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

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2004

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

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

Cost ($ in Millions)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	51.688	62.077	51.114	59.564	76.337	81.755	73.055	Continuing	TBD
5031	Advanced Optics & Laser Space Tech	14.012	19.437	19.158	22.755	25.303	26.800	27.814	Continuing	TBD
5032	Advanced Space Materials	6.381	11.615	0.000	0.000	5.813	5.316	3.909	Continuing	TBD
5033	Rocket Propulsion Demonstration	24.369	22.032	22.437	28.155	30.710	32.714	33.239	Continuing	TBD
5034	Advanced Space Sensors	4.511	6.018	9.519	8.654	11.605	16.055	7.633	Continuing	TBD
5062	Advanced Structures for Space Vehicles	2.415	2.975	0.000	0.000	2.906	0.870	0.460	Continuing	TBD

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 2004, 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 studies in PE 0602500F, Multi-Disciplinary Space Technology, Project 5027.

(U) A. Mission Description and Budget Item Justification

This program develops and demonstrates multi-disciplinary space technologies in five 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 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. 5) Advanced structures for space vehicles develop space unique requirements of a horizontal launched Transatmospheric vehicle operating in an extreme environment.

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2004
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 2003	FY 2004	FY 2005
(U)	Previous President's Budget	54.161	62.610	55.814
(U)	Current PBR/President's Budget	51.688	62.077	51.114
(U)	Total Adjustments	-2.473	-0.533	
(U)	Congressional Program Reductions			
	Congressional Rescissions		-0.533	
	Congressional Increases			
	Reprogrammings	-0.160		
	SBIR/STTR Transfer	-2.313		

(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.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2004

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 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
5031 Advanced Optics & Laser Space Tech	14.012	19.437	19.158	22.755	25.303	26.800	27.814	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2003, space unique tasks in PE 0603605F, Projects 3150 and 3647, were transferred into this project in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

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

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2003	FY 2004	FY 2005
(U) MAJOR THRUST: Perform directed energy and space environment assessments on satellites in support of national space control and space situational awareness requirements.	0.019	0.000	0.000
(U) In FY 2003: Provided data to U.S. Space Command for the performance of Laser Clearinghouse functions. Fused finite state models with other satellite data and observables to produce a more complete space situational awareness picture.			
(U) In FY 2004: Not Applicable.			
(U) In FY 2005: Not Applicable.			
(U)			
(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.	1.228	5.172	3.670
(U) In FY 2003: Developed system concepts and design technology demonstrations of laser relay mirrors and membrane mirrors to advance global strike, global presence, and ballistic missile defense capabilities for the warfighter. Quantified the performance of a membrane mirror coated with a high-energy laser dielectric coating and designed a space membrane mirror experiment. Developed modeling and simulation tools for space-based relay mirrors.			
(U) In FY 2004: Develop laser relay mirror concepts and design technology demonstrations to advance global strike, global presence, and ballistic missile defense capabilities for the warfighter. Further develop modeling and simulation tools for relay mirrors.			
(U) In FY 2005: Developing critical optical technologies. Integrate mature technologies onto an airborne relay mirror system for developmental and field tests and ultimately an airborne risk reduction demonstration. Complete design of ultra-light mirror space demonstration experiment.			
(U)			
(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for applications including	7.926	4.229	4.618

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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**

