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

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602601F Space Technology

	COST ($ in Thousands)	FY 2000 Actual	FY 2001 Estimate	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	141,083	68,850	61,086	56,479	62,222	69,153	71,107	73,263	Continuing	TBD
1010	Space Systems Protection Technology	27,284	28,031	18,430	13,186	16,284	17,818	18,322	18,878	Continuing	TBD
1011	Rocket Propulsion Technology	40,553	0	0	0	0	0	0	0	Continuing	TBD
3326	Lasers and Imaging Technology	17,279	0	0	0	0	0	0	0	Continuing	TBD
4846	Spacecraft Payload Technologies	0	8,318	11,734	10,308	9,752	13,830	14,217	14,651	Continuing	TBD
5797	Advanced Weapons and Survivability Technology	18,110	0	0	0	0	0	0	0	Continuing	TBD
8809	Spacecraft Vehicle Technologies	37,857	32,501	30,922	32,985	36,186	37,505	38,568	39,734	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2001, spectral sensing (intelligent satellite systems and hyperspectral technology) efforts in Project 3326 move into Project 8809. In FY 2001, in order to align projects within the Air Force Research Laboratory organization, all rocket propulsion efforts performed in Project 1011 were transferred to PE 0602203F, Project 4847, and all lasers and imaging efforts in Project 3326 and all advanced weapons and survivability technology efforts in Project 5797 were transferred to PE 0602605F, Projects 4866 and 4867. In FY 2001, Project 8809 has been split with spacecraft payload technology being moved into Project 4846. In FY 2001, the satellite protection related work currently in Project 8809 moved into Project 1010. FY 2003 - FY 2007 budget numbers do not reflect the DoD strategy review results.

(U) A. Mission Description

This PE focuses on three major areas. First, space systems protection develops technologies to understand, mitigate, and exploit effects of weather and geophysics environments on the design and operation of Air Force systems. Second, spacecraft payload technologies improve satellite payload operation by investigating advanced component and subsystem capabilities. The last major area, spacecraft vehicles, focuses on spacecraft platform, payload, and control technologies, and their interactions. Note: In FY 2001, Congress added $16.8 million ($7.0 million for the High-frequency Active Auroral Research Program, $3.0 million for S&T Space Survivability, $1.8 million for Advanced Aluminum Aerostructures, $1.0 million for Composite Cryogenic Fuel Tanks, and $4.0 million for Terabit).

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(U) B. Budget Activity Justification

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

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

		FY 2000	FY 2001	FY 2002	Total Cost
(U)	Previous President's Budget (FY 2001 PBR)	146,021	57,687	54,495	
(U)	Appropriated Value	147,118	69,487		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-73			
	b. Small Business Innovative Research	-3,467			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	-1,442			
	e. Rescissions	-1,053	-637		
(U)	Adjustments to Budget Years Since FY 2001 PBR			6,591	
(U)	Current Budget Submit/FY 2002 PBR	141,083	68,850	61,086	TBD

(U) Significant Program Changes:

Changes to this program since the previous President's Budget are due to Program Element and Project realignment.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology	PROJECT: 1010

	COST ($ in Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
1010	Space Systems Protection Technology	27,284	28,031	18,430	13,186	16,284	17,818	18,322	18,878	Continuing	TBD

(U) A. Mission Description

This project develops the technologies to exploit the aerospace environment to the warfighter's benefit. The project focuses on characterizing the battlespace environment for realistic space system design, modeling, and simulation. It includes technologies to specify and forecast the environment from 'mud to sun' for planning operations and ensuring uninterrupted system performance. Finally, it includes technologies that allow the opportunity to mitigate or exploit the aerospace environment for both offensive and defensive operations. Note: In FY 2001, Congress added $10.0 million ($3.0 million for S&T Space Survivability and $7.0 million for the High-frequency Active Auroral Research Program (HAARP)).

