demonstrate advanced guidance technologies applied to emerging designs that sustain current strategic missile systems. Develop new accelerometer technologies with the associated radiation hardenable electronics and flight computers required for future strategic missile applications. Develop, validate, and certify advanced, mobile range safety instrumentation extending prompt missile launch capabilities

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603311F Ballistic Missile Technology / PROJECT: 4091

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

to existing and future range sensors.

(U) $1,485 Develop advanced vehicle structures and designs for improved ballistic missile guidance and control. Develop and demonstrate sustainable technologies and material sources capable of reducing vehicle cost while increasing robustness, maintainability, and controllability to meet the unique requirements of the advanced ballistic missile mission.

(U) $1,485 Develop advanced sensor technologies that are accurate and robust enough to provide the next generation of guidance instrumentation required for a broad range of future ballistic missiles. Identify the critical technical elements and component technologies needed to meet accuracy requirements, to extend range, to reduce maintenance costs, and to lengthen mean time between failures.

(U) $13,159 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 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.

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	1,188	0	0	
(U)	Appropriated Value	1,200	13,300		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-12	-141		
	b. Small Business Innovative Research	-37			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram				
	e. Rescissions	-5			
(U)	Adjustments to Budget Years Since FY 2003 PBR	0	0	0	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603311F Ballistic Missile Technology	PROJECT: 4091

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

	FY 2002	FY 2003	FY 2004	Total Cost
(U) Current Budget Submit/FY 2004 PBR	1,146	13,159	0	TBD

(U) Significant Program Changes:

In FY 1997, the Air Force eliminated this program. However, Congress added funds for Missile Technology Demonstration flight testing and Radiation-Hardened Electronics in FY 1998, for Ballistic Missile Technology and Range Safety in FY 1999, for Ballistic Missile Technology in FYs 2000 and 2001, for Global Positioning System Range Safety in 2002, and for Advanced Guidance Technologies for Ballistic Missiles and Range Safety Instrumentation and Common Guidance Development Program of Sensor Technologies in FY 2003.

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

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603333F Unmanned Air Vehicle Dev/Demo

PROJECT: 5067

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5067	Unmanned Combat Air Vehicle Tech Demo	18,903	17,608	0	0	0	0	0	0	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 2002, ongoing Air Force technical efforts related to the Joint Air Force/Defense Advanced Research Projects Agency Unmanned Combat Air Vehicle (UCAV) program have been consolidated into this PE per Congressional direction. Only the UCAV portions of the following PEs and Projects have been transferred into this PE: PE 0602202F, Project 7184; PE 0603203F, Project 665A; PE 0603211F, Project 4920; PE 0603601F, Project 670A; and PE 0603789F, Project 4072.

(U) A. Mission Description

This program will develop, demonstrate, and transition advanced unarmed, unmanned aerial vehicle (UAV) and unmanned combat air vehicle (UCAV) technologies. Flight testing to demonstrate integration of critical technologies, such as autonomous operations, inter-vehicle communications, and multi-vehicle flight operations, will improve the performance and supportability of UAVs and UCAVs.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $10,509 Developed and integrated critical technologies that provide for autonomous operations, inter-vehicle communications, and multi-vehicle flight operations. Obtained test vehicles, flight control software, and ground control station equipment in order to conduct end-to-end ground and flight demonstrations of the mission utility of the UCAV.

(U) $1,684 Completed the development of advanced fusion technology to evaluate the capability of UCAVs to operate in a Command, Control, Communication, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) data-rich environment as part of an integrated Command, Control, and Communications (C3) network. Demonstrated, through flight test, the concept of single distributed control by performing a hand off between a friendly area of operations controller and the area of responsibility controller (i.e., two different ground stations). Demonstrated, through flight test, the software elements for both the air vehicle and the Mission Control Station required for the dynamic command and control of multiple vehicles by one controller.

(U) $1,771 Continued the development and demonstration of technologies to support an affordable UCAV unit recurring flyaway goal in a C4ISR data-rich environment as part of an integrated C3 network. Demonstrated multi-vehicle flight operations, including escort formations, collision avoidance, auto routing, and dynamic re-tasking among others. Demonstrated multiple re-planned weapons drops.

(U) $2,396 Continued to develop and demonstrate both electro-optical and radio frequency technologies for both advanced technologies and complete sensor capabilities on the UCAV.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603333F Unmanned Air Vehicle Dev/Demo
PROJECT 5067	

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

(U)	$1,302	Continued human systems technology support by demonstrating remote operator control/interface that can extend the capability to effectively and affordably perform the 21st century missions of defense suppression and tactical attack.
(U)	$1,241	Continued to integrate miniature munition concepts with the unmanned combat air vehicle (UCAV), as well as support integration and planning of a UCAV flight test.
(U)	$18,903	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$10,869	Complete development and integration of critical technologies that provide for autonomous operations, inter-vehicle communications, and multi-vehicle flight operation. Complete an end-to-end demonstration of the mission utility of the UCAV.
(U)	$2,699	Complete the development and demonstration of technologies to support an affordable UCAV unit recurring flyaway goal in a Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) data-rich environment as part of an integrated Command, Control, and Communication network. Demonstrate multi-vehicle flight operations, including escort formations, collision avoidance, auto routing, and dynamic re-tasking among others. Demonstrate multiple re-planned weapons drops.
(U)	$1,897	Complete development and demonstration of both electro-optical and radio frequency technologies for both advanced technologies on the UCAV.
(U)	$1,095	Complete human systems technology support by demonstrating remote operator control/interface that can extend the capability to effectively and affordably perform the 21st century missions of defense suppression and tactical attack.
(U)	$1,048	Complete integration of miniature munition concepts with UCAV and complete UCAV flight test with miniature munition concepts.
(U)	$17,608	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$0	No Activity
(U)	$0	Total

(U) B. Budget Activity Justification

This program is in Budget Activity 3, Advanced Development, since it develops and demonstrates technologies for new unarmed, unmanned aerial vehicles and UCAVs that have C4ISR capabilities and address warfighter needs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603333F Unmanned Air Vehicle Dev/Demo	PROJECT: 5067

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	20,952	18,000	0	
(U)	Appropriated Value	21,100	18,000		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-148	-190		
	b. Small Business Innovative Research				
	c. Omnibus or Other Above Threshold Reprogram		-202		
	d. Below Threshold Reprogram				
	e. Rescissions	-2,049			
(U)	Adjustments to Budget Years Since FY 2003 PBR			0	
(U)	Current Budget Submit/FY 2004 PBR	18,903	17,608	0	TBD

(U) Significant Program Changes:
In FY 2004, this effort transfers into PE 0604731F, Unmanned Combat Air Vehicle.

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

(U) PE 0602202F, Human Effectiveness.
(U) PE 0602201F, Aerospace Vehicle Technologies.
(U) PE 0603203F, Advanced Aerospace Sensors.
(U) PE 0603601F, Conventional Weapons.
(U) PE 0603789F, C3I Advanced Development.
(U) PE 0604731F, Unmanned Combat Air Vehicle.
(U) PE 0602702E, Tactical Technology.
(U) PE 0603285E, Advanced Aerospace Systems.
(U) PE 0603762E, Sensor and Guidance 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

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603333F Unmanned Air Vehicle Dev/Demo — PROJECT: 5067

(U) F. Schedule Profile Continued

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	57,450	54,884	72,114	60,282	66,072	72,232	88,288	90,806	Continuing	TBD
2181	Spacecraft Payloads	15,964	14,931	19,970	16,109	16,248	18,484	35,169	35,314	Continuing	TBD
3834	Integrated Space Technology Demonstrations	22,823	14,947	20,511	18,633	25,125	27,516	26,543	26,675	Continuing	TBD
4400	Space Systems Protection	5,661	2,732	6,013	3,482	3,515	3,577	3,632	3,682	Continuing	TBD
4938	Space Developmental Planning	4,980	0	0	0	0	0	0	0	0	TBD
5021	Space Systems Survivability	0	3,936	4,171	4,788	4,867	4,992	5,068	5,139	Continuing	TBD
5083	Ballistic Missiles Technology	0	0	6,860	6,877	5,831	4,077	4,139	4,197	Continuing	TBD
682J	Spacecraft Vehicles	8,022	18,338	14,589	10,393	10,486	13,586	13,737	15,799	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2002, efforts were transferred from PE 0603410F, Space Systems Environmental Interactions Technology, into Project 4400 in this PE, in order to align projects within the Air Force Research Laboratory organization. In FY 2003, selected efforts in Project 4400, were transferred within this PE into Project 5021, in order to focus on improving survivability of space systems in natural environments. In FY 2004 and out, the guidance and control efforts in Project 5083 are put in this PE in order to align projects within the Air Force Research Laboratory organization.

(U) A. Mission Description

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft and launch vehicles, ballistic missiles, space systems survivability, and development of advanced laser communications technologies to support next generation satellite communication systems. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. Note: In FY 2003, Congress added $13.7 million ($1.2 million for Capacitively Coupled Interconnect, $1.0 million for Next Generation Hybrid Orbital Maneuver Vehicle, $1.0 million for Integrated Spacecraft

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

(U) A. Mission Description Continued

Engineering Tool, $1.0 for Streaker Small Launch Vehicle, $7.0 million of Thin Amorphous Solar Arrays, and $2.5 million for Robust Aerospace Composite Materials/Structures).

(U) B. Budget Activity Justification

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

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	60,932	42,315	53,323	
(U)	Appropriated Value	61,528	56,015		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-596	-658		
	b. Small Business Innovative Research	-1,259			
	c. Omnibus or Other Above Threshold Reprogram		-473		
	d. Below Threshold Reprogram	-1,940			
	e. Rescissions	-283			
(U)	Adjustments to Budget Years Since FY 2003 PBR		0	18,791	
(U)	Current Budget Submit/FY 2004 PBR	57,450	54,884	72,114	TBD

(U) Significant Program Changes:

Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology program.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 2181

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
2181	Spacecraft Payloads	15,964	14,931	19,970	16,109	16,248	18,484	35,169	35,314	Continuing	TBD

(U) A. Mission Description

This project funds the development, demonstration, and evaluation of radiation-hardened space electronic hardware, satellite control hardware and software for advanced satellite surveillance operations, and development of advanced laser communications technologies to support next generation satellite communications systems. Improved space-qualifiable electronics and software for data and signal processing will be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (i.e., radiation-hardening) commercial data and signal processor technologies for use in Air Force space systems. For mid-term applications, the Improved Space Computer Program 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 Department of Defense satellites. In the long-term, this project area focuses on developing low-cost, easily modifiable software and hardware architectures for fully autonomous constellations of intelligent satellites capable of performing all mission related functions without operator intervention.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $9,740 Developed spacecraft microelectronic devices that will include radiation-hardened data processors and ultra-high density strategically hardened memories, space-qualifiable, high density advanced packaging technology, and micro-electro-mechanical systems components and applications. These devices and technologies enable next generation high performance, small, lightweight, efficient, and reliable on-board space electronic systems. Designed advanced general purpose embedded processors capable of performing at 500 million instructions per second. Designed digital signal processors capable of performing at 1 billion operations per second. Performed full-scale integration of chalcogenide programmable memory elements into high density, low power chips. Investigated integration of chalcogenide into other component applications. Extended fabrication capability for application specific integrated circuit technology for up to eight million gate devices. Developed and demonstrated a micro-electro-mechanical systems switch box that will use discrete components with non-radiation-hardened control circuitry. Investigated the miniaturization of optical cross-links for advanced packaging applications.

(U) $1,626 Continued to develop intelligent satellite system technologies for satellite control, precision navigation, formation flying, and cluster management technologies for spacecraft constellations. These intelligent satellite systems provide improved capabilities to monitor satellites in real-time, reduce the time required for data collection, processing, and dissemination, and decrease anomaly resolution time and ground operations requirements. Developed flight-ready microsatellite cluster management software. Completed and demonstrated flight-ready microsatellite flying algorithms and initiated development of command and control and navigational capability to perform high-fidelity

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology
PROJECT 2181	

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

spacecraft proximity operations. Developed a virtual cluster control ground station capable of commanding and controlling multiple satellite clusters. Initiated development of automated planning and scheduling software and integration of distributed payload processing algorithms with the flight software. Developed a spacecraft and simulation data archiving and storage system.

(U) $803 Continued to develop modeling, simulation, and analysis (MS&A) tools and data exploitation methodologies for space-based surveillance systems and distributed satellite architecture payloads. The MS&A tools provide data and validate research and development systems engineering level technology trade off decisions for space-based surveillance missions/campaign level assessments and for intelligent satellite systems testbeds. Built models for sparse, distributed aperture radio frequency (RF) system simulation to support technology trades, systems engineering, and design reviews for near-term flight test experiments. Built models of sparse aperture RF distributed signal processing to be validated against flight experiment and for systems analysis.

(U) $2,364 Developed advanced space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot targets, as well 'cold body' targets such as decoys, satellites, and midcourse warheads. Fabricated and delivered low temperature multi-color and low background detectors and focal plane arrays, and higher temperature arrays with improved radiation hardness. Continued iterative development of longer wavelength mercury cadmium telluride focal plane arrays, higher operating temperature mid-wavelength infrared focal plane arrays, and focal plane arrays with optimal background-limited performance for stressing space backgrounds.

(U) $1,431 Developed satellite antenna technologies that maximize the use of high density interconnects, embedded the electronics directly onto the antenna itself, and used antenna modules to create large, lightweight space antennas. Satellite antenna technologies will be used to improve the affordability and capability of antenna modules for space-based payload subsystems for surveillance and navigation efforts. Fabricated selected embedded-structural transmit-receive electronics antenna modules. Designed antenna modules that address requirements for minimizing mass and power by embedding lightweight electronics in the structure. Completed fabrication of modular phased-array antenna tiles. Integrated tiles into modules for performance characterization.

(U) $15,964 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $8,281 Develop spacecraft microelectronic devices, including radiation-hardened data processors and ultra-high density strategically hardened memories, space-qualifiable, high density advanced packaging technology, and micro-electro-mechanical systems components and applications. Perform simulations and validate designs of a general purpose embedded processor at 500 million instructions per second and digital signal processors at 1 billion operations per second. Fabricate and characterize high density, low power chips comprised of innovative chalcogenide

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 2181

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

programmable memory elements. Begin integration of chalcogenide into components such as field programmable logic and analog microelectronics. Develop macrocell libraries for application specific integrated circuit technology for up to eight million gate devices. Develop and demonstrate a micro-electro-mechanical based switch box multi-chip module and associated heuristics for multi-switch box applications to smart-wiring manifolds.

(U) $1,756 Continue to develop intelligent satellite system technologies for satellite control, precision navigation, formation flying, and cluster management technologies for spacecraft constellations. Continue to develop microsatellite cluster management software for a flight demonstration of collaborating three microsatellite constellation. Continue development of command and control and navigational capability for high fidelity spacecraft proximity operations. Continue developing automated planning and scheduling software for multiple satellite clusters and the spacecraft and simulation data archiving and storage system. Begin development of guidance, navigation, and control algorithms for a tethered power generation system.

(U) $908 Continue to develop modeling, simulation, and analysis tools and data exploitation methodologies for space-based surveillance systems and distributed satellite architecture payloads. Continue to develop models for sparse, distributed aperture radio frequency (RF) system simulation to support technology trades, systems engineering, and design reviews for near-term flight test experiments. Continue to develop models of sparse aperture RF distributed signal processing to be validated against flight experiment and for systems analysis. Begin building mission operations center to support the collaborating three microsatellite constellation flight experiment.

(U) $482 Develop advanced space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot targets, as well 'cold body' targets such as decoys, satellites, and midcourse warheads. Demonstrate and characterize low temperature multi-color and low background detectors and focal plane arrays, and higher temperature arrays with improved radiation hardness. Fabricate and deliver longer wavelength mercury cadmium telluride focal plane arrays, higher operating temperature mid-wavelength infrared focal plane arrays, and focal plane arrays with optimal background-limited performance for stressing space backgrounds. Transition multi-color quantum well photodetector designs and other promising infrared technologies to large focal plane arrays.

(U) $2,317 Develop satellite antenna technologies which maximize the use of high density interconnects, embed the electronics directly onto the antenna itself, and use antenna modules to create large, lightweight space antennas. Test and integrate selected embedded-structural transmit-receive electronics antenna modules for future multi-microsatellite constellation space flight experiment. Test, integrate, and evaluate multi-beam, wide-bandwidth transmit-receive electronics antenna modules with payloads for possible airborne, multi-mode flight experiment. Fabricate and test antenna modules which address requirements for minimizing mass and power by embedding lightweight electronics in the structure.

(U) $1,187 Develop integrated circuit interconnection technology based on non-conductive approaches. The new approach will provide denser and more powerful computation capabilities, increased bandwidth within and between electronic systems, and improved flexibility and increased

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 2181

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

reliability. Investigate theoretical basis of capacitively coupled interconnects and assess their performance against traditional approaches. Formulate and conduct feasibility proof of principle based on findings.

(U) $14,931 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $8,445 Develop spacecraft microelectronic devices, including radiation-hardened data processors and ultra-high density strategically hardened memories, space-qualifiable, high density advanced packaging technology, and micro-electro-mechanical systems (MEMS) components and applications. Demonstrate functional elements for general-purpose processor at 500 million instructions per second and digital signal processors at 1 billion operations per second. Develop architectures and design electronics circuits in support of adaptable, self-repairing processors and memories. Demonstrate functional elements of chalcogenide-based field programmable logic and analog microelectronics. Continue to develop hardened by design primitive cell libraries enabling the use of state-of-the-art commercial manufacturing plants for high performance, low-cost electronics. Build MEMS and chalcogenide-based switches supporting multi-switch box applications to smart-wiring manifolds.

(U) $2,827 Continue to develop intelligent satellite system technologies for responsive spacecraft operations, and for satellite control, precision navigation, formation flying, and cluster management technologies for spacecraft constellations. Complete and deliver microsatellite cluster management software and integrate into the distributed architecture test bed in preparation for a flight demonstration of collaborating three microsatellite constellation. Continue development of command and control and navigational capability for high fidelity spacecraft proximity operations with application to counterspace operations. Complete development of automated planning and scheduling software for multiple satellite clusters and the spacecraft and simulation data archiving and storage system. Continue development of guidance, navigation, and control algorithms for a tethered power generation system. Begin command and telemetry simulation development for cluster management and mission operations center testing.

(U) $973 Continue to develop modeling, simulation, and analysis tools and data exploitation methodologies for space-based surveillance systems and distributed satellite architecture payloads. Continue to develop models for sparse, distributed aperture radio frequency system simulation to support systems engineering and hardware integration and testing for near-term flight test experiments. Continue to develop models of sparse aperture radio frequency distributed signal processing to be validated against flight experiment. Complete mission operations center to support the collaborating three microsatellite constellation flight experiment.

(U) $3,285 Develop advanced space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot targets, as well 'cold body' targets such as decoys, satellites, and midcourse warheads. Accept delivery, for government characterization, higher

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

		operating temperature, mid-wave infrared focal plane arrays (FPA). Complete fabrication and characterize higher operating temperature, mid-wave infrared FPAs. Complete fabrication and characterize first-ever dual band (mid-wave, long-wave) FPAs having an extended long-wave infrared response. Initiate radiation hardness by design development for long wavelength infrared FPAs for space-based passive surveillance applications. Begin investigation of detector interfacing concepts for larger-format, higher capability space hyperspectral imaging systems.
(U)	$1,442	Develop and demonstrate satellite antenna technologies that exploit advanced electronic integration, high density interconnects/packaging and advanced phased array component technologies to create large, lightweight space antennas. Deliver flight-ready multi-beam, wide-bandwidth antenna modules for airborne multi-mode flight experiment. Redesign baseline tile using advanced substrate material to reduce antenna module weight by 25%. Develop and demonstrate 10 milliwatt advanced low power, octave-wide bandwidth, low noise amplifier. Apply Application Specific Integrated Circuit technology to achieve a higher level of integration for the transmit-receive cells, reducing discrete components by 25%. Redesign antenna tile architecture to incorporate next generation miniaturized phased array components to support eight simultaneous beams. Design multi-decade-bandwidth antenna architecture.
(U)	$999	Develop technologies for multi-access laser communications space terminals with reduced weight, power and cost for Transformational Communications Systems. Investigate component integration issues and identify technical challenges for space qualification/flight test of a multi-access laser communications system. Begin designs of space flight system experiment.
(U)	$1,999	Develop satellite payload subsystem technologies to exhibit revolutionary capabilities in operability, responsiveness, and cost-effectiveness. These enabling technologies include on-the-fly programmable, configurable logic and modular, reusable, self-initializing software, as well as technologies that enable rapid satellite integration and minimum time on-orbit satellite checkout.
(U)	$19,970	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0303601F, MILSTAR Satellite Communications System.
(U) PE 0305160F, Defense Meteorological Satellite Program (DMSP).
(U) PE 0602601F, Spacecraft Technology.
(U) PE 0603311F, Ballistic Missile Technology.