	antisatellite weapons, relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imaging.			
(U)	In FY 2003: Performed beam pointing and guidestar radiometry (for atmospheric compensation) tests using a sodium-wavelength laser beacon. Designed and began 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). Demonstrated high-accuracy active satellite tracking on 3.5 meter telescope with simultaneous compensated satellite imaging and compensated laser projection to a low-earth-orbit satellite (integrated beam control demonstration).			
(U)	In FY 2004: 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)	In FY 2005: Complete integration and testing of sodium-beacon adaptive optics system including compensated infrared imaging of low earth orbit satellites. Integrate hybrid-beacon full aperture point-ahead atmospheric compensation system on 3.5-meter telescope.			
(U)				
(U)	MAJOR THRUST: Develop and demonstrate optical technologies for high bandwidth ground-to-air communications.	0.000	10.036	10.870
(U)	In FY 2003: Not Applicable.			
(U)	In FY 2004: Develop advanced modular deformable mirrors and adaptive optical control systems. Develop advanced optical filters, infrared sensors, and signal processing systems. Begin design of communications breadboard for automated ground stations.			
(U)	In FY 2005: Develop and build advanced modular deformable mirrors and adaptive optical control systems. Develop advanced optical filters, infrared sensors, and signal processing systems. Develop a portable enclosure system for optical ground terminal.			
(U)				
(U)	CONGRESSIONAL ADD: Aerospace Relay Mirror System.	4.839	0.000	0.000
(U)	In FY 2003: Developed technologies for an aerospace (airborne) relay mirror testbed. Developed and enhanced techniques for dual line of sight control via a coude path and two separate telescopes. Developed, matured, and integrated beam control, optical, and platform hardware to provide risk reduction for a full-scale relay mirror system. Developed a point design for the optical system and control system, and integrated with all subsystems. Tailored and integrated point-ahead beacon technology into the testbed.			
(U)	In FY 2004: Not Applicable.			
(U)	In FY 2005: Not Applicable.			
(U)	Total Cost	14.012	19.437	19.158

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 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 2004

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 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
5032 Advanced Space Materials	6.381	11.615	0.000	0.000	5.813	5.316	3.909	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

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 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. 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) B. Accomplishments/Planned Program ($ in Millions)	FY 2003	FY 2004	FY 2005
(U) MAJOR THRUST: 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.	1.420	0.000	0.000
(U) In FY 2003: Completed the demonstration of improved material processes with increased yields for robust, high performance, and producible infrared detector materials. Validated and demonstrated materials and materials processing technologies to improve affordability of spacecraft components. Validated measured effects of space exposure on advanced material systems.			
(U) In FY 2004: Not Applicable.			
(U) In FY 2005: Not Applicable.			
(U)			
(U) MAJOR THRUST: 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.	1.320	1.776	0.000
(U) In FY 2003: Identified and evaluated optical limiter materials for the protection of near-infrared to short-wave infrared staring focal plane arrays.			
(U) In FY 2004: Develop optical limiter materials for the protection of near-infrared to short-wave infrared staring focal plane arrays.			
(U) In FY 2005: Not Applicable.			
(U)			

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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

(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.	3.641	9.839	0.000
(U)	In FY 2003: Identified and evaluated cryogenic fluid compatible material and affordable processing technologies for large, lightweight, potentially load bearing tank structures for air-breathing and rocket-based vehicles. Evaluated and characterized ceramic and organic-based composite materials for durable, very high temperature aerospace vehicle and weapon leading edges.			
(U)	In FY 2004: Develop 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. Initiate materials and design concept study on durable reusable high-temperature protection systems for launch vehicles. Develop, characterize and evaluate 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. Develop and assess metallic materials (monolithic and composite) for space access structures and propulsion system components emphasizing increased operating temperature, environmental compatibility, and durability. Demonstrate 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. Develop analytical modeling tools to predict material behavior in cryogenic and hydrocarbon environments for air-breathing and rocket-based vehicles. Develop and assess jamming and damage protection for sensor and payload in space systems and initiate research for agile infrared filters.			
(U)	In FY 2005: Not Applicable.			
(U)	Total Cost	6.381	11.615	0.000

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

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
(U) PE 0602102F, Materials. PE 0602500F, (U) 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									

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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

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

duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE February 2004
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 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
5033 Rocket Propulsion Demonstration	24.369	22.032	22.437	28.155	30.710	32.714	33.239	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

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

(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 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 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 2003	FY 2004	FY 2005
(U) MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles.	11.176	15.020	11.536
(U) In FY 2003: Tested turbopumps for integration into an advanced hydrogen engine for the Integrated Powerhead Demonstration. Completed redesign and analysis of advanced hydrocarbon engines.			
(U) In FY 2004: Complete integration of components for the Integrated Powerhead Demonstration of advanced, long life, hydrogen-based engine technologies. Initiate component designs and analyses of hydrocarbon demonstration for reusable launch vehicle concepts.			
(U) In FY 2005: Complete testing for the Integrated Powerhead Demonstration. Enhance component designs and analyses of hydrocarbon demonstration for reusable launch vehicle concepts. Scale-up advanced cryogenic upper stage technologies including higher efficiency energy conversion systems..			
(U)			
(U) MAJOR THRUST: 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.	3.363	3.600	2.412
(U) In FY 2003: Completed demonstration of solar thermal propulsion technologies, such as strut development and			