(U) FY 2000 ($ in Thousands)

(U) $2,110 Developed technologies to monitor, predict, and control space environmental conditions hazardous to DoD operational space systems. Leads to improved space system design, lifetime, and operational capabilities and aids in anomaly resolution. Demonstrated on-orbit hazardous radiation monitoring using miniaturized radiation sensing technology. Completed analysis of interaction of transmitted radio waves with radiation belts to assess potential for mitigation of hazardous radiation levels.

(U) $8,521 Developed real-time infrared background clutter code, target detection techniques, and decision aids for application to space-based surveillance, laser weapons, and countermeasure systems, including detection of low-observable targets. Completed all-altitude background clutter prediction code to extend capability to all lines-of-sight for space-based sensors to support design of next generation surveillance satellites. Completed measurements of the visibility of surrogate missile target signatures through clouds to support earliest warning of missile launches. Performed measurements of atmospheric optical turbulence in theaters of interest, and developed deployment aids and performance prediction models to minimize operational impacts of optical turbulence on laser weapons. Validated atmospheric turbulence effects on operational laser systems.

(U) $3,365 Developed capability of forecasting outages of communication and navigation systems caused by ionospheric scintillation. This forecasting capability will support the warfighter through situational awareness, allowing operators to use alternate links or systems in times of outages. Designed, fabricated, and began testing of Communications/Navigation Outage Forecasting System (C/NOFS) planar Langmuir probe sensor for measuring ionospheric plasma levels. Began design and fabrication of neutral wind sensor for C/NOFS.

(U) $9,699 Expanded experimental research capabilities to characterize and control the physical processes produced in space via interactions with very high power radio waves at the HAARP Alaska facility. Focused experimental research to assess concepts for imaging underground structures, providing new radio wave propagation modes via the generation of irregularities in the ionosphere, and for characterizing the space weather environment under both normal and naturally disturbed conditions. Transferred the operations center at HAARP facility from a temporary to a

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology / PROJECT: 1010

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

modern control center. Installed additional on- and off-site diagnostic instruments. Developed software to provide real-time access to diagnostic data via the internet. Supported basic and applied research and related applications.

(U) $2,425 Developed software that predicts the impact of weather on precision-guided munitions (PGMs) and navigation and surveillance systems and that predicts weather effects uniquely impacting DoD military operations. Developed and transitioned: target acquisition weather software which provides pilots with PGM target detection and lock-on ranges; night vision goggles (NVG) operations weather software which provides pilots with NVG detection ranges; weather automated mission planning software; infrared target-scene simulation software; and contrail and cloud forecasts software.

(U) $582 Developed algorithms that facilitate the military applications of spectral detection from space with emphasis on target detection and terrain classification. Hyperspectral imaging will allow improvements and new capabilities in target detection, terrain classification, and other surveillance tasks using space-based surveillance assets. Developed and validated atmospheric compensation and image analysis algorithms needed to exploit data collected by space-based hyperspectral sensors. Included background models into data processing system to support analysis and exploitation of data collected by space-based hyperspectral sensors to assess military utility of space-based hyperspectral sensors.

(U) $582 Performed measurements to quantify the effects of current solar cycle maximum on Global Positioning System (GPS) navigation links, developed associated algorithm for specifying GPS link outages, and upgraded and validated ionospheric effects specification model. Specification of outages to GPS navigation links caused by ionospheric scintillation will allow operators to select alternate systems and will provide situational awareness of degraded accuracy of GPS. Improved and validated ionospheric specification provides increased situational awareness for GPS navigation accuracy, communications outages, high frequency communications connectivity, errors and clutter on surveillance radars, and geolocation accuracy. Developed GPS outage nowcasting system using ground-based sensors and advanced algorithms that include effect of solar cycle. Developed assimilation model for ionospheric specification that uses real-time data from ground and space sensors and is upgradeable to a forecasting capability.

