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

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

	Cost ($ in Millions)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	58.192	56.908	53.437	68.586	69.507	72.502	77.919	82.779	Continuing	TBD
5031	Advanced Optics & Laser Space Tech	18.144	18.989	20.871	21.168	22.183	22.046	28.188	28.707	Continuing	TBD
5032	Advanced Space Materials	10.030	0.000	0.000	5.058	4.575	3.274	3.338	3.395	Continuing	TBD
5033	Rocket Propulsion Demonstration	21.161	28.484	25.347	27.543	29.159	33.880	37.992	39.159	Continuing	TBD
5034	Advanced Space Sensors	6.112	9.435	7.219	12.049	12.767	12.843	7.915	8.058	Continuing	TBD
5062	Advanced Structures for Space Vehicles	2.745	0.000	0.000	2.768	0.823	0.459	0.486	3.460	Continuing	TBD

Note: In FY 2005, efforts in Projects 5032 and 5062 will be delayed until FY 2007 due to higher Air Force priorities.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates multi-disciplinary space technologies focusing on separate technology areas including: 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 develop and demonstrate 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, and electronic counter-countermeasures for spacecraft applications; and 5) advanced structures for space vehicles develop space unique requirements for a horizontally launched transatmospheric vehicle operating in an extreme environment. In FY 2005, Congress added $3.0 million for Streaker - Small Launch Vehicle and $3.3 million for Vortex Cold Wall Low Cost Rocket Engines to PE 0603401F, Advanced Space Technology; the Air Force has requested these funds be moved to this PE. 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.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC

(U) B. Program Change Summary ($ in Millions)

		FY 2004	FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	62.077	51.114	59.564	76.337
(U)	Current PBR/President's Budget	58.192	56.908	53.437	68.586
(U)	Total Adjustments	-3.885	5.794		
(U)	Congressional Program Reductions				
	Congressional Rescissions		-0.506		
	Congressional Increases		6.300		
	Reprogrammings	-1.684			
	SBIR/STTR Transfer	-2.201			

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

(U) Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

PROJECT NUMBER AND TITLE: 5031 Advanced Optics & Laser Space Tech

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5031	Advanced Optics & Laser Space Tech	18.144	18.989	20.871	21.168	22.183	22.046	28.188	28.707	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

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

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: 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.	4.828	3.638	3.051	1.801
(U) In FY 2004: Developed laser relay mirror concepts and designed technology demonstrations to advance global strike, global presence, and ballistic missile defense capabilities for the warfighter. Further developed modeling and simulation tools for relay mirrors.				
(U) In FY 2005: Demonstrate dual line-of-sight tracking technology by tracking a satellite with a relay mirror. Complete the construction of and test the optical quality of a two kilogram per square meter ultra-lightweight mirror.				
(U) In FY 2006: Plan a demonstration to actively track a cruise missile by relaying both the illuminator and the scoring beam through the relay and differentially pointing them at the output. Demonstrate the ability to apply advanced high energy laser (HEL) optical coatings on a three-meter diameter substrate such as lightweight SiC primary mirrors. Design and build a lightweight mirror/micro electro-mechanical system integration test bed for the evaluation of advanced optical components.				
(U) In FY 2007: Begin investigations in support of a high power demonstration to kill a missile through a relay mirror. Apply a dielectric coating on and test an HEL, meter-class, SiC primary mirror. Complete the closed-loop performance of selected advanced wavefront control devices for imaging and beam control from space.				
(U)				
(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for applications including antisatellite weapons, relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imaging.	3.948	4.577	4.929	5.074
(U) In FY 2004: Completed integration and began testing of sodium-beacon laser on Starfire Optical Range (SOR) 3.5 meter telescope. This will enable full aperture point-ahead atmospheric compensation for low-power laser projection to satellites on weapons-class beam director.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5031 Advanced Optics & Laser Space Tech