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

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 3834

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
3834	Integrated Space Technology Demonstrations	22,823	14,947	20,511	18,633	25,125	27,516	26,543	26,675	Continuing	TBD

(U) A. Mission Description

This project is a series of advanced technology demonstrations designed to address mission needs by applying emerging technologies from the Air Force Research Laboratory, other Government laboratories, and industry. These technologies are integrated into system-level demonstrations that are used to test, evaluate, and validate the technologies in an operational environment.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$551	Completed the Warfighter-1 technology demonstration effort, which was intended to provide an inexpensive space-based hyperspectral imagery system for user validation in a tactical environment. Completed final reports, detailing and evaluating lessons learned from the Warfighter-1 development and commercial leveraging efforts.
(U)	$1,493	Developed autonomous microsatellite (10-100kg) technologies for an integrated, robust, flexible, modular microsatellite technology concept. Developed microsatellite technologies for non-cooperative, autonomous operational concept and mission planning tools.
(U)	$9,973	Designed, developed, integrated, and tested an autonomous microsatellite to demonstrate integrated technology concepts for operations around a non-cooperative, resident space object. Performed design reviews and began component/hardware fabrication for an autonomous operations microsatellite. Developed plans for launch vehicle integration and safety analysis.
(U)	$4,066	Developed microsatellite system test scenarios and designed microsatellite hardware-in-the-loop, software simulations, and mission planning/training tools.
(U)	$5,776	Developed scalable booster technologies and a flight vehicle demonstrator for low-cost launch vehicles. Developed the detailed design and fabricated long-lead components for the SR-XM-2 suborbital flight vehicle. Performed post injector design modification developmental test firings and engine qualification firings for the 20,000 lb. thrust flight-weight ablative booster engine for the SR-XM-2.
(U)	$964	Developed technologies for a small, hybrid propulsion module capable of transferring selected Space Shuttle payloads to higher operational orbits after deployment. This orbital maneuvering capability will reduce both launch cost and risk, while enabling payloads to reach optimal orbit. Developed a conceptual design for the propulsion module that meets National Aeronautics and Space Administration safety and performance requirements. Designed, fabricated, and ground-tested critical, high-risk propulsion module components, evaluating both performance and safety aspects.
(U)	$22,823	Total

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology / PROJECT: 3834

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,829	Develop autonomous microsatellite (10-100kg) technologies for an integrated, robust, flexible, modular microsatellite technology concept. Perform mission operations concept trades using hardware-/software-in-the-loop simulations and mission planning tools for non-cooperative proximity operations.
(U)	$8,699	Design, develop, integrate, and test autonomous microsatellite to demonstrate integrated technology concepts for operations around a non-cooperative resident space object (RSO). Complete component development and begin system level integration, functional, and environmental test activities in preparation for launch and operations. Perform final launch vehicle safety analysis and ground test and evaluation.
(U)	$1,452	Use microsatellite hardware-in-the-loop and software simulations to perform comprehensive ground testing of the autonomous micro-satellite around a non-cooperative RSO.
(U)	$989	Develop technologies for a small, hybrid propulsion module capable of transferring selected Space Shuttle payloads to higher operational orbits after deployment. Integrate and ground test fire a propulsion module. Test information will be used to assess whether the hybrid technology meets the relevant orbital transfer and Space Shuttle safety requirements.
(U)	$989	Develop an integrated engineering, modeling, simulation, and design tool to support rapid prototyping and collaborative Research, Development, Test, and Evaluation of advanced spacecraft and launch vehicles. This tool will enable quick turnaround, advanced space mission analyses that incorporate future military space requirements to determine the impact on system performance and capabilities. Integrate government and commercial design, analysis, and optimization software into a combined systems analysis and design tool set that advances the capability to predict performance benefits and impacts for new technologies on space and launch vehicle systems.
(U)	$989	Develop technologies for small launch vehicles for rapid and affordable deployment of small satellite and Common Aero Vehicle payloads. Conduct trade studies to define a responsive, simple, cost-effective small launch vehicle. Define preliminary system design requirements and develop a mission model, a system concept, and mission and life cycle cost estimates for a small launch vehicle to place military payloads (200 - 2000 lb.) into Low Earth Orbit.
(U)	$14,947	Total

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$3,077	Develop autonomous microsatellite (10-100kg) technologies for an integrated, robust, flexible, modular microsatellite technology concept. Develop and test a laser range finder subsystem. Develop and test the ground control system for real-time planning and flight operations of proximity operations microsatellite. Test autonomous operations software against simulated faults and anomalies.
(U)	$14,357	Design, develop, integrate, and test autonomous microsatellite to demonstrate integrated technology concepts for operations around a non-cooperative resident space object. Compete system level integration of microsatellite, complete functional and environmental tests. Integrate microsatellite with launch system and perform functional and environmental tests. Begin integration with launch vehicle.
(U)	$3,077	Integrate ground control system and satellite software simulations. Perform simulated proximity operations missions for mission operations training and for determination of the simulated spacecraft performance and interaction with ground controllers.
(U)	$20,511	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602601F, Spacecraft 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 4400

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4400 Space Systems Protection	5,661	2,732	6,013	3,482	3,515	3,577	3,632	3,682	Continuing	TBD

Note: In FY 2002, efforts were transferred from PE 0603410F, Space Systems Environmental Interactions Technology, into this project in order to align projects within the Air Force Research Laboratory organization. In FY 2003, selected efforts were transferred within this PE from this project into Project 5021 in order to focus on improving survivability of space systems in natural environments.

(U) A. Mission Description

This project develops and demonstrates tools, instruments, and mitigation techniques required to assure operation of U.S. space assets in potentially hostile warfighting environments. The project performs assessments of critical components and subsystems, and evaluates susceptibility and vulnerability to radio frequency (RF) and laser threats. This project also develops technologies that mitigate identified vulnerabilities. Technologies are developed and demonstrated to support balanced satellite protection strategies for detecting, avoiding, and operating in a hostile space environment.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$240	Used multi-threat assessment tool to evaluate space-based electro-optical responses to various candidate RF and laser countermeasures. Provides space platform designees a rapid and robust assessment tool for accurate assessment of various countermeasures. Added interface for analyzing RF and laser interaction effects on satellites. Added response models for satellite subsystems, such as communications, power, and inertial measurement units.
(U)	$1,932	Developed passive satellite countermeasures and mitigation techniques for current and future threats to satellites. Designed plasma shield experiments to determine effectiveness of filtering RFs to allow only selected frequencies to reach the satellite communications antennas. Initiated evaluations and ground-based demonstrations of visible and near-infrared laser protection techniques in preparation for space demonstrations. Initiated assessments of the impact of satellite self-protection and situational awareness technologies on space systems operations.
(U)	$1,348	Developed sensors to specify and forecast conditions in the space environment that degrade the operation of space-based systems. Supported integration, launch, and on-orbit operations of instrumentation to improve space radiation hazard specification and forecasting. Specifying and forecasting hazardous space conditions will improve space system designs and lifetime, and enhance operational capabilities for the warfighter. Initiated integration of plasma sensor for the Communications/Navigation Outage Forecasting System onto payload. Prepared to launch all-sky camera to detect solar disturbances one to three days prior to Earth impact and completed initial on-orbit validation. Completed integration of relativistic detector for mission to map the dynamic radiation belts and quantify hazards to space systems.

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 4400

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

(U)	$932	Conducted collaborative experiments and developed tools to improve the survivability of advanced spacecraft power, communications, and surveillance systems. Developed preliminary design of second-generation miniaturized charge control system to autonomously protect satellites from harsh charging environments. Initiated conceptual design of an experiment to quantify the effects of space plasma on tethered power generation systems. Developed interface between dynamic space plasma and meteor specification and forecast models and web-based spacecraft charging design tool.
(U)	$1,209	Developed technology to warn of spacecraft charging, chemical contamination, and kinetic impact hazards and to mitigate the effect of the space environment on Department of Defense space systems. Space environment hazard warnings minimize loss of space assets due to component and system level failures and, when widely deployed, provide global situational awareness of hazards. Control of spacecraft charging levels and high-energy radiation effects will significantly improve space system reliability and availability and reduce operational costs. Completed validation of compact environment anomaly sensor for geosynchronous and highly elliptic orbits and transition to operational use. Developed detailed design for miniaturized space environment distributed anomaly resolution sensor for on-orbit detection of space particle, chemical, and impact hazards. Completed ground tests of particle enhancement and depletion technologies and began conceptual design of active wave and electron beam space experiment to demonstrate the feasibility of satellite protection technologies.
(U)	$5,661	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$422	Use multi-threat assessment tool to assess space-based electro-optical responses to various candidate radio frequency and laser countermeasures. Begin verification and accreditation of weapons effects satellite assessment tools, complete documentation for users, and continue to develop additional tools for satellite subsystems, such as processor assemblies, optical trains, and satellite buses.
(U)	$1,549	Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites. Design plasma shield to selectively filter the radio frequencies reaching the satellite communications antennas; prepare for conceptual space demonstration. Conduct design and trade studies and analyses to determine the impact of satellite self-protection and situational awareness technologies on space systems operations. Investigate technologies to support automatic wartime deployment of protection technologies for satellites whose peacetime mission would be compromised by on-board protection systems. Investigate electronic protection techniques for optical sensors and systems.
(U)	$761	Develop and demonstrate visible and near-infrared laser protection technologies. Continue evaluations and ground-based demonstrations of visible and near-infrared laser protection techniques in preparation for space demonstrations.
(U)	$2,732	Total

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 4400

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,877	Use multi-threat assessment tool to assess space-based electro-optical, communication, and other responses to various candidate radio frequency and laser countermeasures and directed energy threats and techniques to mitigate these thrusts. Use existing satellite subsystem response data to continue verification of single satellite models of weapons effects for processor assemblies, optical trains, and satellite buses. Integrate single satellite models into satellite constellation analysis tool. Assess electro-optical designs of planned space systems for radio frequency and laser susceptibility and potential mitigation techniques. Assess directed energy threat susceptibility and potential for mitigation techniques for key satellite subsystems, such as communications.
(U)	$2,755	Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites. Complete plasma shield design and define potential system applications. Complete design trade studies and analyses to determine the impact of satellite self-protection and situational awareness technologies on space systems operations. Investigate mitigation technologies such as deployable shields and triggered automatic gain control for radio frequency threats.
(U)	$1,381	Develop and demonstrate visible and near-infrared laser protection technologies. Develop adaptive signal processing techniques to mitigate laser interference effects on readout electronics and focal plane array sensor subsystem components. Design and fabricate an optical sensor subsystem incorporating adaptive signal processing techniques. Develop an optical sensor subsystem threat mitigation techniques using solutions such as acousto-optical switches to deflect incoming laser energy from the focal plane array.
(U)	$6,013	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602102F, Materials.
(U) PE 0602601F, Spacecraft 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.

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PROJECT 4400	

(U) E. Schedule Profile

(U) Not Applicable.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 4938

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4938 Space Developmental Planning	4,980	0	0	0	0	0	0	0	0	TBD

(U) A. Mission Description

This project funds the developmental planning for military space technologies. The project focuses on the Pre-Milestone I systems engineering and integration, studies and analysis, concept development, and architecture efforts needed to transition technology into promising space concepts, capabilities, and systems. Of particular importance is the analysis work performed to link military technologies to mission needs through the strategy-to-task methodology of the Air Force modernization process. Another key aspect of this project is the defining, refining, and demonstrating of select space concepts offering significant future military utility to the warfighter, especially those that integrate existing or planned capabilities from across the entire national space community. A key component of this program is the demonstration of future space capabilities for wargames, exercises, experiments, and demonstrations. This project also funds Modeling and Simulation tools and related infrastructure development that are necessary to conduct studies and provide analysis on future space concepts and capabilities.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,015	Conduct concept development on promising space concepts. Products include comprehensive, high-level, integrated and scientifically sound design solutions across the myriad of space disciplines. Functions include space concept design, cost engineering, and measure of performance/ effectiveness inputs to Air Force Space Command's Optimizer of Utility Toolkit model.
(U)	$1,186	Conduct in-depth studies and analysis to assess and quantify the military worth of select space concepts. Provides decision-aiding analysis on space capabilities 15 to 25 years into the future.
(U)	$1,027	Conduct continuing system-of-systems engineering and integration for promising space concepts. Defines and refines concepts offering significant military utility to the warfighter, focusing on the integration of air and space capabilities. Supports systems security protection measures for current and planned capabilities across the national space community.
(U)	$963	Develop capability to demonstrate relationship, impacts, and effects of space assets on the military campaign in Air Force campaign and theater simulation models/tools to include processing and presentation hardware and software, model database upgrades, and networking and leased communications lines to support virtual and distributed simulation capability.
(U)	$512	Develop and integrate architectural concepts addressing technology transition opportunities against space mission deficiencies and needs.
(U)	$277	Decrease the time to transition innovative space technology to the warfighter by demonstrating promising future space capabilities in exercises, wargames, experiments, and demonstrations.
(U)	$4,980	Total

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology / PROJECT: 4938

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$0	No Activity
(U)	$0	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$0	No Activity
(U)	$0	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Not Applicable.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 5021

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5021 Space Systems Survivability	0	3,936	4,171	4,788	4,867	4,992	5,068	5,139	Continuing	TBD

Note: In FY 2003, efforts were transferred within this PE from Project 4400 into this project, in order to focus on improving survivability of space systems in natural environments.

(U) A. Mission Description

This project develops and demonstrates technologies to improve space system survivability and reliability of current and future Department of Defense space systems that must continue operation despite natural space hazards. It develops and demonstrates cost-effective solutions to mitigate hazardous space environmental interactions including electrical charge buildup and electronics failures due to both single radiation events and long-term radiation doses.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $962 Develop sensors to specify and forecast conditions in the space environment that degrade the operation of space-based systems. Support integration, launch, and on-orbit operations of instrumentation to provide improved space radiation hazard specification and forecasting. Launch, complete initial on-orbit checkout, and commence validation of solar disturbances forecasting algorithms using space-based all-sky camera. Begin joint agency collaboration to fly relativistic electron and proton detector and demonstrate ability to perform on-orbit mapping of the dynamic radiation belts to quantify hazards to space systems. Begin conceptual design of advanced all-sky, white light camera for operational space weather forecasting system.

(U) $981 Conduct collaborative experiments and develop tools to improve the survivability of advanced spacecraft power, communications, and surveillance systems. Complete design and began fabrication design of second-generation miniaturized charge control system. Complete conceptual design of an experiment to quantify the effects of space plasma on tethered power generation systems and determined feasibility of a space flight test to demonstrate on-orbit electrical power generation. Complete interface between dynamic space plasma and meteor models and web-based spacecraft design tools.

(U) $1,993 Develop technology to warn of spacecraft charging, chemical contamination, and kinetic impact hazards and to mitigate the effect of the space environment on Department of Defense space systems. Develop data assimilation techniques to produce improved dynamic radiation belt

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

models using data from multiple compact environment anomaly sensors. Begin fabrication of miniaturized space environment distributed anomaly resolution sensor for on-orbit detection of space particle, chemical, and impact hazards. Develop detailed design of active wave and electron beam space experiment to demonstrate the feasibility of satellite protection technologies.

(U) $3,936 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,043 Develop sensors to specify and forecast conditions in the space environment that degrade the operation of satellite, communication, navigation, and surveillance systems. Support integration, launch, validation, and operation of instrumentation to provide improved space radiation and ionospheric hazard specification and forecasting. Continue validation of solar disturbance forecast algorithms derived from all-sky heliospheric imager. Develop instrument and data plan for joint-agency mission to map the high-intensity region of the radiation belt that limits choices for spacecraft orbits. Expand space weather forecasting system conceptual design to include interplanetary in situ plasma and magnetic field sensors in addition to miniaturized white-light camera. Begin development of micro- and nano-technology based concepts to miniaturize energetic particle, neutral density, and low energy plasma sensors needed to characterize space weather hazards.

(U) $1,461 Conduct collaborative space and laboratory experiments and develop hardware and software tools to improve the survivability of spacecraft power, communications, navigation, and surveillance systems. Complete model testing of miniaturized charge control system and begin construction of space experiment for the hazardous geosynchronous environment. Begin development of a space experiment to validate on-orbit electrical power generation and particle scattering capabilities of space tether. Initiate development of a suite of comprehensive spacecraft environment effect tools for operational use by integrating full range of environment specification and forecast models with spacecraft hazard, trans-ionsopheric link degradation, and satellite drag specification tools. Begin design of active antenna and passive detection hardware for space experiment to demonstrate techniques of lowering radiation belt intensities to protect satellites.

(U) $1,667 Develop technology to warn of spacecraft radiation, charging, and kinetic impact hazards and to provide space environment situational awareness and anomaly resolution capability for Department of Defense space systems. Complete first-generation data assimilation models specifying global radiation levels based on data from multiple compact environment anomaly sensors. Continue development of space hazard detector components of distributed anomaly resolution sensor and finalize space hardware design. Continue detailed design of active wave and electron beam space experiment to demonstrate the feasibility of satellite protection technologies.

(U) $4,171 Total

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PROJECT: 5021	

(U) B. Project Change Summary

Not Applicable.

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

(U) PE 0602601F, 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 5083

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5083 Ballistic Missiles Technology	0	0	6,860	6,877	5,831	4,077	4,139	4,197	Continuing	TBD

Note: This is a new project, but not a new start. The efforts are part of ongoing work performed in PE 0603311F, Ballistic Missile Technology, and are put in this PE to align efforts within the Air Force Research Laboratory organization.

(U) A. Mission Description

This project develops, integrates, and demonstrates advanced technologies for sustainment and modernization of strategic ballistic missiles. The project focuses on developing robust, low maintenance inertial navigation instruments to sustain current ballistic missile systems as well as provide new, small, low-powered, high precision instrumentation for next generation missile systems.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,940 Develop, integrate, and demonstrate advanced navigation instrumentation applied to emerging vehicle designs and other technologies that sustain current strategic missile systems. Provide critical missile technologies for future systems. Integrate the advanced gyro and accelerometer systems into a breadboard demonstration of a reduced size and reduced power navigation instrument system that approaches or exceeds ballistic missile mission goals.

(U) $2,940 Develop, integrate, and demonstrate advanced navigation technologies with new vehicle designs to provide robust, flexible, lower cost solutions for sustaining current strategic missile systems. Provide the technological base for future systems. Integrate advanced thermal materials into long glide vehicles to provide greater controllability and selective targeting. Demonstrate lower cost, robust leading edge, and control surface materials in a test flight to validate improved properties for future vehicle designs. Demonstrate that robust onboard navigation instruments and

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 5083

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

range safety devices can withstand loads greater than 100G in all axes in laboratory tests.

(U) $980 Investigate advanced, novel concepts critical to advance navigation instrumentation in the next generation of ballistic missiles. Evaluate the most promising technologies. Fabricate and demonstrate an enhanced navigation device that uses the established design and performance goals. Validate the performance goals of the demonstrated technology.

