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

DATE: February 2002

BUDGET ACTIVITY: 03 - Advanced Technology Development

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

	COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	0	0	50,538	45,417	52,216	50,381	52,203	Continuing	TBD
5031	Advanced Optics & Laser Space Tech	0	0	9,842	9,993	12,103	10,362	11,326	Continuing	TBD
5032	Advanced Space Materials	0	0	6,870	2,102	1,889	1,774	2,943	Continuing	TBD
5033	Rocket Propulsion Demonstration	0	0	26,370	29,169	30,734	31,141	31,547	Continuing	TBD
5034	Advanced Space Sensors	0	0	4,856	4,153	7,490	7,104	6,387	Continuing	TBD
5062	Advanced Structures for Space Vehicles	0	0	2,600	0	0	0	0	0	0
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: This is 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 will be 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.

(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 targeting and electronic counter-countermeasures for spacecraft

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(U) A. Mission Description Continued

applications.

(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 2001	FY 2002	FY 2003	Total Cost
(U)	Previous President's Budget	0	0	0	
(U)	Appropriated Value	0	0		
(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 2002 PBR			50,538	
(U)	Current Budget Submit/FY 2003 PBR	0	0	50,538	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.

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DATE: February 2002

BUDGET ACTIVITY: 03 - Advanced Technology Development

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

PROJECT: 5031

COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5031 Advanced Optics & Laser Space Tech	0	0	9,842	9,993	12,103	10,362	11,326	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.

(U) A. Mission Description

This project provides for the demonstration and detailed assessment of space unique technologies needed for advanced optics and high energy laser weapons for space mission areas. Near-term focus is on ground-based lasers for the space control mission.

(U) FY 2001 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2002 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2003 ($ in Thousands)
(U) $521 Develop optics technologies for very long-range laser beam projection, collection, and optical imaging with a space-based bifocal relay mirror. Continue design and development of brassboard laser beam control system utilizing innovative adaptive optics technology for advanced beam steering and aberration correction. Develop technology to demonstrate integration of various optical components scaled to a realistic relay mirror system. Perform theoretical analysis, modeling and simulation, and optical design of a relay mirror optical system, optimizing efficiency. Develop and build hardware associated with this task.
(U) $126 Perform directed energy and space environment vulnerability assessments on satellites in support of national Space Control and Space Situational Awareness requirements. Provide sure-safe 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 posture.
(U) $9,195 Perform atmospheric compensation/beam control experiments from Starfire Optical Range 3.5-meter telescope for applications including antisatellite weapons, relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imaging. Perform beam pointing and

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

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

guidestar radiometry tests using 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 3.5m telescope with simultaneous compensated satellite imaging and compensated laser projection to a low-earth-orbit satellite (integrated beam control demonstration).

(U) $9,842 Total

(U) B. Project Change Summary

Not Applicable.

(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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BUDGET ACTIVITY: 03 - Advanced Technology Development

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

PROJECT: 5032

COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5032 Advanced Space Materials	0	0	6,870	2,102	1,889	1,774	2,943	Continuing	TBD

Note: In FY 2003, space unique tasks in PE 0603112F, Projects 2100 and 3946, 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 and demonstrates materials technologies for transition into Air Force space systems. The laser hardened materials project develops materials technologies for the broadband protection of space sensors from a variety of laser threats. The world laser market is rapidly expanding with easy export to any nation. Survivability solutions must account for a variety of lasers facing a mission. To harden systems against all potential lasers, a combination of approaches is required. The space materials transition task provides critical data for prospective users to make engineering decisions on both structural and non-structural materials for space. Reducing risk in materials technology improves the affordability, reliability, survivability, and operational performance of current and future space systems.

(U) FY 2001 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2002 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2003 ($ in Thousands)
(U) $1,559 Develop and demonstrate advanced materials and processing technologies for space vehicles and subsystems to provide enhanced surveillance capabilities, improved access to space, and improve the 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) $1,411 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 staring

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

focal 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) $3,900 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) $6,870 Total

(U) B. Project Change Summary

Not Applicable.

(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 2002

BUDGET ACTIVITY: 03 - Advanced Technology Development

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

PROJECT: 5033

COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5033 Rocket Propulsion Demonstration	0	0	26,370	29,169	30,734	31,141	31,547	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. 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 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 and reduce the launch and operations and support costs by ~30 percent. 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 projects in this program 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 2001 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2002 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

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

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$12,032	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)	$3,715	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)	$3,711	Develop propellant technologies for the sustainment of strategic systems. 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)	$412	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)	$6,500	Component level evaluation of reusable hydrocarbon boost 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 rocket component technology to be integrated into future combined cycle engine development, as well as hydrocarbon engine components for highly reusable launch.
(U)	$26,370	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 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 2002

BUDGET ACTIVITY: 03 - Advanced Technology Development

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

PROJECT: 5034

COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5034 Advanced Space Sensors	0	0	4,856	4,153	7,490	7,104	6,387	Continuing	TBD

Note: In FY 2003, space unique tasks in PE 0603203F, Project 665A, and PE 0603270F, Projects 431G and 691X, 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 and demonstrates space sensor technologies, including radio frequency (RF) sensors, electro-optical sensors, laser warning sensors, targeting and attack radar sensors, and electronic counter-countermeasures (ECCM). By developing multi-function radar, laser, electronic combat (EC), 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 2001 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2002 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2003 ($ in Thousands)
(U) $186 Develop a signature analysis capability to evaluate the physical/chemical origins of paint/camouflage thermal reflectance features, and to 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.

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

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

(U)	$430	Develop and demonstrate advanced wide-band EC 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 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)	$1,632	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)	$1,617	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)	$4,856	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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BUDGET ACTIVITY: 03 - Advanced Technology Development

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

PROJECT: 5062

COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5062 Advanced Structures for Space Vehicles	0	0	2,600	0	0	0	0	0	0

Note: This is a new PE, but not a New Start, resulting from the Space Commission recommendation to consolidate all space unique activities. Outyear funding profiles will be addressed in future budget activities.

(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 2001 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2002 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2003 ($ in Thousands)
(U) $2,600 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) $2,600 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) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.