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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**

pointing and tracking, for orbit transfer and maneuvering propulsion technology. Developed preliminary electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of low-earth-orbit to geosynchronous-earth-orbit transfer. Tested initial capability of the advanced small satellite propulsion demonstration to develop microsatellite formation flying capability for Air Force imaging requirements.

(U) In FY 2004: Continue program to develop electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of low-earth orbit to geosynchronous-earth-orbit transfer. Prepare for delivery of the advanced small satellite propulsion demonstration unit for a microsatellite demonstration supporting improved capability for Air Force imaging requirements. Begin next phase solar thermal demonstration.

(U) In FY 2005: Advance development of electric propulsion systems for orbit-transfer by developing high-power Hall thrusters capable of low-earth orbit to geosynchronous-earth-orbit transfer. Complete delivery of the advanced small satellite propulsion demonstration unit for a microsatellite demonstration. Enhance solar electric/thermal technology developments improving power efficiency and thruster efficiency. Begin component integration for a high power Hall thruster demonstration.

(U)

(U) MAJOR THRUST: Develop missile propulsion, aging, and surveillance technology for Intercontinental Ballistic Missile to include demonstration of missile propulsion technology and Post Boost Control Systems (PBCS). Efforts support Technologies for the Sustainment of Strategic Systems Program - Phase 1.	3.360	1.490	6.468

(U) In FY 2003: Demonstrated PBCS component technologies with available materials to reduce hardware costs and maintain system performance. Tested strategic sustainment demonstration technologies that integrated advanced propellant, case, and nozzle technologies and demonstrated cost and performance goals.

(U) In FY 2004: Begin fabrication of final PBCS components for testing and demonstration. Fabricate 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 Post Boost Control demonstration test. Complete fabrication and begin integration and testing for the interim strategic sustainment demonstration motors. Commence assessment and fabrication of the final strategic sustainment demonstration motors.

(U)

(U) MAJOR THRUST: Develop electric and advanced chemical based monopropellant propulsion technologies for future satellite propulsion systems.	0.373	1.922	2.021

(U) In FY 2003: Completed brassboard level testing of a pulsed plasma thruster system. Completed preliminary hot fire testing of the thruster integrated with the power-processing unit. Enhanced development of propulsion system for Air Force small satellites required for key Air Force Space Command concepts. Completed preliminary acceptance and verification testing of flight hardware for microsatellite demonstration spacecraft.

(U) In FY 2004: Demonstrate pulsed plasma thruster. Complete development of propulsion system for Air Force small satellites required for key Air Force Space Command Concepts. Develop advanced monopropellant and begin vehicle

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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**

propulsion ground demonstration.

(U) In FY 2005: Demonstrate pulsed plasma thruster. Complete development of propulsion system for Air Force small satellites required for key Air Force Space Command Concepts. Develop advanced monopropellant and begin vehicle propulsion ground demonstration.

(U)

(U)	MAJOR THRUST: Evaluate reusable hydrocarbon scramjet technology to support rocket-based combined cycle engines.	6.097	0.000	0.000

(U) In FY 2003: Evaluated reusable hydrocarbon scramjet component technology to support rocket-based combined cycle engines. Components evaluated were consistent with Integrated High Payoff Rocket Propulsion Technology Phase II hydrocarbon boost demonstration in FYs 2005-2006. Determined component technologies to be integrated into combined cycle engine development, as well as hydrocarbon engine components for highly reusable launch.

(U) In FY 2004: Not Applicable.

(U) In FY 2005: Not Applicable.

(U)

(U)	Total Cost	24.369	22.032	22.437

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

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
(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									

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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)

(U) Expendable Launch Vehicle Program. 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 2004
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 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
5034 Advanced Space Sensors	4.511	6.018	9.519	8.654	11.605	16.055	7.633	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

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.