(U) $6,860 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) PE 0601102F, Defense Research Sciences.
(U) PE 0602601F, Space Technology.
(U) PE 0603311F, Ballistic Missile Technology.
(U) PE 0603601F, Conventional Weapons Technology.
(U) PE 0603851F, Intercontinental Ballistic Missile-Dem/Val.
(U) PE 0604851F, Intercontinental Ballistic Missile-EMD.
(U) PE 0605860F, Rocket System Launch Program-Space.
(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 682J

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
682J Spacecraft Vehicles	8,022	18,338	14,589	10,393	10,486	13,586	13,737	15,799	Continuing	TBD

(U) A. Mission Description

This project develops and demonstrates compact, low-cost, spacecraft and launch vehicle power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. Power generation activities focus on lightweight, low-cost, low-volume, and survivable solar cell arrays. Energy storage work focuses on lightweight nickel hydrogen and sodium sulfur spacecraft batteries and flywheel energy storage systems for extended (five to ten year) satellite missions. The project's power distribution efforts focus on producing lightweight, high-efficiency, standardized power busses for use on future space programs.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,862 Developed and evaluated performance of space conventional power generation technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible solar cell arrays, and radiation resistant solar cell modules. Ground demonstrated deployment and operation of large, free-flying, lightweight, flexible, radiation resistant, array of thin film solar cells. Integrated 32% efficient multi-junction solar cells and 10% efficient thin film solar cells into large modules. Began integration into full arrays.

(U) $769 Developed space conventional energy storage technologies such as the lightweight flywheel integrated power and attitude control system. Ground demonstrated integrated attitude control and energy storage system. Evaluated feasibility of microflywheel technology based on conceptual design; fabricated and tested microflywheel components.

(U) $1,269 Developed technologies for long life, efficient, low vibration, lightweight mechanical cryocoolers for space applications. Characterized performance of 10K model cryocooler. Developed and delivered high efficiency multi-stage cryocooler with radiation-hardened control electronics. Began development of high capacity multi-stage 10K cryocooler system for advanced space surveillance and tracking sensor.

(U) $1,219 Developed composites for launch vehicle and spacecraft structures and space applications, such as launch vehicle shrouds, thermal protection structures, and space antennas. Developed spacecraft to demonstrate multifunctional structures technologies. Flight demonstrated grid stiffened shrouds and thermal protection structures. Completed development of inflatable support structures. Continued ground test of multifunctional structures. Initiated integration of power and thermal technologies into multifunctional structures. Ground tested full-scale secondary payload adapter structure for an expendable launch vehicle.

(U) $2,903 Developed technologies for spacecraft structural controls and mechanisms for on-orbit applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems. Developed launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements. Ground demonstrated smart passive payload isolation

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 682J

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

systems. Designed operational active acoustic attenuation system. Developed and ground demonstrated passive acoustic attenuation system. Integrated low shock separation devices and whole spacecraft vibration isolation systems. Developed autonomous satellite docking and deployment mechanisms. Developed modular vibration-isolating spacecraft transport container.

(U) $8,022 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,790 Develop and evaluate performance of space conventional power generation technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible solar cell arrays, and radiation resistant solar cell modules. Flight demonstrate deployment and operation of large, free-flying, lightweight, flexible, radiation resistant, array of thin film solar cells. Continue integration of 32% efficient multi-junction solar cells and 10% efficient thin film solar cells into full arrays.

(U) $903 Develop innovative space conventional energy storage technologies such as the lightweight flywheel integrated power and attitude control system. Flight demonstrate integrated attitude control and energy storage system. Develop microflywheel demonstration system.

(U) $1,354 Develop technologies for long-life, efficient, low vibration, lightweight mechanical cryocoolers for space applications. Continue development of high capacity multi-stage cryocooler technologies to meet the needs of high resolution, space-based infrared surveillance and tracking sensors with larger focal planes and optics.

(U) $1,293 Develop composites for launch vehicle and spacecraft structures and space applications, such as launch vehicle shrouds, thermal protection structures, and space antennas. Develop spacecraft to demonstrate multifunctional structures technologies. Complete evaluation of operational grid stiffened structures. Fabricate multifunctional spacecraft bus for small satellites. Complete ground test of full-scale Evolved Expendable Launch Vehicle secondary payload adapter structure.

(U) $3,598 Develop technologies for spacecraft structural controls and mechanisms for on-orbit applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems. Develop launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements. Flight demonstrate smart passive payload isolation systems. Ground demonstrate operational active acoustic attenuation system. Flight demonstrate passive acoustic attenuation system. Integrate low shock separation devices into multiple payload adapter. Ground demonstrate smart docking and deployment mechanisms. Complete development of modular vibration-isolating spacecraft transport container.

(U) $6,927 Develop amorphous silicon solar cells for higher performance, next-generation flexible, thin film solar arrays. These thin film arrays will be 3 to 5 times lighter, cost 5 times less, require 5 times less stowed volume, and be more radiation resistant than state-of-the-art rigid panel arrays.

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 682J

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

Increase specific power (Watts/kg) of amorphous silicon solar cells by increasing cell efficiency and developing processes to deposit solar cells on lightweight polymer substrates. Develop monolithic integration technology for the low-cost interconnection of thin film solar cells.

(U) $2,473 Develop a new generation of advanced composite materials to support improved manufacturing techniques for low-cost, lightweight spacecraft adapter and fairing designs. Composite materials decrease primary structure mass and cost by 40% and decrease manufacturing lead times by 50% over conventional metallic structures. Assess material properties and identify suitable epoxy and fiber materials for spacecraft adapter and fairing applications. Develop procedures to flight qualify suitable materials and confirm unique manufacturing processes. Fabricate and test candidate materials identified as viable candidates.

(U) $18,338 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,211 Develop and evaluate performance of space conventional power generation technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible solar cell arrays, and radiation resistant solar cell modules. Demonstrate integration methods for thin-film solar cells on polymer substrates into full arrays. Integrate 32% efficient reduced-mass wafers into full arrays.

(U) $1,359 Develop technologies for long life, efficient, low vibration, lightweight mechanical cryocoolers for space applications. Begin protoflight development of high capacity, multi-stage, low temperature cryocooler system. Develop and characterize performance of second generation engineering design model high capacity 10 Kelvin cryocooler for advanced space surveillance and tracking sensor. Begin development of component cryocooler technologies for regenerative and recuperative cycle devices to transition enabling technology to protoflight cryocooler designs.

(U) $3,933 Develop composites for launch vehicle and spacecraft structures and space applications, such as launch vehicle shrouds, thermal protection structures, and space antennas. Continue to develop spacecraft to demonstrate multifunctional structures technologies. Complete fabrication of multifunctional spacecraft bus components for small satellites. Flight qualify full-scale Evolved Expendable Launch Vehicle secondary payload adapter. Begin design and characterization of linerless composite cryogenic tanks. Initiate development of large deployable optics structures using nanotechnology-enhanced materials.

(U) $7,086 Develop technologies for spacecraft structural controls and mechanisms for on-orbit applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems. Continue to develop launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements. Flight demonstrate operational active acoustic attenuation systems. Flight demonstrate low-shock multiple payload adapter technologies. Build deployment and isolation mechanisms for large

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PROJECT 682J	

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

free-flying solar array and integrate with thin-film solar cell components. Design flight hardware to demonstrate smart docking and deployment mechanisms. Ground demonstrate full multi-axis flywheel attitude control system with integrated energy storage. Develop micro-electro-mechanical attitude control components.

(U) $14,589 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602203F, Aerospace Propulsion.
(U) PE 0602601F, Spacecraft Technology.
(U) PE 0603218C, Research and Support.
(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603436F Transformational Wideband MILSATCOM

PROJECT: A006

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
A006	Transformational Wideband MILSATCOM	9,972	0	0	0	0	0	0	0	0	9,972
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description

ASD(C3I) and the Joint Staff conducted the Transformational Communication Study (TCS) during FY02. The TCS analyzed the opportunity to transform the current communications architecture to incorporate capabilities such as laser communications and additional protection for tactical users. The result of the TCS was that opportunity exists to develop a Transformational Communication Architecture that capitalizes on key technologies to improve connectivity and data transfer capability that will remove bandwidth constraints for global U.S. requirements across DoD, civil and intelligence community operations.

(U) FY 2002 ($ in Thousands)
(U) $8,472 System Definition - architecture definition
(U) $1,500 System Defition - technology maturation
(U) $9,972 Total

(U) FY 2003 ($ in Thousands)
(U) $0 No Activity (transferred to PE 0603845F)
(U) $0 Total

(U) FY 2004 ($ in Thousands)
(U) $0 Accomplishment/Planned Program
(U) $0 No Activity (transferred to PE 0603845F)
(U) $0 Total

(U) B. Budget Activity Justification

Funding is in Budget Activity 3, Science and Technology, since this effort will support the transformation of the current satellite communications architecture in order to incorporate key emerging technologies. Activities transferred to PE 0603845F.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603436F Transformational Wideband MILSATCOM	PROJECT: A006

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget		195,000	435,000	1,260,000
(U)	Appropriated Value	0	0		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-28			
	b. Small Business Innovative Research				
	c. Omnibus or Other Above Threshold Reprogram	10,000			
	d. Below Threshold Reprogram				
	e. Rescissions				
(U)	Adjustments to Budget Years Since FY 2003 PBR			-435,000	
(U)	Current Budget Submit/FY 2004 PBR	9,972	0	0	9,972

(U) Significant Program Changes:
DoD initiated the TCA definition and technology maturation effort in the FY2002 Omnibus to accelerate the effort requested in the FY2003 President's Budget. The FY2003 Appropriations Act moved this effort to PE 0603845F.

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

(U) PE 0603845F & PE 0303602F contain the remaining funds for the TCA SATCOM effort.

(U) E. Acquisition Strategy

See PE 0603845F

(U) F. Schedule Profile

(U) See PE 0603845F

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603444F MAUI SPACE SURVEILLANCE SYSTEM

PROJECT: 4868

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4868	Maui Space Surveillance System	25,958	47,888	6,323	6,323	6,340	6,418	6,516	6,607	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description

This program funds the operation and upgrading of the Maui Space Surveillance System (MSSS) in Hawaii. Note: In FY 2003, Congress added $27 million for the MSSS, $2 million for High Accuracy Network Determination System, and $13 million for Panoramic Survey Telescope And Rapid Response System (Pan-STARRS).

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$3,383	Enhanced operational and research utility of MSSS data products to include thermal mapping of long-wave infrared imagery. Studied the feasibility of daylight imaging and active tracking with Advanced Electro Optical System (AEOS) to include effects on sensor performance and safety issues. Analyzed satellite orientation data for detailed characterization of space reconnaissance threats. Enhanced exploration tools and data dissemination architecture.
(U)	$13,233	Provided technical support to research, development, and operational users and visiting experimenters using the MSSS assets.
(U)	$3,944	Conducted and demonstrated AEOS/MSSS upgrades and enhancements. Completed the AEOS long-wave infrared imager upgrade background subtraction effort by operationalizing the test code (algorithm) to produce accurate radiometric data, temperature maps, and imagery. Upgraded radiometer to allow for simultaneous four-channel capability and increased processing speed. Improved resolution of the sensor on the 1.6-meter telescope by replacing the tracking system. Improved the reliability of the observatory control system to increase acquisition rate of targets.
(U)	$2,030	Continued follow-up role on AEOS and lost satellite search and non-imaging space object identification to detect and characterize smaller/fainter objects.
(U)	$3,368	Executed the Pan-STARRS effort. Defined technical concept for execution of Pan-STARRS to include the development of advanced charged-coupled devices (CCDs) to detect very-dim space objects of the 24th magnitude, a telescope system that uses the CCD detectors, and the hardware/procedures to collect and display the data. Initiated data archiving to support future data collection.
(U)	$25,958	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603444F MAUI SPACE SURVEILLANCE SYSTEM / PROJECT: 4868

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$4,133	Enhance operational and research utility of Maui Space Surveillance System (MSSS) with ability to operate at higher classification levels with dedicated areas. Design and develop heavy lift elevator for movement of the 3.6 meter primary mirror. Perform environmental studies to support recoating the 3.6 meter primary mirror. Provide integrated data architecture for dissemination of information to include integration of sensors in close proximity of MSSS. Analyze and study fusion of infrared and visible data products.
(U)	$21,488	Provide technical support to research, development, and operational users and visiting experimenters using the MSSS assets. Provide support to resolve electromagnetic interference problems at the observatory summit.
(U)	$5,879	Continue MSSS modernization. Execute reliability improvements and capability enhancements for the radiometer, adaptive optics, and spectrograph systems to include sensitivity improvements to the radiometer, enhancement of high order wavefront compensation, and characterization of the spectrograph for non-imaging space object identification applications. Develop and extend the capability to collect active signatures of space objects.
(U)	$1,546	Continue lost satellite search and non-imaging space object identification to detect and characterize smaller/fainter objects including Near-Earth Asteroid Tracking.
(U)	$12,863	Continue Panoramic Survey Telescope And Rapid Response System (Pan-STARRS) effort. Design and develop telescope system to include the development of advanced charged coupled devices (CCDs) to detect very dim space objects of the 24th magnitude, a telescope system that uses the CCD detectors, and the hardware/procedures to collect and display the data. Continue data archiving to support future data collection.
(U)	$1,979	Demonstrate use of High Accuracy Network Determination System (HANDS) for high accuracy orbit prediction, non-imaging signatures, and study the possibilities of use for low resolution imaging.
(U)	$47,888	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$612	Enhance operational and research utility of MSSS. Study and design fast frame rate camera on the adaptive optics system to allow for increased levels of high quality imagery and speckle imaging techniques.
(U)	$4,549	Provide technical support to research, development, and operational users and visiting experimenters using the MSSS assets.
(U)	$1,162	Continue MSSS modernization. Continue efforts in discrimination using active illumination system to validate discrimination algorithms and techniques for high precision range rate data collection. Demonstrate high precision laser pointing, line of sight stabilization, and tilt compensation to increase image resolution using active illumination. Demonstrate the ability to collect signatures for midcourse objects.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603444F MAUI SPACE SURVEILLANCE SYSTEM — PROJECT: 4868

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued
(U) $6,323 Total

(U) B. Budget Activity Justification

This program is in Budget Activity 3, Advanced Technology Development, since it enables 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 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	27,020	6,472	6,452	
(U)	Appropriated Value	27,284	48,472		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-264	-512		
	b. Small Business Innovative Research	-824			
	c. Omnibus or Other Above Threshold Reprogram		-72		
	d. Below Threshold Reprogram	-111			
	e. Rescissions	-127			
(U)	Adjustments to Budget Years Since FY 2003 PBR			-129	
(U)	Current Budget Submit/FY 2004 PBR	25,958	47,888	6,323	TBD

(U) Significant Program Changes:

In FY 2003, Congress added $27 million for the Maui Space Surveillance System, $2 million for High Accuracy Network Determination System, and $13 million for Panoramic Survey Telescope And Rapid Response System (Pan-STARRS).

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

(U) Related Activities:
(U) PE 0602605F, Directed Energy Technology.
(U) PE 0603605F, Advanced Weapons Technology.
(U) PE 0602500F, Multi-Disciplinary Space Technology.
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.

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

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	0	54,161	62,610	55,814	63,389	82,565	88,867	80,936	Continuing	TBD
5031	Advanced Optics & Laser Space Tech	0	14,477	19,604	23,774	26,479	31,426	33,888	35,766	Continuing	TBD
5032	Advanced Space Materials	0	6,720	11,715	0	0	5,825	5,318	3,903	Continuing	TBD
5033	Rocket Propulsion Demonstration	0	25,670	22,221	22,496	28,232	30,773	32,729	33,187	Continuing	TBD
5034	Advanced Space Sensors	0	4,751	6,070	9,544	8,678	11,629	16,062	7,621	Continuing	TBD
5062	Advanced Structures for Space Vehicles	0	2,543	3,000	0	0	2,912	870	459	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2003 this was a new PE, but not a New Start, resulting from the Space Commission recommendation to consolidate all space unique activities. In FY 2003, only the space unique tasks in the following PEs/Projects transferred to this PE in conjunction with the Space Commission recommendation: PE 0603605F, Projects 3150 and 3647, to Project 5031; PE 0603112F, Projects 2100 and 3946, to Project 5032; PE 0603216F, Project 4922, to Project 5033; and PE 0603203F, Project 665A/PE 0603270F, Projects 431G and 691X, to Project 5034. In FY 2003, efforts in Project 5062, will be complete until FY 2007 when efforts will commence to define spacelift vehicles using the results of the hypersonic engine work in PE 0602500F, Multi-Disciplinary Space Technology, Project 5027. In FY 2005, in Project 5032, advanced space material efforts were delayed until FY 2007 due to higher Air Force priorities.

(U) A. Mission Description

This program develops and demonstrates multi-disciplinary space technologies in four projects, each focusing on a separate technology area. 1) Advanced optics and laser space technology demonstrates and assesses space unique advanced optics and high energy laser weapon systems capabilities. 2) Advanced space materials develops and demonstrates materials and processing technologies for future space vehicle components and protection of space sensors from a variety of laser threats. 3) Rocket propulsion develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques for launch and spacecraft applications. 4) Advanced space sensors develops and demonstrates sensor technologies for intelligence, surveillance, and reconnaissance, communications, targeting,

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(U) A. Mission Description Continued

and electronic counter-countermeasures for spacecraft applications. In FY 2003, Congress added $4.9 million for Aerospace Relay Mirror System.

(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.

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	0	50,538	45,417	
(U)	Appropriated Value	0	55,438		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions		-711		
	b. Small Business Innovative Research				
	c. Omnibus or Other Above Threshold Reprogram		-566		
	d. Below Threshold Reprogram				
	e. Rescissions				
(U)	Adjustments to Budget Years Since FY 2003 PBR		0	17,193	
(U)	Current Budget Submit/FY 2004 PBR	0	54,161	62,610	TBD

(U) Significant Program Changes:

This is a new PE, but not a New Start, resulting from the Space Commission recommendation to consolidate all space unique activities. Increases to this PE since the previous President's Budget are due to increased emphasis on Transformational Communications System technologies.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC

PROJECT: 5031

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5031	Advanced Optics & Laser Space Tech	0	14,477	19,604	23,774	26,479	31,426	33,888	35,766	Continuing	TBD

Note: In FY 2003, space unique tasks in PE 0603605F, Projects 3150 and 3647, will be transferred into this project in conjunction with the Space Commission recommendation to consolidate all space unique activities. In FY 2004, increase is due to greater emphasis on Transformation Communications Systems technologies.

(U) A. Mission Description

This project provides for the demonstration and detailed assessment of space unique technologies needed for advanced optical systems and high energy laser weapons.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $126 Perform directed energy and space environment assessments on satellites in support of national space control and space situational awareness requirements. Provide data to U.S. Space Command for the performance of Laser Clearinghouse functions. Fuse finite state models with other satellite data and observables to produce a more complete space situational awareness picture.

(U) $1,306 Develop and demonstrate advanced long-range optical technologies such as space-based relay mirrors to support beam projection and imaging applications. Develop system concepts and design technology demonstrations of relay mirrors and membrane mirrors to advance global strike, global presence, and ballistic missile defense capabilities for the warfighter. Quantify the performance of a membrane mirror coated with a high energy laser dielectric coating and design a space membrane mirror experiment. Begin development of modeling and simulation tools for space-based relay mirrors.

(U) $8,196 Perform atmospheric compensation/beam control experiments for applications including antisatellite weapons, relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imaging. Perform beam pointing and guidestar radiometry (for atmospheric compensation) tests using a sodium-wavelength laser beacon. Design and begin integration of full aperture point-ahead atmospheric compensation system for low-power laser projection to satellites on weapons-class beam director (3.5 meter telescope). Demonstrate high-accuracy active satellite tracking on 3.5 meter telescope with simultaneous compensated satellite imaging and compensate laser projection to a low-earth-orbit satellite

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC
	PROJECT 5031

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

(integrated beam control demonstration).

(U) $4,849 Develop technologies for an aerospace (airborne) relay mirror testbed. Develop and enhance techniques for dual line of sight control via a coude path and two separate telescopes. Develop, mature, and integrate beam control, optical, and platform hardware to provide risk reduction for a full-scale relay mirror system. Develop a point design for the optical system and control system, and integrate with all subsystems. Tailor and integrate point-ahead beacon technology into the tesbed.