(U)	In FY 2005: Complete integration and begin testing of sodium-beacon adaptive optics system including compensated infrared imaging of low earth orbit (LEO) satellites.				
(U)	In FY 2006: Begin testing of advanced laser-beacon adaptive optics system on SOR 3.5 meter telescope to increase imaging resolution/laser beam control. Perform high-resolution satellite imaging at short wavelengths. Demonstrate and characterize performance of point-ahead compensated laser propagation to LEO satellites using sodium-beacon adaptive optics.				
(U)	In FY 2007: Demonstrate fully compensated laser propagation to LEO satellites; measure beam profile and intensity on target. Begin development of precision aimpoint stabilization through turbulence.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate optical technologies for high bandwidth ground-to-air communications.	9.368	0.000	0.000	0.000
(U)	In FY 2004: Developed advanced modular deformable mirrors and adaptive optical control systems. Developed advanced optical filters, infrared sensors, and signal processing systems. Began design of communications breadboard for automated ground stations.				
(U)	In FY 2005: Not Applicable.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate advanced optical beam control technologies for laser propagation through severe and/or extended atmospheric turbulence.	0.000	10.774	12.891	14.293
(U)	In FY 2004: Not Applicable.				
(U)	In FY 2005: Begin fabrication of ground test equipment for field characterization of laser propagation through atmospheric turbulence. Begin development of advanced adaptive optical and tracking technologies for reliable operation in stressing atmospheric conditions.				
(U)	In FY 2006: Complete integration of first phase ground test system for characterization of laser propagation through atmospheric turbulence. Complete laboratory experiments and begin field testing of advanced adaptive optical and tracking technologies in stressing atmospheric conditions.				
(U)	In FY 2007: Begin integration of advanced ground test system for characterization of laser propagation through atmospheric turbulence. Demonstrate and characterize operation of advanced adaptive optical and tracking technologies for laser propagation to space targets in stressing atmospheric conditions.				
(U)	Total Cost	18.144	18.989	20.871	21.168

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5031 Advanced Optics & Laser Space Tech

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

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(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.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

PROJECT NUMBER AND TITLE: 5032 Advanced Space Materials

Cost ($ in Millions)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5032 Advanced Space Materials	10.030	0.000	0.000	5.058	4.575	3.274	3.338	3.395	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2005, efforts in this project will be delayed until FY 2007 due to higher Air Force priorities.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates 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. Sub-scale 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) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate advanced materials and processing technologies to enable revolutionary improvements in the performance of air-breathing and rocket-based aerospace vehicles and weapons.	10.030	0.000	0.000	5.058

(U) In FY 2004: Developed ceramic-based materials (monolithic and composite) capable of being processed into complex shapes for load bearing structures in space access systems and static, turbine-based combined cycle and scramjet components. Initiated materials and design concept study on durable reusable high-temperature protection systems for launch vehicles. Developed, characterized, and evaluated ceramic-based materials (monolithic and composite) for high temperature protection systems in reusable high-speed systems, especially for leading edges, control surfaces, and high temperature protection seals. Developed and assessed metallic materials (monolithic and composite) for space access structures and propulsion system components emphasizing increased operating temperature, environmental compatibility, and durability. Demonstrated innovative material concepts, such as ablative and oxidation - protection coatings coupled with advanced refractory composites, for high-temperature protection system leading edges for reentry vehicles and high-Mach vehicles. Developed analytical modeling tools to predict material behavior in cryogenic and hydrocarbon environments for air-breathing and rocket-based vehicles. Developed and assessed jamming and damage protection for sensors and payloads in space systems and initiate research for agile infrared filters.

(U) In FY 2005: Not Applicable.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Develop advanced materials approaches to provide durable, maintainable high-temperature

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5032 Advanced Space Materials

protection systems for leading edge applications on high-speed, reusable launch, and future reentry vehicle concepts. For management of the thermal and structural loads, combinations of candidate materials, including organic matrix composites, ceramics, metals, carbon foams, aerogels, heat pipes, and phase change materials, will be investigated. Develop advanced ceramic materials and processing technologies for load bearing structures designed for high-temperature, multi-cycle applications in an oxidizing environment. Develop rocket propulsion materials for liquid and solid rocket engine components and validate performance in scaled component demonstrations.

(U)	Total Cost	10.030	0.000	0.000	5.058

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

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602102F, Materials.										
PE 0602500F,										
(U) Multi-Disciplinary Space Technology.										
PE 0603112F, Advanced										
(U) Materials for Weapon Systems.										
This project has been coordinated through the										
(U) Reliance process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

PROJECT NUMBER AND TITLE: 5033 Rocket Propulsion Demonstration

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5033	Rocket Propulsion Demonstration	21.161	28.484	25.347	27.543	29.159	33.880	37.992	39.159	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced and innovative low-cost rocket turbomachinery and components, low-cost space launch propulsion system technologies, and 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 could improve the performance of expendable systems' payload capabilities by ~20 percent, and reduce launch, operations, and support costs by ~30 percent. Responsiveness and operability of propulsion systems will be enhanced for reusable launch systems. Technology advances could 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 contribute to 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) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles. Note: In FY 2007, increase in funding is due to greater emphasis on the upper stage technology efforts.	14.528	14.206	14.093	20.927

(U) In FY 2004: Completed integration of components for the Integrated Powerhead Demonstration of advanced, long life, hydrogen-based engine technologies.