(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; 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 2003	FY 2004	FY 2005
(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.	0.283	0.323	0.194
(U) In FY 2003: Performed chemical analyses and developed an enhanced surface scattering model. Developed and validated a baseline predictive signature prediction model for space-qualified hyperspectral electro-optical sensors.			
(U) In FY 2004: Develop 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) In FY 2005: Expand 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)			
(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.	0.951	1.020	2.362
(U) In FY 2003: Designed advanced M-Code technologies. Developed assured reference technologies to operate in space to provide precise time, position, and velocity for multiple platforms. Demonstrated virtual flight test technology for improved assessment of GPS anti-jam technologies.			
(U) In FY 2004: Design direction finding technologies to maximize Navigation Warfare exploitation techniques for enhanced offensive and defensive combat capabilities. Develop assured reference technologies to provide precise			

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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

	time, position, and velocity for on-board and off-board platform applications. Develop antenna wavefront simulation technology to assess anti-jam Global Positioning System (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)				
(U)	MAJOR THRUST: Develop and demonstrate advanced wide-band electronic combat (EC) radio frequency 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 systems.	0.430	0.000	0.000
(U)	In FY 2003: Developed requirements analysis and hardware and software designs of future space electronic combat systems.			
(U)	In FY 2004: Not Applicable.			
(U)	In FY 2005: Not Applicable.			
(U)				
(U)	MAJOR THRUST: Develop space-based support jamming technologies and techniques that will counter advanced radio frequency threats.	1.430	0.000	0.000
(U)	In FY 2003: Completed study of and continued developing and assessing physical requirements for applying space-based support jamming technologies in space unique environments.			
(U)	In FY 2004: Not Applicable.			
(U)	In FY 2005: Not Applicable.			
(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.	1.417	0.559	1.111
(U)	In FY 2003: Completed design of space-hardened processor, geolocation, and spectrometer modules. Completed false alarm package hardware and began integration onto flight platform. Completed false alarm test planning. Performed risk reduction analysis for space-hardened geolocation, spectrometer, and processor modules. Fabricated initial components of space laser warning sensor modules.			
(U)	In FY 2004: Integrate false alarm package for space flight. Breadboard geolocation, spectrometer, and algorithm processor modules. Complete fabrication of space-qualified false alarm sensor modules. Plan for on-orbit testing.			
(U)	In FY 2005: Complete designs for space-qualified laser warning sensors for rapid detection and characterization of laser designators, trackers, dazzlers, and weapons. Develop geolocation, spectrometer, and algorithm processor modules, and integrate false-alarm reduction techniques in preparation for space flight test. Initiate characterization of space-qualified false-alarm sensor modules. Fabricate and integrate space-qualified components for space flight			

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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**

engineering test unit. Develop mechanical, electrical, and functional interfaces to a host satellite. Plan for on-orbit testing, data collection, and system evaluation.

(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).	0.000	4.116	5.852
(U)	In FY 2003: Not Applicable.			
(U)	In FY 2004: 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 requirements for laser communication channelization to develop multiple user access capability. Develop 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)	Total Cost	4.511	6.018	9.519

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

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 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									

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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)

Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2004

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 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
5062	Advanced Structures for Space Vehicles	2.415	2.975	0.000	0.000	2.906	0.870	0.460	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2003, space unique efforts transferred from PE 0603211, Projects 4920 and 486U, into this project in conjunction with the Space Commission recommendation 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 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 2003	FY 2004	FY 2005
(U) MAJOR THRUST: Develop the airframe and payload technologies required to enable horizontal launch.	2.415	2.975	0.000
(U) In FY 2003: 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. Investigated integration of the multidisciplinary technologies required to design and demonstrated these aerospace vehicle configurations such as materials, munitions, human effectiveness, and both rocket- and airbreathing-based hypersonic propulsion.			
(U) In FY 2004: 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) In FY 2005: Not Applicable. Efforts in this project will be delayed until FY 2007 due to higher Air Force priorities.			
(U) Total Cost	2.415	2.975	0.000

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

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
PE 0602500F, (U) Multi-Disciplinary Space Technology.									

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
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)

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

(U) D. Acquisition Strategy

Not Applicable.