(U) $14,477 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $4,149 Develop and demonstrate advanced long-range, relay mirror optical technologies such as advanced adaptive optics, beam control, large lightweight optics, optical coatings, throughput, dual line of sight control, spacecraft and optical control integration, beam stabilization, and jitter control. Develop relay mirror concepts and design technology demonstrations to advance global strike, global presence, and ballistic missile defense capabilities for the warfighter. Continue the development of modeling and simulation tools for relay mirrors.

(U) $5,295 Perform atmospheric compensation/beam control experiments for applications including antisatellite weapons, relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imaging. Complete integration and begin testing of full aperture point-ahead atmospheric compensation system for low-power laser projection to satellites on weapons-class beam director (3.5-meter telescope).

(U) $10,160 Develop and demonstrate optical technologies for high bandwidth ground-to-air communications. Begin development of advanced modular deformable mirrors and adaptive optical control systems. Begin development of advanced optical filters, infrared sensors, and signal processing systems. Conduct optical communications experiments between the Starfire Optical Range and an aircraft-based test bed.

(U) $19,604 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) PE 0602500F, Multi-Disciplinary Space Technology.
(U) PE 0602605F, Directed Energy Technology.
(U) PE 0603444F, Maui Space Surveillance System.
(U) PE 0603605F, Advanced Weapons Technology.
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.
(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

(U) Not Applicable.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC

PROJECT: 5032

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5032 Advanced Space Materials	0	6,720	11,715	0	0	5,825	5,318	3,903	Continuing	TBD

Note: In FY 2003, space unique tasks in PE 0603112F, Projects 2100 and 3946, were transferred into this project in conjunction with the Space Commission recommendation to consolidate all space unique activities. In FY 2004, increase is due to greater emphasis on National Aerospace Initiative technologies. In FY 2005, efforts in this project have been delayed until FY 2007 due to higher Air Force priorities.

(U) A. Mission Description

This project develops, demonstrates, and validates materials and processing technologies for transition into Air Force space systems. Materials and processes development is scaled up to the appropriate level to demonstrate materials capability in the relative environment. Subscale components and nonstructural material components are developed and demonstrated to validate expected materials characteristics. Critical data on both structural and nonstructural materials is developed and provided for engineering and system design decisions. Laser hardened materials technologies are developed, demonstrated, and transitioned for the broadband protection of space sensors from a variety of laser threats. Reducing risk in materials technology improves the affordability, reliability, survivability, and operational performance of current and future space systems.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$0	No Activity
(U)	$0	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,494	Develop and demonstrate advanced materials and processing technologies for space vehicles and subsystems to provide enhanced surveillance capabilities, improved access to space, and improved overall affordability of space vehicles. Complete the demonstration of improved material processes with increased yields for robust, high performance, and producible infrared detector materials. Continue efforts to validate and demonstrate materials and materials processing technologies to improve affordability of spacecraft components. Validate measured effects of space exposure on advanced material systems.
(U)	$1,389	Develop and demonstrate advanced materials technologies that enhance laser hardening of Air Force spacecraft sensors to ensure safety, survivability, and operability in a laser threat environment. Demonstrate hybrid optical limiters for the protection of mid-wave infrared focal

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	PROJECT 5032

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

plane arrays. Demonstrate hardened coating process for Rugate fixed-wavelength filters and optical switches for mid-wave infrared space systems. Conduct tests of hardening solutions for critical space sensor designs and environments based on successful approaches employed in tactical sensors. Identify and evaluate optical limiter materials for the protection of near-infrared to short-wave infrared staring focal plane arrays. Identify coating materials and processes for filters and optical switches for long-wave infrared space systems.

(U) $3,837 Develop and demonstrate advanced materials and processing technologies to enable revolutionary improvements in the performance of airbreathing and rocket-based aerospace vehicles and weapons. Identify and evaluate cryogenic fluid compatible material and affordable processing technologies for large, lightweight, potentially load bearing tank structures for airbreathing and rocket-based vehicles. Evaluate and characterize ceramic and organic-based composite materials for durable, very high temperature aerospace vehicle and weapon leading edges.

(U) $6,720 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,876 Fabricate hybrid optical limiters for the protection of mid-wave infrared staring focal plane arrays. Validate repeatability in hardened coating process for rugate fixed-wavelength filters and optical switches for mid-wave infrared space systems. Integrate hardening solutions previously demonstrated in tactical systems into space unique sensor designs and environments. Develop optical limiter materials for the protection of near-infrared to short-wave infrared staring focal plane arrays. Develop coating materials and processes for filters and optical switches for long-wave infrared space systems.

(U) $9,839 Further evaluate and develop material and affordable processing technologies for large, lightweight, potentially load bearing tank structures for airbreathing and rocket-based vehicles. Develop analytical modeling tools to predict material behavior in cryogenic and hydrocarbon environments. Initiate materials and design concept study on durable reusable thermal protection systems for launch vehicles. Demonstrate innovative material concepts for single use thermal protection systems for reentry vehicles. Develop and assess metallic, carbon, and ceramic-based composite materials for space access structures and hypersonic ramjet, scramjet, and combined cycle propulsion structural components. Specific materials and process applications will emphasize increased operating temperature, environmental compatibility, and durability.

(U) $11,715 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) PE 0602102F, Materials.

(U) PE 0602500F, Multi-Disciplinary Space Technology.

(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

(U) Not Applicable.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC

PROJECT: 5033

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5033	Rocket Propulsion Demonstration	0	25,670	22,221	22,496	28,232	30,773	32,729	33,187	Continuing	TBD

Note: In FY 2003, space unique tasks in PE 0603216F, Project 4922, will be transferred into this project in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This project develops advanced and innovative low-cost rocket turbomachinery and components, low-cost space launch propulsion system technologies, and demonstrates advanced propellants for launch and orbit transfer propulsion. Additionally, this project develops technologies for the Technology for Sustainment of Strategic Systems Phase 1. Characteristics such as environmental acceptability, affordability, reliability, responsiveness, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. This project also develops chemical, electrical, and solar rocket propulsion system technologies for stationkeeping and on-orbit maneuvering applications. 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 propellants. Technological advances developed in this program will improve the performance of expendable systems' payload capabilities by ~20 percent, reduce the launch, operations, and support costs by ~30 percent. Responsiveness and operability of propulsion systems will be enhanced for reusable launch systems. Technology advances will also lead to seven-year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload. The efforts in this project are part of the Integrated High Payoff Rocket Propulsion Technology program, a joint Department of Defense, National Aeronautics and Space Administration, and industry effort to focus rocket propulsion technology on national space launch needs.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$0	No Activity
(U)	$0	Total

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC
	PROJECT 5033

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$11,773	Develop liquid rocket propulsion technology for current and future space launch vehicles. Initiate fabrication of turbopumps for integration into an advanced hydrocarbon booster engine. Commence testing in an advanced hydrocarbon test-bed engine.
(U)	$3,543	Develop solar thermal and solar electric propulsion technologies for existing and future upper stage and orbit transfer vehicles. Continue to demonstrate solar thermal propulsion technologies, such as strut development and pointing and tracking, for orbit transfer and maneuvering propulsion technology. Continue program to develop electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of low-earth-orbit - geosynchronous-earth-orbit transfer. Initiate testing of the advanced small satellite propulsion demonstration to develop microsatellite formation flying capability for Air Force imaging requirements.
(U)	$3,539	Develop propellant technologies for the sustainment of strategic systems Phase 1. Continue testing of the Post Boost Control System program to demonstrate component technologies with available materials to reduce hardware costs and maintain system performance. Continue testing Strategic Sustainment Demonstration program technologies that integrates advanced propellant, case, and nozzle technologies and demonstrates cost and performance goals.
(U)	$393	Develop electric propulsion technologies for satellite formation flying, stationkeeping, and repositioning. Complete brass board level testing of a pulsed plasma thruster system. Initiate hot fire testing of the thruster integrated with the power processing unit. Continue development of propulsion system for Air Force small satellites (<100kg) required for key Air Force Space Command concepts. Initiate acceptance and verification testing of flight hardware for formation flying demonstration spacecraft.
(U)	$6,422	Begin component level evaluation of reusable hydrocarbon scramjet technology to support rocket-based combined cycle engines. Components to be evaluated are consistent with Integrated High Payoff Rocket Propulsion Technology Phase II hydrocarbon boost demonstration in FYs 2005-2006. Determines component technologies to be integrated into combined cycle engine development, as well as hydrocarbon engine components for highly reusable launch.
(U)	$25,670	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$10,890	Develop liquid rocket propulsion technology for current and future space launch vehicles. Complete Integrated Powerhead Demonstration of advanced, long life, hydrogen-based engine components. Initiate component designs and analyses for hydrocarbon demonstration for reusable launch vehicle concepts.

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

(U)	$6,479	Develop solar thermal and solar electric propulsion technologies for existing and future upper stage, orbit transfer vehicles, and satellite formation flying, station keeping, and repositioning. Continue program to develop electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of low-earth orbit - geosynchronous-earth-orbit transfer. Prepare for delivery of the advanced small satellite propulsion demonstration unit for a microsatellite formation flying demonstration supporting improved capability for Air Force imaging requirements. Begin next phase solar thermal demonstration.
(U)	$2,840	Develop technologies for the sustainment of strategic systems. Continue evaluating the Strategic Sustainment Demonstration program hardware.
(U)	$2,012	Develop advanced monopropellant propulsion technologies for future chemical based propulsion systems for satellites. Continue component fabrication and preparation for demonstration tests.
(U)	$22,221	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) PE 0602102F, Materials.
(U) PE 0602203F, Aerospace Propulsion.
(U) PE 0602500F, Multi-Disciplinary Space Technology.
(U) PE 0602601F, Spacecraft Technology.
(U) PE 0603114N, Power Projection Advanced Technology.
(U) PE 0603216F, Aerospace Propulsion Power Technology.
(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

(U) Not Applicable.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC

PROJECT: 5034

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5034 Advanced Space Sensors	0	4,751	6,070	9,544	8,678	11,629	16,062	7,621	Continuing	TBD

Note: In FY 2003, space unique tasks in PE 0603203F, Project 665A, and PE 0603270F, Projects 431G and 691X, transferred into this project in conjunction with the Space Commission recommendation to consolidate all space unique activities. In FY 2004, increased emphasis is placed on laser warning sensor and laser communication technologies.

(U) A. Mission Description

This project develops and demonstrates space sensor technologies, including radio frequency sensors; intelligence, surveillance, and reconnaissance sensors; electro-optical sensors; laser warning sensors; targeting and attack radar sensors; and electronic counter-countermeasures (ECCM) and communications. By developing multi-function radar, laser, electronic combat, and ECCM technologies for space applications, this project provides space platforms with the capability to precisely detect, track, and target air- and ground-based, high-value, time-critical targets, while remaining invulnerable to hostile and natural threats.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $283 Develop a signature analysis capability to evaluate the physical/chemical origins of paint/camouflage thermal reflectance features, and develop a forward predictive capability validated with empirical measurements. Perform chemical analyses and develop an enhanced surface scattering model. Develop and validate a baseline predictive signature prediction model for space-qualified hyperspectral electro-optical sensors.

(U) $991 Develop and demonstrate technologies to maximize Global Positioning System (GPS) jam resistance, positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities. Design advanced M-Code technologies. Develop reference technologies to operate in space to provide precise time, position, and velocity for multiple platforms. Demonstrate virtual flight test technology for improved assessment of GPS anti-jam technologies.

(U) $430 Develop and demonstrate advanced wide-band electronic combat (EC) radio frequency (RF) receiver encoding/pre-processing/sorting concepts and techniques to handle increasing digitization of the modern complex RF signal environment for applications in existing and future space EC

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	PROJECT 5034

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

systems. These concepts and techniques will stress reconfigurability, modularity, interconnectivity, and affordability by using advanced digital technologies, such as Field Programmable Gate Arrays. Initiate requirements analysis, and hardware and software designs of future space electronic combat systems.

(U) $1,530 Complete study of and continue developing space-based support jamming technologies and techniques that will counter advanced radio frequency threats. Continue developing and assessing physical requirements for applying these technologies in space unique environments.

(U) $1,517 Complete design of space-hardened processor, geo-location, and spectrometer modules. Develop space laser warning sensor technologies for timely alert to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals. Complete false alarm package hardware and begin integration onto flight platform. Complete false alarm test planning. Continue risk reduction analysis for space-hardened geo-location, spectrometer, and processor modules. Initiate fabrication of space laser warning sensor modules.

(U) $4,751 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $323 Continue developing a material signature analysis capability to evaluate the physical/chemical origins of paint/camouflage thermal reflectance features, and continue developing a forward predictive capability validated with empirical measurements. Perform chemical analyses of an expanded target set and continue developing an enhanced surface scattering model. Assess environmental influences on spectral signatures.

(U) $1,020 Design direction finding technologies to maximize Navigation Warfare exploitation techniques for enhanced offensive and defensive combat capabilities. Develop assured reference technologies to provide precise time, position, and velocity for on-board and off-board platform applications. Develop antenna wavefront simulation technology to assess anti-jam Global Positioning System III techniques.

(U) $559 Develop space-qualified laser warning sensor technologies for timely alerts of advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals. Integrate false alarm package for space flight. Breadboard geo-location, spectrometer, and algorithm processor modules. Complete fabrication of space-qualified false alarm sensor modules. Continue planning for on-orbit testing.

(U) $4,168 Develop advanced laser communication component and sub-system technology to support a network-level topology for Airborne Intelligence Surveillance and Reconnaissance. Integrate and test electro-optical communication component technology into an airborne communication testbed, and evaluate performance with ground terminals under simulated space-to-ground, low elevation angle path lengths. Define

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

requirements for laser communication channelization to develop multiple user access capability. Begin aircraft optical network development to switch and route high bandwidth laser communication signals to lower level radio frequency systems through a distributed fiber bus providing lower bandwidth link connectivity and redundancy.

(U) $6,070 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) PE 0602204F, Aerospace Sensors.
(U) PE 0602500F, Multi-Disciplinary Space 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

(U) Not Applicable.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC

PROJECT: 5062

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5062	Advanced Structures for Space Vehicles	0	2,543	3,000	0	0	2,912	870	459	Continuing	TBD

This is a new project but not a New Start resulting from the Space Commission recommedation to consolidate all space unique activities. In FY 2005, efforts in this project will be delayed until FY 2007 due to higher Air Force priorities.

(U) A. Mission Description

This project identifies, develops, and demonstrates the technologies to enable advanced access-to-space aerospace vehicles that deliver revolutionary capability, operability, responsiveness, and cost-effectiveness. Enabling technologies include thermal protection, structures, vehicle systems, configurations, aerodynamics, and controls. Technology demonstration includes multi-disciplinary system level integration of the enabling technologies.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,543 Develop the airframe and payload technologies required to enable next generation reusable access to space systems including the thermal protection, structural, configuration, and vehicle and payload system technologies that enable aerospace vehicles to exhibit revolutionary capability, operability, responsiveness, and cost-effectiveness. Investigate integration of the multidisciplinary technologies required to design and demonstrate these aerospace vehicle configurations such as materials, munitions, human effectiveness, and both rocket- and airbreathing-based hypersonic propulsion.

(U) $2,543 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $3,000 Continue to develop the airframe and payload technologies required to enable next generation reusable access to space systems including the thermal protection, structural, configuration and vehicle and payload system technologies that enable aerospace vehicles to exhibit revolutionary capability, operability, responsiveness, and cost-effectiveness.

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

(U)	$0	No Activity
(U)	$3,000	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) PE 0602500F, Multi-Disciplinary Space 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	37,190	43,605	30,516	22,456	22,656	23,071	23,420	23,748	Continuing	TBD
670A	Ordnance Technology	13,077	20,731	21,647	13,862	13,975	14,222	14,437	14,640	Continuing	TBD
670B	Guidance Technology	24,113	22,874	8,869	8,594	8,681	8,849	8,983	9,108	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2004, the Low-Cost Autonomous Attack System (LOCAAS) Advanced Technology Demonstration (ATD) is transitioning from the initial powered flight test phase of the ATD to a second phase of the ATD that requires less investment and will incorporate other technologies, potentially a datalink, enhancing LOCAAS mission effectiveness; therefore, the level of investment in 670B is being reduced.

(U) A. Mission Description

This program develops, demonstrates, and integrates ordnance and advanced guidance technologies for air-launched conventional weapons. The program includes two projects: (1) development of conventional ordnance technologies including warheads, fuzes, and explosives; and (2) development of advanced guidance technologies including seekers, navigation and control, and guidance. Note: In FY 2003, Congress added $3.5 million for the LOCAAS and $3.0M for the BLU-109 Heavy Warhead.

(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.

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	39,729	38,001	25,017	
(U)	Appropriated Value	40,117	44,501		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-388	-471		
	b. Small Business Innovative Research	-1,000			

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

		FY 2002	FY 2003	FY 2004	Total Cost
	c. Omnibus or Other Above Threshold Reprogram		-425		
	d. Below Threshold Reprogram	-1,358			
	e. Rescissions	-181			
(U)	Adjustments to Budget Years Since FY 2003 PBR			5,499	
(U)	Current Budget Submit/FY 2004 PBR	37,190	43,605	30,516	TBD

(U) Significant Program Changes:
Not Applicable.

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DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology

PROJECT: 670A

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
670A	Ordnance Technology	13,077	20,731	21,647	13,862	13,975	14,222	14,437	14,640	Continuing	0

(U) A. Mission Description

This project develops, demonstrates, and integrates ordnance technologies for enhancing the effectiveness of air-launched conventional weapons. The project develops conventional ordnance including warheads, fuzes, explosives, carriage and release, and munition integration technologies. This project improves the capability for conventional ordnance supporting an Air Expeditionary Force.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $4,574 Developed and demonstrated advanced conventional armament warhead technologies, including heavy metal liners, dense metal cases, and less sensitive explosives. The goals of these efforts are to destroy hardened targets by more effectively penetrating protective surfaces and to enhance kill mechanisms against softer surface targets. Fabricated and tested an innovative warhead capable of defeating a broad range of soft targets associated with development, production, and storage of chemical and biological weapons. Designed a weapon capable of high-speed penetration of extremely hard targets by combining a new warhead case technology, insensitive explosives, and a multiple-event fuze.

(U) $4,980 Developed and demonstrated advanced air-delivered munition fuze technologies and mass focusing warhead technologies to improve munition effectiveness, allowing for smaller warheads and munition airframes, thereby improving sortie effectiveness by increasing strike aircraft load-outs. Sled tested the multiple-event, hard target fuze in an ordnance package. Continued cooperative program with the United Kingdom to design an integrated fuze, an improved target detection device, and a directional warhead package. Designed a fuze using Microwave Monolithic Integrated Circuit technologies that will give a burst accuracy of 0.5 meters for weapons that have closure rates up to 2,500 meters/sec.

(U) $3,523 Developed and demonstrated conventional munition subsystem and platform integration technologies. These technologies include innovative air-delivered munition carriage and release equipment, miniature weapon release concepts, and reduced airframe size to provide the capability to safely carry, launch, and communicate among the aerospace vehicle and multiple miniature weapons. These integration technologies will increase weapon load-outs and improve sortie effectiveness for current and future strike aircraft while reducing munition airlift requirements. Integrated subsystems by combining ordnance and guidance subsystem technologies into an effective payload size. Designed a low-cost, precision-guided weapon with a Circular Error Probable of 1.4 meters.