(U) In FY 2005: Complete Integrated Powerhead Demonstration test series. Begin scale-up of advanced lightweight thrust chamber and nozzle technologies. Start scale-up of advanced cryogenic upper stage technologies including higher efficiency energy conversion systems.

(U) In FY 2006: Continue scale-up and begin testing of advanced lightweight thrust chamber and nozzle technologies. Continue scale-up of advanced cryogenic upper stage technologies including higher efficiency energy conversion systems.

(U) In FY 2007: Complete testing of advanced lightweight thrust chamber and nozzle technologies. Continue scale-up of advanced cryogenic upper stage technologies including higher efficiency energy conversion systems.

(U)

Exhibit R-2a, RDT&E Project Justification			DATE: February 2005
BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE: 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE: 5033 Rocket Propulsion Demonstration	

(U)	MAJOR THRUST: Develop solar electric propulsion technologies for existing and future upper stage, orbit transfer vehicles, and satellite formation flying, station keeping, and repositioning.	4.072	2.620	3.792	4.023
(U)	In FY 2004: Developed electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of low earth orbit (LEO) to geosynchronous earth orbit (GEO) transfer. Prepared for delivery of the advanced small satellite propulsion demonstration unit for a microsatellite demonstration supporting improved capability for Air Force imaging requirements				
(U)	In FY 2005: Continue development of electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of LEO to GEO transfer. Begin component integration for a high-power Hall thruster demonstration. Complete delivery of the advanced small satellite propulsion demonstration unit for a microsatellite demonstration.				
(U)	In FY 2006: Continue development of electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of LEO to GEO transfer. Continue component development for the high-power Hall thruster demonstration. Support test flight of the advanced small satellite propulsion demonstration unit for a microsatellite demonstration.				
(U)	In FY 2007: Continue development of electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of LEO to GEO transfer. Begin component integration for the high-power Hall thruster demonstration. Complete support of test flight of the advanced small satellite propulsion demonstration unit for a microsatellite demonstration. Initiate hardware scale-up for an advanced hybrid propulsion system for satellites.				
(U)					
(U)	MAJOR THRUST: Develop missile propulsion, aging, and surveillance technology for intercontinental ballistic missiles to include demonstration of missile propulsion technology and Post Boost Control Systems (PBCS). Note: Efforts complete in FY 2006.	1.413	4.528	6.615	0.000
(U)	In FY 2004: Fabricated final PBCS components for test and demonstration. Fabricated final components (to include propellant, case, and nozzle) for the interim strategic sustainment demonstration motors.				
(U)	In FY 2005: Complete fabrication of components for the PBCS demonstration and conduct test. Continue fabrication and begin integration and test for the interim strategic sustainment demonstration motors. Commence assessment and fabrication of the final strategic sustainment demonstration motors.				
(U)	In FY 2006: Complete fabrication of final components for the final strategic sustainment demonstration motors and prepare for test. Complete assessment and fabrication of the final strategic sustainment demonstration motors.				
(U)	In FY 2007: Not Applicable.				
(U)					

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5033 Rocket Propulsion Demonstration

(U)	MAJOR THRUST: Develop electric and advanced chemical based monopropellant propulsion technologies for future satellite propulsion systems.	1.148	0.885	0.847	2.593
(U)	In FY 2004: Demonstrated pulsed plasma thruster. Completed development of propulsion system for Air Force small satellites. Developed advanced monopropellant and began vehicle propulsion ground demonstration.				
(U)	In FY 2005: Continue demonstration of pulsed plasma thruster. Continue development of advanced monopropellant and vehicle propulsion ground demonstration.				
(U)	In FY 2006: Continue demonstration of pulsed plasma thruster. Complete advanced monopropellant thruster demonstration.				
(U)	In FY 2007: Complete demonstration of pulsed plasma thruster. Initiate development of an advanced space storable bi-propellant engine.				
(U)					
(U)	CONGRESSIONAL ADD: Streaker - Small Launch Vehicle.	0.000	2.974	0.000	0.000
(U)	In FY 2004: Not Applicable.				
(U)	In FY 2005: Develop core boosters and payload interfaces for possible use in the small launch vehicle to be used for rapid and affordable deployment of small satellite payloads.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Vortex Cold Wall Low Cost Rocket Engines.	0.000	3.271	0.000	0.000
(U)	In FY 2004: Not Applicable.				
(U)	In FY 2005: Mature technologies for an advanced low-cost, low-weight, high-performance hydrocarbon vortex thrust chamber to integrate and test in flight-type engines.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	Total Cost	21.161	28.484	25.347	27.543

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

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0602102F, Materials.										
(U) PE 0602203F, Aerospace Propulsion.										
(U) PE 0602500F,										

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

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

Multi-Disciplinary Space Technology.