(U) $13,077 Total

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology	PROJECT 670A

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$9,075	Develop and demonstrate advanced conventional armament warhead technologies, including heavy metal liners, dense metal cases, and insensitive explosives. The goals of these efforts are to destroy hardened targets by more effectively penetrating protective surfaces and to enhance kill mechanisms against softer surface targets. Begin designing a unitary warhead penetrator capable of damaging weapons of mass destruction production and storage facilities with minimum collateral damage. Continue design and begin fabrication of a weapon capable of high-speed penetration of extremely hard targets by integrating a new warhead case technology, insensitive explosives, and a multiple-event fuze. Begin a program to mature design of advanced reactive materials such as nano-scale aluminum.
(U)	$6,715	Develop and demonstrate advanced air-delivered munitions fuze and mass focusing warhead technologies to improve munition effectiveness, allowing for smaller warheads and munition airframes, thereby improving sortie effectiveness and increasing strike aircraft load-outs. Develop a fuzing capability that will transmit function data from penetrating weapons through various hard target mediums. Continue cooperative program with the United Kingdom to design an integrated fuze, an improved target detection device, and a directional warhead package. Continue design of a fuze using Microwave Monolithic Integrated Circuit technologies that will give a burst accuracy of 0.5 meters for weapons that have closure rates up to 2,500 meters per second. Begin design trades for a precision-guided munition with precise, time-of-arrival attributes that can be used to defeat hard and deeply buried targets. Simultaneous delivery of multiple, precise, time-of-arrival munitions will be used to overpower protective tunnel doors, destroying tunnel contents with intruding blast pressures.
(U)	$4,941	Develop and demonstrate conventional munition subsystem and platform integration technologies. These integration technologies include innovative air-delivered munition carriage and release equipment, miniature weapon release concepts, and reduced airframe size providing the capability to safely carry, launch, and communicate among the aerospace vehicle and multiple miniature weapons. These integration technologies will increase weapon load-outs and improve sortie effectiveness for current and future strike aircraft while reducing munition airlift requirements. Initiate design of a low-cost, precision-guided weapon with a Circular Error Probable of 1.4 meters and lethal effectiveness against 85% of the MK-83 and BLU-109 targets.
(U)	$20,731	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$11,309	Develop and demonstrate advanced conventional armament warhead technologies, including heavy metal liners, dense metal cases, and insensitive explosives with increased energy release performance attributes. The goal of these efforts is to destroy hardened targets by more effectively penetrating protective surfaces and by enhancing kill mechanisms against softer surface targets. Demonstrate a Tantalum warhead to

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2003
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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

provide attack capability against armored targets employing 'Active Protection Systems.' Continue design and begin fabrication of a warhead capable of surviving high-speed penetration of extremely deep targets by integrating a new warhead case technology, insensitive explosives, and a multiple-event fuze.

(U) $7,317 Develop and demonstrate advanced air-delivered munitions fuze and mass-focusing warhead technologies to improve munition effectiveness, allowing for smaller warheads and munition airframes, thereby improving sortie effectiveness and increasing strike aircraft load-outs. Develop a fuzing capability that will transmit function data from penetrating weapons through various hard target mediums. In collaboration with the United Kingdom's Ministry of Defense, ground test an integrated fuze, an improved target detection device, and a directional warhead package that selects a vulnerable aim-point to center a focused warhead fragment pattern. Continue design of a fuze using Microwave Monolithic Integrated Circuit technologies that will give a burst accuracy of 0.5 meters for weapons that have closure rates up to 2,500 meters per second. Begin design of a hard target influence fuze capable of denying access to and from hard and deeply buried facilities.

(U) $3,021 Develop and demonstrate conventional munition subsystem and platform integration technologies. These integration technologies include innovative air-delivered munition carriage and release equipment, miniature weapon release concepts, and reduced airframe size providing the capability to safely carry, launch, and communicate with the aerospace vehicle and other multiple miniature weapons. These integration technologies will increase weapon load-outs and improve sortie effectiveness for current and future strike aircraft while reducing munition airlift requirements. Begin an effort to develop a weapon that can neutralize chemical and biological warfare facilities. Begin an effort to mass-focus an ordnance package for minimally hardened surface targets. Demonstrate large blast munitions.

(U) $21,647 Total

(U) B. Project Change Summary

Not Applicable

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

(U) Related Activities:

(U) PE 0602602F, Conventional 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

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology — PROJECT: 670A

(U) E. Schedule Profile Continued

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology

PROJECT: 670B

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
670B Guidance Technology	24,113	22,874	8,869	8,594	8,681	8,849	8,983	9,108	Continuing	0

(U) A. Mission Description

This project develops, demonstrates, and integrates affordable, autonomous, and adverse weather advanced guidance technologies for conventional armament delivered from manned and unmanned aerospace vehicles. This project includes development of conventional weapon guidance systems including terminal seekers, midcourse navigation sensors for standoff delivery weapons, and target detection and identification processing algorithms for reducing target location error to improve target kill probability.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,152 Developed and demonstrated advanced conventional armament seeker technologies for miniature munitions' applications. These seeker technologies will autonomously detect, acquire, and guide to targets of interest in adverse weather and battlefield conditions. Also, the seeker technologies will increase the probability of kill and minimize collateral damage while providing increased weapons load-out and improved sortie effectiveness. Demonstrated laser radar terminal seeker for a miniature munition that will be effective against high-value fixed and mobile targets.

(U) $1,133 Developed and demonstrated advanced conventional armament navigation and control technologies to provide increased armament navigation accuracy, improved stand off range, enhanced weapon control, and operation in electronic jamming environments. Developed interface design between target detection device, fuze, directional warhead, and weapon terminal guidance seeker. Completed design and fabrication of an integrated laser radar terminal seeker and Global Positioning System/Inertial Navigation System (GPS/INS) navigation and control system.

(U) $2,028 Integrated advanced conventional guidance technologies including seekers, processors, controls, and algorithms. Provided improved adverse weather performance, faster processing of target information, higher probability of target detection, an operationally acceptable target false alarm rate, and enhanced the effectiveness of miniature munitions against both mobile and hardened fixed ground targets. Completed flight readiness review and final subsystem integration of an autonomous guidance seeker against ground fixed and mobile targets. Conducted free flight tests and analyzed flight test data of a powered miniature munition with an integrated laser radar seeker and GPS/INS guidance to demonstrate design and determine target false alarm rate.

(U) $19,800 Enhanced the current Low-Cost Autonomous Attack System (LOCAAS) Advanced Technology Demonstration (ATD) program by adding more flight and ground testing. Additional LOCAAS ATD tasks included flight testing of a LOCAAS with a live warhead to demonstrate that the integrated technologies perform as expected and preparing the LOCAAS flight test vehicle for carriage and release from a tactical fighter aircraft.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology / PROJECT: 670B

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

Other Advanced Technology Demonstration (ATD) tasks included continuing automatic target recognition algorithm development; designing the Low-Cost Autonomous Attack System (LOCAAS) datalink to improve cooperative attack and communicate bomb damage assessment to the command and control network; and evaluating electronic safe and arm fuzing.

(U) $24,113 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,782 Develop and demonstrate advanced conventional armament seeker technologies for miniature munitions applications. These seeker technologies will autonomously detect, acquire, and guide to targets of interest in adverse weather and battlefield conditions. Also, the seeker technologies will increase the probability of kill and minimize collateral damage while providing increased weapons load-out and improved sortie effectiveness. Begin developing a low-cost, laser radar seeker to be used to search and identify fixed, re-locatable, and moving targets that will increase data rate and reduce moving parts of earlier generation laser seeker technologies.

(U) $1,932 Develop and demonstrate advanced conventional armament navigation and control technologies to increase armament navigation accuracy, improve stand off range, and enhance weapons control and operation in electronic jamming environments. Develop interface between a target detection device, fuze, directional warhead, and weapon terminal guidance seeker. Develop a munition navigation system using micro-electromechanical system technology to provide an accurate (less than one meter), miniature (less than 25 cubic inches), and affordable (less than $6,000 per unit) Global Positioning System/Inertial Measurement Unit navigation system.

(U) $3,781 Integrate advanced conventional guidance technologies including seekers, processors, controls, and algorithms. Provide improved adverse weather performance, faster processing of target information, higher probability of target detection, an operationally acceptable target false alarm rate, and enhance the effectiveness of miniature munitions against both mobile and hardened fixed ground targets. Begin development and fabrication of a low-cost seeker, guidance hardware, and autonomous target recognition software for a small bomb to attack mobile and re-locatable targets.

(U) $14,379 Enhance the current LOCAAS ATD program by adding more flight and ground testing. Additional LOCAAS ATD tasks include flight testing of a LOCAAS with a live warhead to demonstrate that the integrated technologies perform as expected. Also, the ATD will include separating the LOCAAS flight test vehicle from a tactical fighter aircraft. Other ATD tasks will include continuing automatic target recognition algorithm development, designing the LOCAAS datalink to improve cooperative attack and communicate bomb damage assessment to the command and control network, and evaluating electronic safe and arm fuzing.

(U) $22,874 Total

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603601F Conventional Weapons Technology	PROJECT: 670B

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,417	Develop and demonstrate advanced conventional armament seeker technologies for miniature munitions applications. These seeker technologies will autonomously detect, acquire, and guide to targets of interest in adverse weather and battlefield conditions. Also, the seeker technologies will increase the probability of kill and minimize collateral damage while providing increased weapons load-out and improved sortie effectiveness. Develop a low-cost, laser detection and ranging seeker that will increase data rate and reduce moving parts of earlier generation laser seeker technologies.
(U)	$2,175	Develop and demonstrate advanced conventional armament navigation and control technologies to increase armament navigation accuracy, improve stand off range, and enhance weapons control and operation in electronic jamming environments. Develop a munition navigation system using micro-electromechanical system technology to provide an accurate (less than one meter), miniature (less than 25 cubic inches), and affordable (less than $6,000 per unit) Global Positioning System/Inertial Measurement Unit navigation system.
(U)	$4,277	Integrate advanced conventional guidance technologies including seekers, processors, controls, datalinks, and algorithms. Provide improved adverse weather performance, faster processing of target information, higher probability of target detection, an operationally acceptable target false alarm rate, and enhance the effectiveness of miniature munitions against both mobile and fixed ground targets. Continue technology development tasks to further reduce risk of integrating the Low-Cost Autonomous Attack System onto manned and unmanned aircraft.
(U)	$8,869	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602602F, Conventional 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	60,729	53,381	27,024	30,229	29,246	31,732	30,239	30,658	Continuing	TBD
3150	Advanced Optics Technology	21,547	23,803	0	0	0	0	0	0	Continuing	TBD
3151	High Power Solid State Laser Technology	5,002	8,638	14,241	15,125	15,643	15,923	16,164	16,388	Continuing	TBD
3152	High Power Microwave Technology	7,478	12,670	8,414	11,534	11,590	13,677	11,915	12,083	Continuing	TBD
3647	High Energy Laser Technology	26,702	8,270	4,369	3,570	2,013	2,132	2,160	2,187	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2003, space unique tasks in Projects 3150 and 3647 were transferred to PE 0603500F in conjunction with the Space Commission recommendation to consolidate all space unique activities. FY 2003 funding reflects Congressional adds.

(U) A. Mission Description

This program provides for the development and demonstration of advanced directed energy and optical concepts that are not space unique. In solid state lasers, compact, reliable, relatively high power, cost-effective single devices and arrays of devices are demonstrated. In high power microwaves, technologies such as narrowband and wideband devices and antennas are demonstrated. In high energy lasers, technologies such as high power chemical lasers and beam control technologies are demonstrated. Note: In FY 2003, Congress added $3 million for Geo Light Imaging National Testbed (GLINT), $2.2 million for sodium wavelength laser, $115 million for the Field Laser Demonstration (FLD) Upgrades, and $5.1 million for Mobile Active Targeting Resource for Integrated Experiments (MATRIX).

(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.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	66,905	28,271	32,420	
(U)	Appropriated Value	67,558	54,271		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-653	-573		
	b. Small Business Innovative Research	-1,533			
	c. Omnibus or Other Above Threshold Reprogram		-317		
	d. Below Threshold Reprogram	-1,338			
	e. Rescissions	-3,305			
(U)	Adjustments to Budget Years Since FY 2003 PBR			-5,396	
(U)	Current Budget Submit/FY 2004 PBR	60,729	53,381	27,024	TBD

(U) Significant Program Changes:

The reduction in FY 2004 reflects a reallocation of funding to higher priority Air Force programs. Additionally there were significant Congressional adds in FY 2002 and FY 2003.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3150

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
3150 Advanced Optics Technology	21,547	23,803	0	0	0	0	0	0	Continuing	

Note: In FY 2003, space unique tasks in Project 3150 were transferred to PE 0603500F in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This project develops advanced optical technologies for various strategic and tactical beam control applications and for locating, identifying, and analyzing distant and dim objects such as geosynchronous orbit satellites.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $489 Developed technologies to support a space relay mirror system. These technologies include beam control; beam acquisition, tracking, and pointing; dual line of sight pointing; and beam stabilization. Developed engineering model of space-based relay mirrors.

(U) $6,215 Developed technologies for an aerospace (airborne) relay mirror testbed. Developed and enhanced techniques for dual line of sight pointing from two separate telescopes. Developed/integrated subscale hardware to provide risk reduction for a full-scale relay mirror system. Developed an optical payload to perform beam characterization and clean-up. Tailored and integrated point ahead beacon technology for this application.

(U) $6,803 Developed technologies for active imaging of geosynchronous space objects. Continued development and integration of hardware for the Geo Light Imaging National Testbed (GLINT) at White Sands Missile Range, NM. Developed/tested operating procedures and software for passive identification of satellites in support of GLINT experiments.

(U) $8,040 Continued to explore the utility of an operational Field Laser Demonstrator laser radar integrated with the Advanced Electro-Optical System for deep space metric and space object identification missions, microsatellite tracking, and ballistic missile defense discrimination. Continued technology development with the objective of providing compact, remote sensing systems for integration onboard unmanned aerial platforms for a variety of battlefield surveillance mission applications.

(U) $21,547 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $255 This project previously included space unique funding which has been transferred to PE 0603500F, Multi-disciplinary Space Technology. These funds represent the civilian salaries for the work effort transferred.

(U) $11,379 Continue to explore the utility of an operational Field Laser Demonstrator laser radar integrated with the Advanced Electro-Optical System for

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT 3150

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

deep space metric and space object identification missions, microsatellite tracking, and ballistic missile defense discrimination. Investigate vibromerty, polarmetry, and 3D imaging using laser radars to provide detailed information on satellites. Investigate laser radars to provide a range of battlefield information such as battle damage assessment and camouflage penetration.

(U) $2,968 Developed technologies for active imaging of geosynchronous space objects. Continued development and integration of hardware for the Geo Light Imaging National Testbed (GLINT) at White Sands Missile Range, NM. Build three heliostats and a compact collector. Perform field experiment to collect light from satellite in geosynchronous orbit.

(U) $4,155 Develop a Laser Illuminated Viewing and Ranging sensor for use on an unmanned air vehicle. Develop and demonstrate technologies for eye-safe active laser sensing systems for gathering battlefield images. Develop advanced sensor technology for eye-safe laser imaging including gated transferred electron bombarded charged coupled devices cameras and laser imaging beam control assemblies.

(U) $5,046 Develop the Mobile Active Targeting Resource for Integrated Experiments. Develop a testbed for assessment of tactical laser beam control/fire control sensors. Evaluate tracking, discrimination, and targeting algorithms for tactical high energy lasers and surveillance/situational awareness missions.

(U) $23,803 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity.

(U) $0 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0603444F, Maui Space Surveillance Systems.

(U) PE 0602102F, Materials.

(U) PE 0602605F, Directed Energy Technology.

(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.

(U) PE 0602500F, Multi-Disciplinary Space Technology.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology
PROJECT: 3150	

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

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3151

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
3151	High Power Solid State Laser Technology	5,002	8,638	14,241	15,125	15,643	15,923	16,164	16,388	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. This is a long-term technology development project with both near-term and long-term payoffs. Near-term goals include developing compact, reliable infrared sources that can be used 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 that could be applied to military weapons-type applications including aircraft self-protection. This project leads the development of, and builds upon, a wide range of commercial advancements. Commercially available solid state 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 and efficiencies and to military application-specific wavelengths. This project is divided into two technology areas. The first area investigates methods to develop low-cost, scalable, high power solid state lasers. This effort builds upon a strong industrial technology base. The second area develops wavelength specific solid state lasers for military applications such as infrared countermeasures.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,712 Developed low-cost, scalable, high power solid state laser architectures by integrating fiber lasers with diode-laser pump sources for directed energy applications such as unmanned aerial vehicle designators/imagers and next generation weapons applications such as space-based and airborne lasers. Began work to demonstrate high electrical efficiency (approaching 30%) and beam combining at high power to enable future applications requiring high power lasers. Demonstrated coherent beam combining of multiple 10 watt fiber amplifiers showcasing the building block technology of future directed energy, weapons-class electric lasers. Demonstrated wavelength-versatile integrated laser/nonlinear optics at five watt power levels. Continued development of an all-fiber solution, with no free space optical elements, at power levels approaching 100 watts.

(U) $2,427 Developed and demonstrated a laser source needed to counter current air-to-air and surface-to-air missile threats. Demonstrated a multi-wavelength source (two and four microns) with sufficient brightness, based on novel device structures and incoherent beam combining techniques developed in FY 2001, for countering current generation threats to aircraft platforms.

(U) $863 Developed and demonstrated high energy laser and beam control technologies for airborne tactical applications, including air-to-air and surface-to-air scenarios. Technologies investigated included lasers for long-range detection of targets in clutter and advanced beam control to control platform vibration, atmospheric jitter, and aero-optic effects. Initiated laser effect analysis and testing to determine required energy levels

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT 3151

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

and issues for tactical applications that address next generation threats.

(U) $5,002 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $4,759 Demonstrate scalability of high power solid state laser architectures for tactical directed energy applications such as unmanned aerial vehicle designators/imagers and next generation weapons applications such as advanced gunship and airborne laser illuminators. Begin to develop future directed energy, weapons-class electric laser technology at power levels greater than 10 kilowatts, with scalability to 100 kilowatts.

(U) $3,351 Develop and demonstrate laser source technologies needed to counter current air-to-air and surface-to-air missile threats. Demonstrate a reliable and compact multispectral (bands I, II, and IV), solid state laser for countering current generation threats to aircraft platforms.

(U) $528 Develop and demonstrate high energy laser technologies for airborne tactical applications, including air-to-air and surface-to-air scenarios. Technologies being addressed include lasers for long-range detection of targets in clutter, high power compact laser scalability, and advanced beam control to compensate platform vibration, atmospheric jitter, and aero-optic effects. Continue laser effects testing and begin development of a multi-kilowatt solid state laser testbed to determine required energy levels, propagation effects, and beam control requirements for tactical applications that address next generation threats.

(U) $8,638 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $7,371 Demonstrate scalability of high power solid state laser architectures for tactical directed energy applications such as unmanned aerial vehicle designators/imagers and next generation weapons/components applications such as advanced gunship and airborne laser illuminators. Demonstrate future directed energy, weapons-class electric laser technology at power levels greater than 10 kilowatts, with scalability to 100 kilowatts. Begin design for 25 kilowatt demonstrator laser. Investigate systems-level issues such as weight and volume.

(U) $3,257 Develop and demonstrate laser source technologies needed to counter current air-to-air and surface-to-air missile threats. Deliver a low-cost, reliable, and compact multispectral (bands I, II, and IV), solid state laser subsystem to the Large Aircraft Infrared Countermeasures System Program Office for future integration into aircraft platforms.

(U) $3,613 Develop and demonstrate high energy laser technologies for airborne tactical applications, including air-to-air and surface-to-air scenarios. Technologies being addressed include lasers for long-range detection of targets in clutter, high power compact lasers, and advanced beam control to compensate for platform vibration, atmospheric jitter, and aero-optic effects. Complete laser effects testing using surrogate laser sources.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
03 - Advanced Technology Development (ATD)	0603605F Advanced Weapons Technology	3151

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

Begin installation of a multi-kilowatt solid state laser testbed to confirm previous test results at system power levels and wavelengths.

(U) $14,241 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0603270F, Electronic Combat Technology.

(U) PE 0602605F, Directed Energy 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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3152

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
3152	High Power Microwave Technology	7,478	12,670	8,414	11,534	11,590	13,677	11,915	12,083	Continuing	

(U) A. Mission Description

This project develops high power microwave (HPM) generation and transmission technologies that support a wide range of Air Force missions such as the potential denial, degradation, damage, or destruction of an adversary's electronic infrastructure and military capability. These targeted capabilities include local computer and communication systems as well as large and small air defense and command and control systems. In many cases this effect can be generated covertly with no collateral structural or human damage. Millimeter wave force protection technologies are also developed. 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 are tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) technologies are being developed.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $3,585 Developed and demonstrated narrowband HPM technologies that damage or destroy an adversary’s electronic systems. Demonstrated pulsed power and narrowband HPM source capabilities applicable to munitions and airborne concepts. Selected repetitively pulsed HPM technology for gigawatt application development. Evaluated narrowband technologies to address aircraft protection against surface-to-air missiles. Developed and demonstrated wideband HPM technologies to disrupt, degrade, damage, or destroy an adversary’s command and control and infrastructure. Developed integrated compact source design based on effects data and technology advances for improved effectiveness in HPM munitions and airborne electronic attack missions.

(U) $2,030 Conducted effects experiments on targets to refine source parameters, expand target set, and support susceptibility predictions. Began building a probability of effect database using experimental data from several programs. Transitioned selected technologies. Refined modeling and simulation codes to more accurately predict wideband HPM coupling in realistic scenarios. Completed probability of effect predictions for engagement models. Investigated and developed models to quantify the effectiveness of a narrowband repetitively pulsed system against electronic targets of interest applicable to munitions or airborne platforms.

(U) $1,863 Developed and evaluated active denial technologies for non-lethal weapons applications. Continued development of in-house expertise applicable to future platforms (i.e., airborne) via support of characterization/effects with upgraded active denial field system. Began engineering design of next generation millimeter wave sources for airborne active denial technology. Continued analyzing critical technologies for airborne active denial. Began investigation of test cell development of millimeter wave source for airborne applications.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology	PROJECT: 3152

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

(U) $7,478 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $4,688 Develop and demonstrate narrowband high power microwave (HPM) technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems. Demonstrate pulsed power and narrowband HPM source capability applicable to munitions and airborne concepts. Demonstrate a repetitively pulsed gigawatt-class HPM experiment. Conduct wideband field experiments with integrated compact devices to demonstrate effectiveness of wideband HPM for munitions and airborne electronic attack. Conduct initial ground-based, field experiments demonstrating effectiveness of air-delivered HPM munitions.

(U) $2,270 Conduct effects experiments to expand database and support susceptibility predictions. Apply computer codes to predict HPM coupling to targets and validate code prediction accuracy. Continue to investigate and develop models to quantify the effectiveness of HPM waveforms against electronic targets of interest applicable to munitions or airborne platforms. Continue to refine the ability to calculate probability of kill for representative targets.

(U) $2,012 Develop and evaluate active denial technologies for non-lethal, anti-personnel, weapons applications including ground and airborne applications. Conduct specific characterization/effects/demonstrations with the active denial Advanced Concept Technology Demonstration ground system demonstration or the upgraded active denial field brassboard. Complete engineering design of next-generation millimeter wave sources for airborne active denial technology. Analyze critical technologies for airborne active denial including the use of unique computational simulation. Design hardware for a ground-based system demonstrator of millimeter wave source for airborne applications.

(U) $3,700 Develop the means to integrate HPM devices on aerial platforms and investigate specific target sets of interest. Begin target identification efforts: individual targets, groups, and clusters. Begin conducting experiments with a HPM source within a new, appropriately sized transverse electromagnetic cell anechoic chamber. Install and use a trans/twist reflector antenna on the existing anechoic chamber for smaller experiments. Perform integration tests on existing aircraft so as to define the vehicle integration environment for a HPM device. For several aircraft, obtain hardware and software interface specifications for integration of source on aircraft. Start performing integration, thermal control, and target studies for such concepts.

(U) $12,670 Total

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT 3152

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$3,423	Develop and demonstrate narrowband and wideband high power microwave (HPM) technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems. Continue to demonstrate pulsed power and narrowband HPM source capability applicable to munitions and airborne concepts. Demonstrate an integrated repetitively pulsed gigawatt-class HPM breadboard. Continue to conduct wideband field experiments with integrated compact devices to demonstrate effectiveness of wideband HPM for munitions and airborne electronic attack. Continue to conduct ground-based, field experiments demonstrating effectiveness of air-delivered HPM munitions. Conduct an integrated wideband target identification experiment.
(U)	$1,400	Conduct effects experiments to expand database and support susceptibility predictions. Continue to apply computer codes to predict HPM coupling to targets and validate code prediction accuracy. Continue refinement of models to quantify the effectiveness of HPM waveforms against electronic targets of interest applicable to munitions or airborne applications. Continue to refine the ability to calculate probability of kill for representative targets.
(U)	$2,727	Develop and evaluate active denial technologies for non-lethal, anti-personnel, weapons applications to include ground and airborne system variants. Acquire knowledge and capabilities critical for future active denial systems via field support of operation/testing/demonstration of the first ground-based system. Begin the development of millimeter wave source for airborne applications including interacting with system specific computational physics simulations to validate design before source construction. Improve active denial system specific computational physics simulations capability for millimeter wave sources. Begin the development of ground-based airborne level system demonstration hardware.
(U)	$864	Develop the technology to integrate HPM devices on aerial platforms and investigate specific target sets of interest. Continue airborne electronic attack specific target identification efforts for individual targets and group and/or cluster of targets. Continue conducting experiments in the new transverse electromagnetic cell anechoic chamber and the upgraded smaller anechoic chamber. Begin investigation of source to aircraft integration issues (e.g., electrical, interface, and thermal control). Define aircraft alterations and source shielding required to mount a HPM source on an aircraft. Begin investigating the feasibility of using a wideband HPM source to geolocate and identify targets of interest, and perform battle damage assessment.
(U)	$8,414	Total

(U) B. Project Change Summary

Not Applicable.

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
PROJECT 3152	

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

(U) Related Activities:

(U) PE 0602202F, Human Systems Technology.

(U) PE 0602605F, Directed Energy Technology.

(U) PE 0603851M, Nonlethal Weapons - Dem/Val.

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3647

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
3647 High Energy Laser Technology	26,702	8,270	4,369	3,570	2,013	2,132	2,160	2,187	Continuing	

Note: In FY 2003, space unique tasks in Project 3647 were transferred to PE 0603500F in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This project provides for the development, demonstration, and detailed assessment of non-space unique technologies needed for high energy laser weapons. Near-term focus is on airborne high energy laser missions, although the technology developed for this project is directly applicable to most high energy laser applications. Critical technologies developed and demonstrated include advanced high energy laser devices and laser beam control to efficiently compensate and propagate laser radiation through the atmosphere to a target. Correcting the laser beam for distortions induced by propagation through the turbulent atmosphere is the key technology in most high energy laser applications. Detailed computational models to establish high energy laser weapon effectiveness and target vulnerability are developed.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $447 Performed vulnerability assessments on potential high energy laser targets to provide critical design data for laser systems, both to defeat these targets and to understand the potential for collateral damage to other targets in the area. Provided data from predictive avoidance analysis to Air Force Space Command to allow them to set standards for laser illumination of space objects. Improved the data fusion of optical and radar measurements of space objects.

(U) $6,829 Performed atmospheric compensation/beam control experiments from the Starfire Optical Range 3.5-meter telescope for applications including antisatellite weapons, relay mirror systems, satellite health and diagnostics, and high-resolution satellite imaging. Performed compensated laser propagation to satellite targets and used the detailed measurements of energy and beam profile on target to characterize anisoplanatic effects and validate propagation models. Designed and began integration of laser beam control system using active tracking and target return loop adaptive optics with higher bandwidth signal processing and enhanced data capture capabilities. Integrated scoring laser and sensors for integrated beam control demonstration. Designed Rayleigh beacon point-ahead atmospheric compensation system for laser projection to satellites on weapons-class beam director (3.5-meter telescope).

(U) $13,007 Developed and evaluated beam control/compensation techniques for atmospheric attenuation and distortion on laser beam propagation from airborne platforms for applications such as theater missile defense. These efforts supported the Airborne Laser (ABL) Advanced Technology Demonstration to enhance high energy laser delivery from the ABL weapon system to missile targets. Developed and demonstrated in the laboratory advanced tracking and adaptive optics methods to mitigate the negative optical turbulence effects on an uncompensated high energy

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT 3647

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

laser beam under propagation conditions scaled to represent those expected in Airborne Laser engagements. Began wave-optics simulation of two wavefront sensors to enhance the ability to correct for atmospheric disturbances. Updated wave-optics computer simulations based on field test results to more effectively evaluate and improve subsequent advanced concepts.

(U) $1,564 Developed and demonstrated the technology for scalable, high energy laser devices with improved efficiency, for insertion in future airborne lasers and other potential weapon applications. Analyzed and enhanced multiple high pressure ejector nozzles performance using modeling and simulation. Began development of a laboratory nozzle test stand to evaluate new designs. Explored iodine injection and iodine generation methods and selected the most promising for insertion into advanced chemical oxygen iodine test sequence utilizing a laboratory test stand.

(U) $1,685 Developed and analyzed technology that supports manufacturing of the Advanced Tactical Laser. Evaluated designs and manufacturing capability for compact inertial reference units, including upgrades to the Stabilized Inertial Measurement System (SIMS) stable platform, to reject base motion disturbances due to aircraft vibration and acoustics. Incorporated manufacturing analysis results into a design for a next-generation SIMS with improved performance.

(U) $1,486 Continued to investigate the LaserSpark missile Infrared Countermeasure (IRCM) technology and develop/demonstrate the infrared countermeasure effectiveness of the multiple internal laser effects (MILE) associated with plasma/sparks. Conducted critical experiments on components and subsystems to establish error budgets and performance specifications. Continued testing of MILE on advanced focal plane array seeker mockups. Assessed IRCM effectiveness on flyout simulations of MILE on conical scan and focal plane array seekers. Conducted laboratory hardware experiments to validate flyout modeling and anchor computer simulations.

(U) $1,684 Fabricated brassboard sodium-wavelength laser to be used as a mesospheric beacon for adaptive optics systems on large-aperture telescopes. Designed and began radiometry experiments to characterize sodium beacon performance. Began design of a hybrid beacon adaptive optics system combining sodium and Rayleigh laser beacons for atmospheric compensation of large telescopes at visible and near-infrared wavelengths.

(U) $26,702 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,192 This project previously included space unique efforts which have been transferred to PE 0603500F, Multi-disciplinary Space Advanced Development Technology. These funds represent the civilian salaries for the work effort transferred.

(U) $371 Perform vulnerability assessments on potential high energy laser targets to provide critical design data for laser systems, both to defeat these targets and to understand the potential for collateral damage to other targets in the area. Update target system response databases for improved predictive avoidance analyses.

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT 3647

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

(U)	$3,564	Develop and evaluate beam control/compensation techniques for atmospheric attenuation and distortion on laser beam propagation from airborne platforms for applications such as theater missile defense. These efforts support the Airborne Laser (ABL) Advanced Technology Demonstration to enhance high energy laser delivery from the ABL weapon system to missile targets. Complete experimental testing of advanced active tracking and atmospheric compensation concepts and begin transition of algorithmic approaches to the ABL acquisition program. Begin field testing of advanced beam control architectures against a scaled target. Assess advanced technology improvements to support ABL block upgrades. Continue concept refinement through modeling and simulation of improved wave front sensors and the two-beacon concept. Begin technology transition to the ABL System Program Office.
(U)	$966	Develop and demonstrate the technology for scalable, high energy laser devices with improved efficiency for insertion in future airborne lasers and other potential weapon applications. Continue to evaluate, demonstrate, and enhance multiple high pressure ejector nozzles performance using modeling and simulation and laboratory nozzle test stand evaluations. Begin integration of the most promising iodine injection and iodine generation methods into an advanced chemical oxygen iodine test sequence utilizing a laboratory test stand. Validate performance of components.
(U)	$2,177	Fabricate brassboard sodium-wavelength laser to be used as mesospheric beacon for adaptive optics systems on large-aperture telescopes. Complete low power laser sky tests. Start high power laser tests.
(U)	$8,270	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,293	Develop and demonstrate the technology for scalable, high energy laser devices with improved efficiency for insertion in future airborne lasers and other potential weapon applications. Demonstrate optimized high pressure ejector nozzles performance for airborne laser systems. Demonstrate advanced iodine generation, iodine injection, and advanced chemical oxygen iodine test sequence utilizing a laboratory test stand. Integrate components to predict system level performance and discover system level issues. Investigate chemical recirculation on tactical airborne platforms.
(U)	$2,076	Develop and evaluate beam control/compensation techniques for atmospheric attenuation and distortion on laser beam propagation from airborne platforms for applications such as theater missile defense. These efforts support the ABL Advanced Technology Demonstration to enhance high energy laser delivery from the ABL weapon system to missile targets. Demonstrate advanced tracking methods and adaptive optics compensation techniques that double the Strehl ratio (peak intensity on target) in stressing atmospheric turbulence. Demonstrate the performance of various wavefront sensors to maximize the ability to correct for atmospheric disturbances through field demonstrations.

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BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
PROJECT 3647	

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

Complete demonstration and evaluation of the compensated beacon illumination technique. Anchor wave optics propagation code to the demonstrated beam control performance. Complete technology transition to the Airborne Laser System Program Office.

(U) $4,369 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0602605F, Directed Energy Technology.
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.
(U) PE 0602500F, Multi-Disciplinary Space Technology.
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.
(U) The technology efforts in this PE that are supporting future enhancements to airborne lasers have been coordinated with the Airborne Laser program office.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603723F Environmental Engineering Technology

PROJECT: 2103

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
2103	Environmental Quality Technology	0	1,187	0	0	0	0	0	0	0	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2000, the Air Force terminated this program. However, Congress restored $1.5 million for environmental quality technology and added $4.0 million for the Environmental Systems Management Analysis and Reporting Network (E-SMART) in FY 2000, added $1.0 million for joint environmental clean-up in FY 2001, and added $1.2 million for bioreactor technologies evaluation and testing in FY 2003.

(U) A. Mission Description

This program develops and demonstrates advanced technologies to address Air Force-unique environmental compliance, site remediation, and pollution prevention problems.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $1,187 Initiate Congressionally-directed effort to demonstrate bioreactor technologies to treat dilute aqueous waste streams and reduce the toxicity of wastewater.

(U) $1,187 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603723F Environmental Engineering Technology	PROJECT: 2103

(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.

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	0	0	0	
(U)	Appropriated Value	0	1,200		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions		-13		
	b. Small Business Innovative Research				
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram				
	e. Rescissions				
(U)	Adjustments to Budget Years Since FY 2003 PBR				
(U)	Current Budget Submit/FY 2004 PBR	0	1,187	0	TBD

(U) Significant Program Changes:

In FY 2000, the Air Force terminated this program. However, Congress restored $1.5 million for environmental quality technology and added $4.0 million for the Environmental Systems Management Analysis and Reporting Network (E-SMART) in FY 2000, added $1.0 million for joint environmental clean-up in FY 2001, and added $1.2 million for bioreactor technologies evaluation and testing in FY 2003.

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

(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.

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

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603755F High Performance Computing Modernization Program

PROJECT: 5093

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5093	High Performance Computing Modernization Program	0	0	185,282	186,911	191,407	193,425	196,816	199,976	0	0
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2004, the Office of the Secretary of Defense transferred this program to the Air Force.

(U) A. Mission Description

This program provides High Performance Computing (HPC) activities that could enable future superior warfighting capabilities. Funds are used to support developmental operations, maintenance, and performance upgrades to the four major shared resource supercomputing centers and the several smaller special purpose distributed supercomputing centers. Funds also are used to develop and sustain area networks, information security/assurance technologies, and associated HPC-specific codes. These supercomputer centers support the Department of Defense by providing a resource that enables the modeling and simulation activities necessary to maintain and advance military superiority and dominance on the battlefield. By exploiting HPC technologies early in the research and development process, scientists and engineers are able to resolve critical scientific and engineering problems in a more timely and cost-effective manner than by using physical hardware experimentation and test. The four major shared resource supercomputing centers are located at: Air Force Materiel Command, Wright-Patterson Air Force Base, Ohio; Army Research Laboratory, Aberdeen Proving Ground, Maryland; Army Corps of Engineers Research and Development Center, Vicksburg, Mississippi; and Naval Oceanographic Office, Stennis Space Center, Mississippi. The smaller, special-purpose distributed supercomputing centers are located at various installations across the United States. This program is subject to long-range strategic planning and technical review by a DoD-led, tri-Service advisory and oversight panel.

(U) FY 2002 ($ in Thousands)
(U) $0 Accomplishments/Planned Program.
(U) $0 No Activity; previously managed by OSD.
(U) $0 Total

(U) FY 2003 ($ in Thousands)
(U) $0 Accomplishments/Planned Program.
(U) $0 No Activity; previously managed by OSD.
(U) $0 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603755F High Performance Computing Modernization Program / PROJECT: 5093

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program.
(U)	$84,846	Enhance, modernize, and expand the operational and research utility of high performance computing systems, scientific visualization equipment, and associated infrastructure at DoD major shared resource centers (MSRC). Ensure U.S. scientists' and engineers' access to state-of-the-art supercomputing resources enabling timely and high precision advanced technology computational services in the development and deployment of U.S. weapon systems and system support. Provide technical support to research, development, and operational users.
(U)	$21,757	Enhance, modernize, and expand the operational and research utility of high performance computing systems, scientific visualization equipment, and associated infrastructure at DoD specialized distributed centers (DC) and establish new, unique capability, special purpose DCs. Ensure U.S. scientists' and engineers' access to state-of-the-art supercomputing resources enabling timely and high precision advanced technology computational services in the development and deployment of U.S. weapon systems and system support. Provide technical support to research, development, and operational users.
(U)	$26,646	Continue development of an extensive nationwide DoD network (Defense Research and Engineering Network) ensuring scientists and engineers have rapid and secure connectivity between the major resource centers, distributed centers, and DoD Science and Technology and Test and Evaluation sites. Advance and exploit technologies and process improvements in information exchange.
(U)	$52,033	Develop, benchmark, distribute, sustain, and employ validated supercomputing application code or software, as well as state-of-the-art information assurance/protection technologies, processes, and methodologies for DoD HPC systems. Evaluate optimum tradeoffs between code efficiency, performance, accuracy, and precision driven by the completeness of the theoretical principles incorporated. These efforts should be done, while simultaneously minimizing associated inefficiencies, inherent delays, and resource reallocation requirements. Conduct an aggressive research and development activity in Software Application Support. Develop and mature Common HPC Software Support Initiative activities in sharing and improving efficiencies in scalable HPC application software. Support the Programming Environments and Training efforts that provide computational and computer science sustainment through interaction and collaboration between academic, industry, and government institutions.
(U)	$185,282	Total

(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.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603755F High Performance Computing Modernization Program
	PROJECT: 5093

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	0	0	0	
(U)	Appropriated Value				
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions				
	b. Small Business Innovative Research				
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram				
	e. Rescissions				
(U)	Adjustments to Budget Years Since FY 2003 PBR			185,282	
(U)	Current Budget Submit/FY 2004 PBR			185,282	

(U) Significant Program Changes:
This program is part of the OSD program management divestiture. Air Force program management begins in FY 2004.

(U) D. Other Program Funding Summary ($ in Thousands)
(U) Not Applicable.

(U) E. Acquisition Strategy
Not Applicable.

(U) F. Schedule Profile
(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603789F C3I Advanced Development

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	32,530	45,030	31,538	28,599	30,916	38,223	30,758	33,142	Continuing	TBD
4072	Dominant Battlespace Awareness	11,157	24,064	15,344	11,816	12,020	16,120	13,197	13,070	Continuing	TBD
4216	Battlespace Information Exchange	11,263	9,999	6,432	6,486	6,540	6,656	6,756	6,851	Continuing	TBD
4872	Dynamic Aerospace C2 & Execution	7,195	9,101	7,496	8,412	10,454	13,511	8,840	11,228	Continuing	TBD
4925	Collaborative C2	2,915	1,866	2,266	1,885	1,902	1,936	1,965	1,993	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2002, efforts previously accomplished in PE 0603726F, Project 4850, moved into Project 4925, and efforts previously accomplished in PE 0603726F, Project 2810, moved into Project 4072. These actions are part of the Air Force's Science and Technology PE realignment.