(U) PE 0602601F, Spacecraft Technology.

PE 0603114N, Power

(U) Projection Advanced Technology.

PE 0603216F, Aerospace

(U) Propulsion Power Technology.

(U) PE 0603401F, Advanced Spacecraft Technology.

PE 0603853F, Evolved

(U) Expendable Launch Vehicle Program.

This project has been coordinated through the

(U) Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

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BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

PROJECT NUMBER AND TITLE: 5034 Advanced Space Sensors

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5034	Advanced Space Sensors	6.112	9.435	7.219	12.049	12.767	12.843	7.915	8.058	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates space sensor technologies, including radio frequency sensors; intelligence, surveillance, and reconnaissance sensors (ISR); 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) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop a material 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. Note: Efforts complete in FY 2005.	0.306	0.193	0.000	0.000
(U) In FY 2004: Developed a forward predictive capability validated with empirical measurements. Performed chemical analyses of an expanded target set and continue developing an enhanced surface scattering model. Assessed environmental influences on spectral signatures.				
(U) In FY 2005: Complete the development of material signature analysis research into the area of polarimetric signatures. Develop an enhanced system-level modeling capability that incorporates additional signature modalities, including the addition of polarimetric signatures.				
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Not Applicable.				
(U)				
(U) MAJOR THRUST: 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.	0.965	2.341	2.234	1.321
(U) In FY 2004: Designed direction finding technologies to maximize navigation warfare exploitation techniques for enhanced offensive and defensive combat capabilities. Developed assured reference technologies to provide precise time, position, and velocity for on-board and off-board platform applications. Developed antenna wavefront simulation technology to assess anti-jam GPS III techniques.				
(U) In FY 2005: Demonstrate assured reference technologies to provide precise time, position, and velocity for on-board and off-board platform applications. Demonstrate antenna wavefront simulation technology to assess anti-jam GPS III techniques.				
(U) In FY 2006: Design space-based distributed position, navigation, and time (PNT) technologies to				

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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5034 Advanced Space Sensors

	achieve optimal sensor fusion for a Common Operation Picture (COP). Design multi-ship virtual flight test simulation technology to assess networked clusters of "mini" unmanned aerial vehicles, ISR, and space-based platforms.				
(U)	In FY 2007: Develop space-based distributed PNT technologies to achieve optimal sensor fusion for a COP. Develop multi-ship virtual flight test simulation technology to assess networked clusters of "mini" unmanned aerial vehicles, ISR platforms, and space-based platforms.				
(U)					
(U)	MAJOR THRUST: 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.	0.529	1.101	1.653	1.640
(U)	In FY 2004: Completed designs and initiated fabrication of false alarm package hardware for space flight. Coordinated on-orbit experimental testing. Developed initial concept for space-hardened geolocation, spectrometer, and processor modules. Developed breadboard for geolocation, spectrometer, and algorithm processor modules.				
(U)	In FY 2005: Initiate characterization of space-qualified false-alarm sensor modules. Fabricate and integrate space-qualified components for false-alarm sensor space flight engineering test units. Develop mechanical, electrical, and functional interfaces to a host satellite. Plan for on-orbit testing, data collection, and system evaluation. Downselect designs for space-qualified laser warning sensors for rapid detection and characterization of laser designators, trackers, dazzlers, and weapons.				
(U)	In FY 2006: Integrate false alarm package space-flight components onto space flight host. Continue planning and coordinating for on-orbit testing, data collection, and system evaluation. Develop risk-reduction technology for space-qualified laser warning sensors for rapid detection and characterization of laser designators, trackers, dazzlers, and weapons. Complete development of a space-based laser threat scenario testbed for satellite-as-a-sensor technology evaluations				
(U)	In FY 2007: Space flight of false alarm package space-flight components. Initiate on-orbit testing, data collection and system evaluation with false alarm phenomenology suite. Initiate fabrication of advanced space-qualified laser warning sensors for rapid detection and characterization of laser designators, trackers, dazzlers, and weapons. Initiate testing with space-based laser threat scenario testbed for satellite-as-a-sensor technology evaluations.				
(U)					
(U)	MAJOR THRUST: Develop advanced laser communication component and sub-system technology to support a network-level topology for Airborne Intelligence Surveillance and Reconnaissance (AISR).	4.312	5.800	3.000	5.000
(U)	In FY 2004: Integrated and tested electro-optical communication component technology into an airborne communication testbed, and evaluate performance with ground terminals under simulated				