(U) A. Mission Description

This program develops and demonstrates Aerospace Command, Control, Communications, and Intelligence (C3I) technologies for the warfighter. The technologies address the ability to support the global information exchange of correlated and fused information to ensure the Air Force can plan and execute missions in a dynamic environment. The Dominant Battlespace Awareness project will provide affordable operational data capabilities for personnel to understand militarily relevant situations, on a consistent basis, with the precision and timeliness needed to accomplish the mission. The Battlespace Information Exchange project will develop the reliable, secure, jam-resistant, inter-operable worldwide global information enterprise capabilities, providing the Air Force assured communications and reach-back capability in a joint/coalition environment. The Dynamic Aerospace Command, Control, and Execution project provides the technology and demonstrations needed to allow the warfighter to plan, assess, execute, monitor, and re-plan on the compressed time scales required for tomorrow's conflicts, whether they be combat or peacekeeping missions. The Collaborative Command and Control (C2) project provides the technology and demonstrations needed to establish virtual, distributed C2 centers, allowing the majority of the C2 center resources to remain in the Continential United States, while only a small command element is deployed forward. The resultant products of this program will be technologies needed to build the capability to dynamically plan and replan over a secure network. Note: In FY 2003, Congress added $2.8 million for Fusion SIGINT Enhancements to ELINT; $3.2 million for Information Protection and Authentication; $1.75 million for Automatic Acoustic Target Recognition; and $3.9 million for Identification of Time-Critical Targets.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603789F C3I Advanced Development

(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 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	33,217	34,288	36,190	
(U)	Appropriated Value	33,544	45,938		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-327	-525		
	b. Small Business Innovative Research	-922			
	c. Omnibus or Other Above Threshold Reprogram		-383		
	d. Below Threshold Reprogram	393			
	e. Rescissions	-158			
(U)	Adjustments to Budget Years Since FY 2003 PBR			-4,652	
(U)	Current Budget Submit/FY 2004 PBR	32,530	45,030	31,538	TBD

(U) Significant Program Changes:

The reduction in FY 2004 is due to reallocation of funding to higher priority Air Force programs.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603789F C3I Advanced Development

PROJECT: 4072

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4072 Dominant Battlespace Awareness	11,157	24,064	15,344	11,816	12,020	16,120	13,197	13,070	Continuing	TBD

Note: Prior to FY 2002, a portion of this effort was accomplished in PE 0603726F, Project 2810.

(U) A. Mission Description

This project develops, integrates, and demonstrates advanced technologies to achieve Dominant Battlespace Awareness (DBA) and Predictive Battlespace Awareness (PBA) using information from all sources, exploiting government and commercial technologies in support of the Global Strike Task Force and the Space / Command and Control, Intelligence, Surveillance, and Reconnaissance Task Force. DBA is the information required to support dynamic planning and execution with the accuracy, fidelity, and timeliness needed to dominate in battle. Technology development includes: tasking information collectors (intelligence, surveillance, and reconnaissance platforms, national intelligence sources, etc,); correlating and geo-registering the collected data; exploiting the data to extract information of military significance; fusing information from multiple sources to create a digital representation of the battlespace; assessing the situation; predicting enemy course of action; and archiving the results for ready use by decision makers. This is a dynamic process that involves technologies for information access, extraction, fusion, processing, storage, and retrieval, as well as technologies for machine reasoning, pattern recognition, and timeline analysis.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/ Planned Program

(U) $3,341 Developed and demonstrated advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets, and information extraction technologies for situational awareness. Developed tools to extract information from data derived from acoustic, image, and signal intelligence. Continued to develop and demonstrate information extraction tools that automatically extract events and their relationships from free form text, allowing the warfigther more time to perform analysis.

(U) $6,464 Developed and demonstrated advanced data and information fusion capabilities to support multi-source missions, new sensor types, cognitive models, and automated fusion process management. Continued to develop and demonstrate an all-source advanced capability for the detection and tracking of time-critical targets. Continued to develop fusion systems and architectures capable of exploiting multiple sources to find, fix, identify, and track moving air and ground targets, and to detect and track targets employing camouflage, concealment, and deception techniques. Continued to develop fusion algorithms and tools to exploit fused sensor information to provide higher levels of intelligence such as enemy force structures, lines of communication, and possible courses of action.

(U) $1,352 Developed and demonstrated advanced data handling and event visualization technologies. Continued to develop and demonstrate automated capabilities to access, extract, process, and display fused multi-source intelligence for near-real-time situational awareness. Developed timeline, event, and motion pattern recognition tools for analysis, visualization, and decision aids to detect enemy activity. Developed and demonstrated

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

probabilistic approaches for accumulation of data/information to support target/activity identification and situational awareness. Initiated development of a capability for precise geo-location and identification of targets exploiting multi-sensor data. Continued to develop the technologies to use multiple source correlation of sensor reports to optimize allocation and tasking of sensor resources.

(U) $11,157 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/ Planned Program

(U) $7,912 Develop and demonstrate advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets, and information extraction technologies for situational awareness. Develop tools to extract information from data derived from image, and measurement and signature intelligence. Continue to develop and demonstrate information extraction tools that automatically extract events and their relationships from free form text, allowing the warfigther more time to perform analysis.

(U) $11,558 Develop and demonstrate advanced data and information fusion capabilities to support multi-source capabilities, new sensor types, cognitive models, and automated fusion process management. Continue to develop and demonstrate an all-source advanced capability for the detection and tracking of time-critical targets. Demonstrate fusion systems and architectures capable of exploiting multiple sources to find, fix, identify, and track moving air and ground targets, and to detect and track targets employing camouflage, concealment, and deception techniques. Continue to develop fusion algorithms and tools to exploit fused sensor information to provide higher levels of intelligence such as enemy force structures, lines of communication, and possible courses of action. Initiate collaborative collection and fusion of intelligence, surveillance, and reconaissance information to improve accuracy and timeliness for situational awareness and targeting.

(U) $4,594 Develop and demonstrate advanced data handling and event visualization technologies. Continue to develop and demonstrate automated capabilities to access, extract, process, and display fused multi-source intelligence for in-time situational awareness. Continue development of tools for timeline, event, and motion pattern recognition to support analysis, visualization, and decision aids to detect enemy activity. Continue to develop probabilistic approaches for accumulation of data/information to support target/activity identification and situational awareness. Develop a capability for precise geo-location and identification of targets exploiting multi-sensor data. Continue to develop the technologies to use multiple source correlation of sensor reports to optimize allocation of sensor resources.

(U) $24,064 Total

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/ Planned Program
(U)	$4,666	Develop and demonstrate advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets, and information extraction technologies for situational awareness. Complete the development of tools to extract information from data derived from image, and measurement and signature intelligence (MASINT). Continue to develop and demonstrate information extraction tools that automatically extract events and their relationships from free text, including human intelligence and communication intelligence sources, allowing the warfighter more time to perform analysis. Initiate development of an exploitation toolkit for advanced intelligence, surveillance, and reconnaissance (ISR) platforms that provide the detection and tracking of air and ground targets. Initiate investigation of tools for the exploition of High Range Resolution (HRR), Identification Friend or Foe (IFF) and Synthetic Aperture Radar (SAR) sensor characteristics for feature-aided tracking and targeting. Start development of automated sensor management tools to support collection planning for ISR platforms.
(U)	$6,501	Develop and demonstrate advanced data and information fusion capabilities to support multi-source capabilities, new sensor types, cognitive models, and automated fusion process management. Demonstrate and deliver an all-source advanced capability for the detection and tracking of time-critical targets that employ camouflage, concealment, and deception techniques. Complete the demonstration of fusion system architectures capable of exploiting multiple sources of data to provide situational awareness, indications and warnings, and time-critical target identification and tracking. Complete the development of fusion algorithms and tools to exploit fused sensor information to provide higher levels of intelligence, such as enemy force structures, lines of communications, and possible courses of action. Complete the collaborative collection and fusion of ISR information to improve accuracy and timeliness for situational awareness and targeting. Develop, complete and demonstrate a capability for fusing signal intelligence, moving target indicator, foliage penetrating radar, and imagery data for the detection and tracking of time-critical targets.
(U)	$4,177	Develop and demonstrate advanced data handling and event visualization technologies. Develop and deliver probabilistic approaches for accumulation of data/information to support target/activity identification and situational awareness, in support of Predictive Battle Space Awareness (PBA). Complete development of the interface required to feed fused sensor information and derived higher levels of intelligence, such as enemy force structures, lines of communications, and possible courses of actions, into effects-based operations tools and decision aids. Continue development of tools for timeline, event, and motion pattern recognition to support analysis, visualization, and decision aids to detect enemy activity. Initiate development of an operations-based approach for intelligent and adaptive ISR management, based upon quantified information deficiencies in the fused data-space. Initiate development of a fusion evaluation environment and provide the analysis, evaluation, and transition of fusion products to the warfighter.
(U)	$15,344	Total

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(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0603203F, Advanced Aerospace Sensors.

(U) PE 0602702F, Command, Control, and Communications (C3).

(U) PE 0603742F, Combat Identification 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

(U) Not Applicable.

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BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603789F C3I Advanced Development

PROJECT: 4216

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4216	Battlespace Information Exchange	11,263	9,999	6,432	6,486	6,540	6,656	6,756	6,851	Continuing	TBD

(U) A. Mission Description

This project develops and demonstrates advanced communications technologies to implement a secure information grid for the worldwide information exchange of near-real-time multimedia (i.e., voice, data, video, and imagery) information in a joint/coalition environment. This secure information grid will be rapidly deployable, mobile, interoperable, and seamless between aircraft, either en route or in theater, and command and control (C2) centers. It will: a) provide interoperability across echelon, Service, and multi-national force boundaries; b) support mobile C2, sensor-to-shooter operations, and the battle management decision process; and c) provide in-transit visibility of en route aircraft, cargo, mission status, and reachback capabilities for aircraft to operations centers in the Continential United States (i.e., updating information and mission changes to en route aircraft). Technology developments include an information assurance decision support system, advanced information management, multi-level secure communications, secure survivable networks, and communications transmission systems.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/ Planned Program

(U) $1,209 Developed, integrated, and demonstrated advanced expert system decision algorithms to prioritize and control resources for global reach in a mobility environment. Demonstrated an intelligent information manager agent that throttled and regulated mission information flow among Air Mobility Command (AMC) components based on changing system capabilities. Integrated, in an AMC airlifter, the airborne components of the Intelligent Information Manager, Integrated Network Controller, and the Global Media Access Controller to produce a combined commercial/ military global communications system, a dynamically switched network, and an intelligent heterogeneous database access interface to prioritize and control resources in a mobility environment.

(U) $1,206 Developed, integrated, and demonstrated advanced network protocols and commercial management technologies to provide communications from deployed aircraft and ground elements to the AMC Tanker Airlift Control Center (TACC), as well as in-transit visibility at the TACC of all aircraft, personnel, and cargo. Demonstrated technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Integrated and demonstrated the ground-based components of the Intelligent Information Manager, Integrated Network Controller, and Global Media Access Controller in AMC's TACC and AMC's forward deployed unit, the Tanker Airlift Control Element, resulting in a seamless information infrastructure providing total asset visibility and enhanced situational awareness.

(U) $696 Developed and demonstrated improved global networking and resource management technologies that provide reliable, efficient, secure, interoperable, and dynamic deployable communications to Air Combat Command. Continued to develop the ability to manage and control

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

adaptive communications controller system(s) and to integrate additional and emerging media types for increased bandwidth capabilities. Continued development of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between command and control (C2) applications and network transport services. Continued development of affordable multi-level secure network management capabilities and incorporate additional management mechanisms to affect commander's control of all information grid network resources.

(U) $1,312 Developed and demonstrated intelligent wireless networking technologies to provide seamless and assured connectivity to all aerospace forces while reducing the forward-deployed footprint. Developed and demonstrated technology to support an en route and in-theater information grid for the worldwide exchange of near-real-time multimedia (i.e., voice, data, video, and imagery). Continued to develop and demonstrate dynamic intelligent bandwidth management concepts and militarized protocols for highly dynamic and ad-hoc wireless network topologies.

(U) $1,166 Developed and demonstrated theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities. Continued to develop space weather impact decision aid capability. Continued to develop master caution panel capability to centrally monitor and manage command and control assets within the air operations center C2 process. Developed interface methodologies for seamless integration of theater battle management applications into the joint battlespace information environment.

(U) $2,801 Developed and demonstrated an information assurance decision support system to provide real-time defensive courses-of-action relating to intrusion detection, intrusion response, and information system recovery. Developed data correlation and data fusion tools for detection of large-scale coordinated attacks, and provide automatic forensics analysis of attack information. Developed and demonstrated Adaptive Information Protection Technologies that will allow systems to tolerate adversary attacks and intrusions, gracefully degrade, recover, and reconstitute not only the system, but also the critical processes, programs, and data.

(U) $2,873 Developed and demonstrateed Information Hiding, Steganography, and Digital Watermarking for Information Protection and Authentications Systems. Developed stegongraphic algroithms that detect if infomation and information systems have been tampered with and demonstrate this capability in Air Force operational systems.

(U) $11,263 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/ Planned Program

(U) $1,246 Develop, integrate, and demonstrate advanced expert system decision algorithms to prioritize and control resources for global reach in a mobility environment. Continue to demonstrate an intelligent information manager agent that will throttle and regulate mission information flow among Air Mobility Command (AMC) components based on changing system capabilities. Continue to integrate, in an AMC airlifter, the airborne

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

components of Intelligent Information Manager, Integrated Network Controller, and the Global Media Access Controller to produce a combined commercial/military global communications system, a dynamically switched network, and an intelligent heterogeneous database access interface to prioritize and control resources in a mobility environment.

(U) $1,255 Develop, integrate, and demonstrate advanced network protocols and commercial management technologies to provide communications from deployed aircraft and ground elements to the Air Mobility Command (AMC) Tanker Airlift Control Center (TACC), as well as in-transit visibility at the TACC of all aircraft, personnel, and cargo. Continue to demonstrate technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Continue to integrate and demonstrate the ground-based components of the Intelligent Information Mannager, Integrated Network Controller, and Global Media Access Controller in AMC's TACC and AMC's forward deployed unit, the Tanker Airlift Control Element, resulting in a seamless information infrastructure providing total asset visibility and enhanced situation awareness.

(U) $1,028 Develop and demonstrate improved global networking and resource management technologies that provide reliable efficient, secure, interoperable, and dynamic deployable communications to Air Combat Command. Complete the adaptive communications controller system(s), integrating additional and emerging media types for increased bandwidth capability. Continue development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services based on mission priorities. Complete development of affordable multi-level secure network management capabilities to provide commanders with status and control of information grid network resources.

(U) $1,358 Develop and demonstrate intelligent wireless networking technologies to provide seamless and assured connectivity to all aerospace forces while reducing the forward-deployed footprint. Continue to develop and demonstrate technology to support an en route and in-theater information grid for the worldwide exchange of near-real-time multimedia (i.e., voice, data, video, and imagery). Develop and demonstrate beyond line of sight wideband technologies between airborne platforms and ground terminals.

(U) $1,036 Develop and demonstrate theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities. Complete development and demonstrate technologies that integrate, illuminate, and manage command and control (C2) assets within the air operations center C2 process. Develop and demonstrate advanced application and network technologies that provide the capability to monitor, understand, and maintain the status of distributed C2 weapon systems. Continue development of interface methodologies for seamless integration of theater battle management applications into the joint battlespace infosphere.

(U) $997 Develop and demonstrate an information assurance decision support system to provide real-time defensive courses-of-action relating to intrusion detection, intrusion response, and information system recovery. Demonstrate data correlation and data fusion tools for detection of large-scale coordinated attacks, and provide automatic forensics analysis of attack information. Develop the capability to assess attacks and sophistication

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

of the threat level against the mission. Initiate development and demonstration of automated deployment of defensive counter measures.

(U) $3,079 Continue development and demonstration of information hiding, steganography, and digital watermarking for information protection and authentication systems. Continue development of steganographic techniques for data embedding, tamper detection and proofing, image and video content authentication, and secure information dissemination. Begin investigation of new generation methods for digital security using steganographic techniques, and for detection of digital forgeries without watermarks.

(U) $9,999 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/ Planned Program

(U) $1,346 Finalize and demonstrate advanced expert system decision algorithms to prioritize and control resources for global reach in the Air Mobility Command (AMC) environment. Complete and demonstrate an intelligent information manager agent that will autonomously throttle and regulate mission information flow among AMC components based on changing system capabilities. Complete Phase 1 integration in an AMC airlifter (carry-on capability) of the airborne components of the Intelligent Information Manager, Integrated Network Controller, and the Global Media Access Controller to produce a combined commercial/military global communications system, a dynamically switched network, and an intelligent heterogeneous database access interface to prioritize and control resources in a mobility environment.

(U) $1,675 Finalize development and integration of advanced network protocols and commercial management technologies to provide communications from deployed aircraft and ground elements to the AMC Tanker Airlift Control Center (TACC), as well as, in-transit visibility at the TACC of all aircraft, personnel, and cargo. Complete the demonstration of technology to dynamically reconfigure the network and communications systems to optimally match the requirements for information transfer with changing transmission path availability. Complete development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services based on mission priorities. Continue to integrate and demonstrate additional capabilities for ground-based components of the Intelligent Information Manager, Intelligent Network Controller, and Global Media Access Controller into AMC, Air Combat Command, and other DoD users' communications architecture, resulting in a seamless information infrastructure, providing total asset visibility and enhanced situational awareness.

(U) $1,832 Develop secure cross-domain technology in support of managing fixed and deployed networks. Complete the development and integration of mechanisms that intelligently and dynamically negotiate quality of service and bandwidth between applications and network transport services, based on mission priorities. Initiate advanced cross-domain network management technology for enabling the exchange of network management, command and control applications status, and information assurance events, across security domains. Develop a highly flexible

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

real-time controlled interface that parses and filters protocol level information with a fine degree of granularity. This advanced cross domain technology will enable the eventual development of a Network Common Operational Picture for situational awareness to assist in gauging the overall security and health of the multi-level information infrastructure.

(U) $1,137 Develop and demonstrate intelligent networking technology to provide assured, seamless, battlespace connectivity to the aerospace forces with a greatly reduced footprint. Develop and demonstrate user-friendly, assured wideband wireless intelligent networking capability that automatically senses and adapts to its environment and service demands. Conduct preliminary demonstration of a self-organizing wideband network among airborne platforms.

(U) $442 Develop and demonstrate an enterprise management system that collects and evaluates status information from multiple systems and sources, monitors enterprise integrity, analyzes situations, and displays enterprise-wide information. Initiate the development of an integrated command and control Enterprise Management System tool suite, comprised of common, scalable, and tailorable visualizations and management-control capabilities to support various fixed and deployed operations of command, control, and communications centers.

(U) $6,432 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602702F, Command, Control, and Communications (C3).

(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

(U) Not Applicable.

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PROJECT: 4872

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4872	Dynamic Aerospace C2 & Execution	7,195	9,101	7,496	8,412	10,454	13,511	8,840	11,228	Continuing	TBD

(U) A. Mission Description

In order to perform command, control, and execution for the Expeditionary Aerospace Force (EAF), the Air Force must be able to plan, assess, monitor, and replan missions rapidly in a dynamic environment. This project develops and demonstrates technologies necessary for dynamic command and control (C2) decision making. It provides the technology and demonstrations needed to enable the warfighter to plan, assess, execute, monitor, and replan on the compressed time scales required for tomorrow's conflicts, whether they be combat or operations other than war. It will develop and demonstrate a new generation of planning assessment technologies that enable a new paradigm of effects-based operations, allowing the aerospace commanders to determine the desired operational effects and prosecute the mission accordingly. It will develop innovative capabilities capable of realizing a strategy to task approach to aerospace warfare exploiting a link between command, strategy, and assessment functions. It will develop and demonstrate distributed C2 technologies that provide the commander and staff with seamless access to tailored multi-media, multi-spectral data within a mobile, dynamic C2 center. Knowledge-based intelligent information technologies will be developed to support robust, real-time, large-scale Air Force C2 systems.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,928 Developed and demonstrated an effects-based approach for the next generation of planning and assessment techniques that enable aerospace commanders to determine the desired operational effects at the right place at the right time. Continued to develop the effects-based operations capability through active template technologies to provide recommended priorities, resource availability, and provide the information to the battle managers in time to achieve mission objectives. Continued to develop and demonstrate model abstraction to replicate/replay military exercises, provide near-real-time dynamic situation assessment, and identify preferred courses of action for decision making, while predicting likely outcomes. Developed effects-based tools to operate in the battlespace infosphere that will allow the commander and his/her staff to make decisions with uncertain, ambiguous, or vague information during the course of an air campaign.

(U) $1,474 Developed and demonstrated distributed C2 technologies that are scalable and reconfigurable and provide seamless access to tailored multi-media, multi-spectral data for commanders and staff within mobile, dynamic command and control centers. Continued to develop and integrate multi-user collaborative interaction technology for adaptive visualization and presentation to enhance joint force battle plan simulation, assessment, and implementation focused on aerospace operations within the battlespace infosphere. Continued to develop technology that integrates offensive, defensive, and support elements into an aerospace command center that provides the Expeditionary Aerospace Force (EAF) a cohesive environment for planning, execution, and assessment. Developed and demonstrated the techniques to produce and manage

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

information objects within the battlespace infosphere from numerous web-enabled information sources, to customize information products, and to deliver decision-quality information to any warfighter.

(U) $3,793 Developed and demonstrated knowledge-based intelligent information tools to support robust, real-time, large-scale aerospace command and control (C2) systems. Demonstrated knowledge-based C2 technologies in support of network intrusion detection. Continued to develop and integrate planning and information-based intelligent agents for adaptive replanning. Continued to develop and demonstrate the initial improved integrated flight management capability that will enhance decisions by providing commanders and decision makers a totally integrated perspective of available forces and employment options, including both operational and supporting element capabilities and limitations, within Air Mobility Command's info-centric environment.

(U) $7,195 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/ Planned Program

(U) $2,025 Develop and demonstrate an effects-based approach for the next generation of planning and assessment techniques that enable aerospace commanders to determine the desired operational effects at the right place at the right time. Demonstrate the effects-based operations capability through active template technologies to provide recommended priorities, resource availability, and provide the information to the battle managers in time to achieve mission objectives. Continue to develop and demonstrate effects-based tools to operate in the battlespace infosphere that will allow the commander and his/her staff to make decisions with uncertain, ambiguous, or vague information during the course of an aerospace campaign. Develop a dynamic tasking toolkit that enables the warfighter to develop a comprehensive, coherent, and integrated joint aerospace operations plan.

(U) $2,167 Develop and demonstrate distributed C2 technologies that are scalable and reconfigurable and provide seamless access to tailored multi-media, multi-spectral data for commanders and staff in mobile, dynamic command and control centers. Continue to develop and demonstrate multi-user collaborative interaction technology for adaptive visualization and presentation to enhance joint force battle plan simulation, assessment, and implementation focused on aerospace operations within the battlespace infosphere. Continue to develop technology that integrates offensive, defensive, and support elements into an aerospace command center that provides the EAF a cohesive environment for planning, execution, and assessment. Develop embedded training technologies to provide rapid mission readiness for the warfighter.

(U) $2,209 Develop and demonstrate knowledge-based intelligent information tools to support robust, real-time, large-scale aerospace C2 systems. Continue to develop and integrate planning and information-based intelligent agents for adaptive replanning. Continue to develop and demonstrate improved integrated flight management capabilities for mobility operations such as an improved search, retrieval, and handling of

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

data and information required for optimal use of available mobility resources. Develop and demonstrate continuous updating of the type, location, and status of DoD transportation assets to improve situational awareness

(U) $2,700 Continue to develop and demonstrate the techniques to produce and manage information objects within the Joint Battlespace Infosphere (JBI) from numerous web-enabled information sources, to customize information products, and to deliver decision-quality information to any warfighter. Develop and demonstrate data system wrapper technologies to dynamically integrate disparate command and control, intelligence, surveillance, and reconnaissance information systems into the JBI. Evaluate and integrate core JBI information management services that enable information exchange among disparate information systems.

(U) $9,101 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/ Planned Program

(U) $1,762 Develop and demonstrate an effects-based approach for the next generation of planning and assessment techniques that enable aerospace commanders to determine the desired operational effects, at the right place, and at the right time. Complete the demonstration of effects-based operational capability, using planning and decision-aid technologies that provide recommended priorities, resource availability, tasking, and scheduling to the battle managers in time to achieve mission objectives. Complete demonstration of combat air forces' and mobility air forces' command and control (C2) tools to operate in the battlespace infosphere, which will allow the commander and his/her staff to quickly obtain relevant information, and make timely decisions during the course of a global aerospace campaign. Develop and complete a dynamic tasking process architecture that enables the warfighter to develop a comprehensive, coherent, and integrated joint aerospace operations plan, which can be dynamically executed.

(U) $1,791 Develop and demonstrate distributed C2 technologies that are scalable and reconfigurable and provide seamless access to tailored multi-media, multi-spectral data for commanders and staff within mobile, dynamic C2 centers. Demonstrate multi-user collaborative interaction technology for adaptive visualization and presentation to enhance joint force battle plan simulation, assessment, and implementation, focused on aerospace operations within the battlespace infosphere. Deliver and demonstrate technology that integrates offensive, defensive, and support elements into an aerospace command center, that provides the Expeditionary Air Force a cohesive environment for planning, execution and assessment. Complete and transition to the Theater Battle Management Core System Program Office an integrated C2 system capability spiral that provides seamless access to tailored multi-media, multi-spectral data for commanders and staff within the Air and Space Operations Center weapon system, allowing them to monitor the status of the command and control (C2) system. Initiate the design and development of a baseline of critical functionality and supporting infrastructure that will support the evolving Advanced Technology Air and Space Operations Center weapon

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

		system and its split-operations concept. Define essential elements of information for the Advanced Technology Air Operations Center and develop methodologies and information representations that can be seamlessly exchanged across security boundaries.
(U)	$1,566	Develop and demonstrate the integration of planning tools and information-based intelligent agents for adaptive replanning and decision support tools for aerospace C2 systems. Demonstrate improved integrated flight management capabilities for mobility operations, such as improved search, retrieval, and handling of data and information required for optimal use of available mobility resources. Complete the development of tools to continuously update type, location, and status of DoD transportation assets to improve situational awareness. Demonstrate decision support tools and technologies to better manage and define the defense transportation system, accomplish mission viability and conflict analyses, and course of action assessment and evaluation.
(U)	$2,377	Continue to develop and demonstrate the techniques to manage information objects within the Joint Battlespace Infosphere (JBI), from diverse information sources and data environments. Develop and demonstrate publish, subscribe, and query information management capabilities to aggregate, share, and tailor information products, enabling horizontal integration of Air Force command, control, intelligence, surveillance and reconnaissance (C2ISR) information management systems. Develop and demonstrate data system wrapper technologies to dynamically integrate disparate and legacy C2ISR information systems into the JBI. Continue to evaluate and integrate core JBI information management services to enable information exchange among disparate information systems.
(U)	$7,496	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602702F, Command, Control,and Communications (C3).

(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

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603789F C3I Advanced Development / PROJECT: 4925

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4925	Collaborative C2	2,915	1,866	2,266	1,885	1,902	1,936	1,965	1,993	Continuing	TBD

(U) A. Mission Description

This project develops and demonstrates technologies for the next generation of distributed collaborative environments, which will provide cross-disciplinary information to a decision-maker when, where, and how it is needed. Technologies developed will demonstrate advanced integrated information architectures for the near-real-time transfer of large volumes of information over existing and future command, control, and communications systems. The application of these new technologies will allow reconfiguration and adaptation of existing operational aerospace systems to support seamless integrated operations.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/ Planned Program

(U) $966 Developed and demonstrated next generation distributed collaborative environments and integrated aerospace information architectures. Continued to develop collaborative technologies for split aerospace operations; coalition warfare; simulation-based acquisition; platform information mining; blended air/ground decision aiding; and information migration.

(U) $982 Developed communications technology to increase aerospace platform information transfer capacity. Continued to develop the technology to increase aerospace platform information transfer capacity for exchange of time-critical threat, sensor, and command and control (C2) information between aircraft and cooperating space, airborne, and surface communication assets. Developed the design of a high capacity, bandwidth efficient, modulation/network and phased array antenna control technology for point-to-point and multiple platform connectivity.

(U) $967 Developed and demonstrated embedded information system technologies to support a transparent framework for seamless, rapid insertion of battlespace infosphere technology. Developed techniques for inserting battlespace infosphere technology that do not require a comprehensive re-test of the entire C2 system. Developed capability for modernization of aerospace and C2 platforms to support system-of-systems interoperability within the battlespace infosphere.

(U) $2,915 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/ Planned Program

(U) $256 Develop and demonstrate next generation distributed collaborative environments and integrated aerospace information architectures. Continue to develop next generation collaborative environments and integrated aerospace information architectures for advanced Air Force enterprises. Demonstrate technology to perform platform information mining and collaborative environments for simulation-based acquisition.

(U) $881 Develop communications technology to increase aerospace platform information transfer capacity. Continue to develop technology to increase

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT 4925

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

aerospace platform information transfer capacity for exchange of time-critical threat, sensor, and command and control (C2) information between aircraft and cooperating space, airborne, and surface communication assets. Complete the design and begin the fabrication of high capacity, bandwidth efficient, modem technology for point-to-point and multiple platform connectivity.

(U) $729 Develop and demonstrate embedded information system technologies to support a transparent framework for seamless, rapid insertion of battlespace infosphere technology. Continue to develop techniques for inserting battlespace infosphere technology that do not require a comprehensive re-test of the entire C2 system. Continue to develop capability for modernization of aerospace and C2 platforms to support system-of-systems interoperability within the battlespace infosphere.

(U) $1,866 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/ Planned Program

(U) $461 Develop, demonstrate, and integrate a broad range of technologies that have potential applications within an embedded information architecture applicable to manned and unmanned vehicles. Develop, demonstrate, and integrate technologies to address a broad range of sensor-to-decision maker-to-shooter functions and concepts of operations. Initiate development of a time-critical target (TCT) automated decision-aiding capability to deny the enemy the sanctuary of time, for use in a C2 facility. Initiate development of airborne platform capabilities to engage in the TCT environment either as information sources or information sinks (using both on-board and off-board resources) to maximize exploitation of fielded assets to reduce the timeline of the TCT kill chain. Complete and demonstrate technology to perform platform information mining and collaborative environments for simulation-based acquisition

(U) $1,198 Develop communication technologies to increase aerospace platform information transfer capacity. Continue to develop technology to increase aerospace platform information transfer capacity for the exchange of time-critical threat, sensor, and C2 information between aircraft and cooperating space, airborne, and surface communication assets. Complete the fabrication of high capacity, bandwidth efficient, modem technology for point-to-point and multiple platform connectivity. Initiate development of an initial weapon data link capability for modernization of aerospace and C2 platforms to support the system-of-systems interoperability within the Global Strike Task Force concept. Start investigations of the interface of weapon systems to the C2 structure that will implement a high tempo, weapons on target capability. Begin definition of munitions data link capabilities and munitions-to-weapon platform pairing.

(U) $607 Develop and demonstrate embedded information system technologies to support a transparent framework for seamless, rapid insertion of battlespace infosphere technology. Complete development techniques for inserting battlespace infosphere technology that do not require a comprehensive re-test of the entire C2 system. Complete the demonstration of capability for modernization of aerospace and C2 platforms to

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603789F C3I Advanced Development
PROJECT: 4925	

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

support system-of-systems interoperability within the battlespace infosphere. Initiate development of embedded information technology to support command and control of autonomous unmanned systems.

(U) $2,266 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) related Activities:

(U) PE 0602702F, Command, Control, and Communications.

(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

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603850F Integrated Broadcast Service (DEM/VAL)

PROJECT: 4778

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4778	Integrated Broadcast Service	0	0	8,537	8,558	0	0	0	0	0	0
	Quantity of RDT&E Articles	0	1	0	0	0	0	0	0	0	0

In FY 03, the Air Force funds this ACTD in the Joint Expeditionary Force Experiment (JEFX) program (PE 0207028F).

(U) A. Mission Description

The Air Force's Blue Force Tracking ACTD is a continuation of an ACTD started in 2003. Because the ground forces use different communications and distribution methods to develop the Blue Force ground picture, there are latency and granularity problems in the Blue Force ground picture, resulting in a lack of data interoperability. This ACTD will develop, integrate, and sustain web-enable Common Operating Picture (COP) capabilities for Blue Force Tracking that will be interoperable with Service systems. All candidate solutions for these capabilities will be tested under this ACTD before migration to the Service for sustainment.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$0	No Activity
(U)	$0	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$0	No Activity
(U)	$0	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,200	Training, Tactics, Procedure (TTP)/CONOP Development
(U)	$500	Field Tests
(U)	$6,837	Spiral 3 software development
(U)	$8,537	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.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603850F Integrated Broadcast Service (DEM/VAL) — PROJECT: 4778

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget			8,537	
(U)	Appropriated Value				
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions				
	b. Small Business Innovative Research				
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram				
	e. Rescissions				
(U)	Adjustments to Budget Years Since FY 2003 PBR				
(U)	Current Budget Submit/FY 2004 PBR			8,537	

(U) Significant Program Changes:
Not Applicable.

(U) D. Other Program Funding Summary ($ in Thousands)
(U) Not applicable.

(U) E. Acquisition Strategy
Not Applicable.

(U) F. Schedule Profile
(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603924F High Energy Laser Advanced Technology Program

PROJECT: 5095

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5095	High Energy Laser Advanced Technology Program	0	0	10,910	8,569	6,153	3,834	3,889	3,952	0	0
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2004, this program was transferred to the Air Force by the Office of the Secretary of Defense. The Air Force plans to continue the tri-Service operation of the program under the High Energy Laser (HEL) Joint Technology Office (JTO).

(U) A. Mission Description

This program funds DOD HEL advanced technology development aimed at translating technology solutions for broadly defined military problems into demonstrated pay-offs such as increased capabilities, increased supportability, or increased affordability. HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, nearly unlimited magazine depth, low-cost per kill, and reduced logistics requirements since there is no need for stocks of munitions or warheads. As a result, HELs have the potential to perform a wide variety of military missions. These include interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and the ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DOD initiative in HEL science and technology being conducted by the HEL JTO. In general, efforts funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions. As a result of this focus and of close coordination with the Military Departments and Defense Agencies, this program complements other DOD HEL programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid-state lasers, beam control, optics, propagation, and free-electron lasers. Under this program these technologies are integrated and tested in sub-scale demonstration systems or sub-systems. When appropriate, the JTO will transition these technologies to appropriate Military Department, Defense Agency, and/or industry programs.

(U) FY 2002 ($ in Thousands)

(U) $0 This activity was performed under PE 0603924D8Z, High Energy Laser Research. Funding was approximately $15.8 million.

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 This activity is performed under PE 0603924D8Z, High Energy Laser Research. Funding is approximately $13.6 million.

(U) $0 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2003
BUDGET ACTIVITY 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603924F High Energy Laser Advanced Technology Program
	PROJECT 5095

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$5,000	Develop solid state lasers that have potential as future high energy laser (HEL) weapon laser devices because they require only electrical energy in order to run, thereby greatly simplifying systems engineering and supportability. A major focus will be the Joint High Power Solid State Laser (HPSSL) project to accelerate the demonstration of the solid state laser at initial weapon grade power levels. Demonstrate a 25 kilowatt laboratory laser. Continue development of a design for a 100 kilowatt laser. Assemble successful pieces from individual applied research projects (e.g., reliable pump diode lasers, diode-laser drivers, thin-disk amplifiers, phase-conjugate mirrors, mist cooling) into a demonstration sub-system scalable to weapon power levels.
(U)	$3,110	Develop beam-control technologies for surface, air, and space mission areas, as well as develop supporting technologies. Using successful pieces from individual applied research projects (e.g., deformable mirrors, wavefront sensors, advanced tracking and compensation algorithms) begin to develop a fieldable, sub-scale tactical beam-control system.
(U)	$800	Develop free electron laser (FEL) technologies that scale to high power and permit FELs to be fielded on military platforms. Begin designing and planning tests of a scalable FEL that can be operated on a military platform (e.g., a ship).
(U)	$1,000	Develop chemical laser advanced technologies and concepts that allow higher performance and more supportable chemical lasers. Begin development of an integrated closed-cycle chemical laser device of high power, to include realistic capability to regenerate spent laser fuels.
(U)	$1,000	Develop modeling and simulation technologies to provide a fully realistic model of end-to-end system performance, from birth of photons in the laser to their death at the target, thereby improving the design of HEL systems and reducing the need for expensive field testing. Demonstrate a fully realistic end-to-end system performance model applicable to many different HEL weapon systems.
(U)	$10,910	Total

(U) B. Budget Activity Justification

This program is in Budget Activity 3, Advanced Technology Development, since it enables 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 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603924F High Energy Laser Advanced Technology Program
	PROJECT: 5095

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	0	0	0	
(U)	Appropriated Value				
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions				
	b. Small Business Innovative Research				
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram				
	e. Rescissions				
(U)	Adjustments to Budget Years Since FY 2003 PBR			10,910	
(U)	Current Budget Submit/FY 2004 PBR			10,910	

(U) Significant Program Changes:
In FY 2004, this program was transferred to the Air Force by the Office of the Secretary of Defense. The Air Force plans to continue the tri-Service operation of the program under the High Energy Laser (HEL) Joint Technology Office (JTO).

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

(U) PE 0602500F, Multi-Disciplinary Space Technology.
(U) PE 0602890F, High Energy Laser Research.
(U) PE 0603444F, Maui Space Surveillance System.
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.
(U) PE 0603605F, Advanced Weapons Technology.
(U) PE 0601108F, High Energy Laser Research Initiatives.
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.
(U) PE 0602605F, Directed Energy Technology.
(U) PE 0602307A, Advanced Weapons Technology.
(U) PE 0602114N, Power Projection Applied Research.
(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 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603924F High Energy Laser Advanced Technology Program / PROJECT: 5095

(U) E. Acquisition Strategy

Not Applicable.

(U) F. Schedule Profile

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0804757F JOINT NATIONAL TRAINING CENTER

PROJECT: 5124

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5124	Training Transformation	0	0	2,940	2,947	2,916	3,009	2,998	3,080	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

In FY04 84757F, Joint National Training Center, is a new PE and includes new start efforts.

(U) A. Mission Description

Supports the SECDEF's Transformation in Training/Joint National Training Capability (JNTC). Develops capabilities that integrate live, virtual, and constructive elements into a seamless joint training environment. Using a scientific and phased approach, researches new technologies and methods that provide a crucial technology-based foundation supporting all JNTC operations.

(U) FY 2002 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2003 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2004 ($ in Thousands)
(U) $500 Begin basic operating support, system acquisition, and engineering support
(U) $500 Begin Joint National Training Capability development studies
(U) $1,940 Begin Combat Training Range development efforts to include Joint National Training Capability requirements
(U) $2,940 Total

(U) B. Budget Activity Justification

This program is in budget activity 3 - Advanced Technology Demonstration because it supports rapid transformation of Department of Defense training into a Joint National Training Capability.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE: February 2003
BUDGET ACTIVITY: 03 - Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0804757F JOINT NATIONAL TRAINING CENTER	PROJECT: 5124

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

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	0	0	0	
(U)	Appropriated Value	0	0		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	0	0		
	b. Small Business Innovative Research	0	0		
	c. Omnibus or Other Above Threshold Reprogram	0	0		
	d. Below Threshold Reprogram	0	0		
	e. Rescissions	0	0		
(U)	Adjustments to Budget Years Since FY 2003 PBR	0	0	2,940	
(U)	Current Budget Submit/FY 2004 PBR	0	0	2,940	TBD

(U) Significant Program Changes:

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

(U) Related Activities:
(U) PE 0604735F, Combat Training Ranges
(U) PE 0207429F, Combat Training Range Equipment
(U) PE 0207428F, Air Warfare Center-Nellis Range Complex

(U) E. Acquisition Strategy

The acquisition strategy will be competitive, with cost plus fixed fee and firm fixed price contracts.

(U) F. Schedule Profile

(U) Not applicable