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5034 Advanced Space Sensors

space-to-ground, low elevation angle path lengths. Defined requirements for laser communication channelization to develop multiple user access capability. Developed aircraft optical network technologies 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) In FY 2005: Develop an integrated electro-optical communication terminal for evaluation and testing of AISR links between an airborne communication testbed and ground terminals under simulated space to ground atmospheric conditions. Develop subsystem technologies for a shared radio frequency/ electro-optical aperture to service high bandwidth communication needs. Examine applicability of shared apertures to multiple user access capability. Develop aircraft optical network 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) In FY 2006: Continue development of an integrated electro-optical communication terminal for evaluation and testing of AISR links between an airborne communication testbed and ground terminals. Continue development of shared radio frequency/electro-optical apertures to service high bandwidth communication needs. Test applicability of shared apertures to maintaining air network link connectivity under in weather conditions. Install aircraft optical network 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. Demonstrate a combined radio frequency/ optical communication air to air to ground high bandwidth network.

(U) In FY 2007: Begin development of an integrated wideband radio frequency/electro-optical communication terminal and shared aperture antenna for evaluation and testing in an air network layer. Continue development of technologies for shared radio frequency/electro-optical apertures to service high bandwidth communication needs. Continue testing applicability of shared apertures to maintaining air network link connectivity under in weather conditions. Expand flight demonstrations of air network layer technologies radio frequency, optical and combined radio frequency/optical communication terminals.

(U)

(U) MAJOR THRUST: Develop, demonstrate, and evaluate spectral-temporal sensing technologies for detection and identification of transient and moving targets for battlespace surveillance and space situational awareness. Note: In FY 2006, spectral sensing technology efforts from PE 0603203F, Advanced Aerospace Sensors, are extended to the space environment.	0.000	0.000	0.332	1.088

(U) In FY 2004: Not Applicable.

(U) In FY 2005: Not Applicable.

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5034 Advanced Space Sensors

(U)	In FY 2006: Design a testbed sensor to evaluate the performance potential of spectral-temporal sensing for battlespace surveillance missions. Model expected performance for a variety of targets, including muzzle flashes, artillery and tank fire, and battlefield explosions					
(U)	In FY 2007: Finalize design of a testbed sensor to evaluate the performance potential of spectral-temporal sensing for battlespace surveillance missions and begin sensor system fabrication. Perform supporting laboratory and field experiments, as necessary, and develop a performance characterization plan.					
(U)						
(U)	MAJOR THRUST: Reduce technology risk for space sensor platform payload components and exploitation of infrastructure integration. Note: In FY 2007, spectral platform and integration efforts from PE 0603203F, Advanced Aerospace Sensors, are extended to the space environment.	0.000	0.000	0.000	3.000
(U)	In FY 2004: Not Applicable.					
(U)	In FY 2005: Not Applicable.					
(U)	In FY 2006: Not Applicable.					
(U)	In FY 2007: Initiate integration of space-sensor technologies into a complete payload simulation test bed with selected hardware in the loop and demonstrate system design feasibility.					
(U)	Total Cost	6.112	9.435	7.219	12.049	

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

		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(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										

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5034 Advanced Space Sensors

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

eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

PROJECT NUMBER AND TITLE: 5062 Advanced Structures for Space Vehicles

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5062	Advanced Structures for Space Vehicles	2.745	0.000	0.000	2.768	0.823	0.459	0.486	3.460	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2005, efforts in this project will be delayed until FY 2007 due to higher Air Force priorities.

(U) A. Mission Description and Budget Item Justification

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) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop the airframe and payload technologies required to enable horizontal launch of reusable high altitude aerospace vehicles.	2.745	0.000	0.000	2.768
(U) In FY 2004: Further developed 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.				
(U) In FY 2005: Not Applicable.				
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Continue developing 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.				
(U) Total Cost	2.745	0.000	0.000	2.768

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

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
PE 0602500F, (U) Multi-Disciplinary Space Technology.										

(U) This project has been coordinated through the

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5062 Advanced Structures for Space Vehicles

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

Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.