(U) $27,284 Total

(U) FY 2001 ($ in Thousands)

(U) $2,424 Develop technology to predict space environmental hazards, including solar disturbances and the earth's radiation belts, and the resultant disruptions of operational space systems. Develop technology that control hazardous space particle populations in extreme environments resulting from natural or adversary actions. Begin algorithm development for predicting solar disturbances impacting Air Force systems using all-sky images from new space-based detector system. Develop time-dose probability codes for improved space system design using data from new compact environment anomaly sensors. Begin detailed design of active space particle control experiment to demonstrate the feasibility of

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology
PROJECT: 1010	

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

space-based mitigation technologies.

(U) $9,783 Develop real-time infrared background clutter code, target detection techniques, and decision aids for application to space-based surveillance, laser weapons, and countermeasure systems, including detection of low-observable targets. Validate all-altitude background clutter prediction code through the use of space-based sensor data. Complete deployment aids and performance prediction models that minimize the operational impacts of atmospheric optical turbulence on laser weapons. Complete an assessment of advanced missile detection technologies that provide for the earliest detection of theater ballistic missiles in boost phase.

(U) $3,862 Develop artificial intelligence techniques, forecasting tools, and sensors for improved ionospheric specification and forecasting, including communications/navigation outage forecasting and space-based geolocation demonstrations. Communications/navigation outage forecasting will provide the warfighter with situational awareness and will permit operators to use alternate links or systems in times of outages. Complete the fabrication and test of instrumentation for communication/navigation outage forecasting system demonstration. Develop algorithms for correcting ionospheric effects on geolocation accuracy.

(U) $2,054 Develop key satellite threat warning technologies and tools for on-board satellite use that detect, geolocate, and characterize acquired intentional and unintentional ground-based radio frequency and laser signals. Satellite threat warning technologies enable the warfighter to have increased knowledge of possible hostile acts directed at mission critical satellites and aid in satellite anomaly resolution. Design key satellite protection technologies, such as geolocation algorithms, radio frequency antennas, and miniaturized sensor and processing electronics, for advanced satellite threat warning/attack reporting capabilities.

(U) $6,936 Expand experimental research capabilities to characterize and control the physical processes produced in space with very high power radio waves at the High Frequency Active Auroral Research Program (HAARP) Alaska facility. Continue to further develop and test concepts for imaging underground structures and provide new radio-wave propagation modes via the generation of irregularities in the ionosphere. Continue the collection of diagnostic data to characterize the space weather environment. Investigate ionospheric Extremely Low Frequency/Very Low Frequency (ELF/VLF) virtual antenna properties. Expand the high frequency radio transmitter capability from 8-MHz to 10-MHz. Extend roads and install additional diagnostic pads and instruments that reduce interference problems and enhance radio science capabilities.

(U) $2,972 Develop technologies that improve the survivability of space systems by specifying, forecasting, and mitigating the effects of the ionosphere and space radiation environment. Expand the coverage of the Scintillation Network Decision Aid (SCINDA), which is a component of a global system for predicting the effects of ionospheric scintillation on communication and navigation systems. Develop advanced, space-borne sensors to detect hazards to spacecraft from space particles and chemical contamination. Develop advanced instrumentation and analysis techniques for real-time monitoring of solar activity and improved prediction of space environmental hazards.

(U) $28,031 Total

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BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology
PROJECT: 1010	

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands)

(U) $2,475 Develop technologies for monitoring, predicting, and controlling space environmental conditions hazardous to DoD operational space systems. These technologies lead to improved space system design, lifetime, and operational capabilities and aid in anomaly resolution. Use simulations to assess technologies that control hazardous space particle populations in extreme environments resulting from natural or adversarial actions. Use all-sky images from space-based detector system to develop advanced algorithms for tracking system-impacting solar eruptions en route to Earth. Develop algorithms for short-term forecasting of solar flares, based on observations of plasma flow in solar active regions. Validate time-dose probability codes for space system design using data from compact environment anomaly sensors. Complete design of space particle control experiment and make the transition to Advanced Technology Development. Construct dynamic radiation belt data assimilation and forecast models to predict energetic electron spacecraft hazards.

(U) $8,270 Develop real-time infrared backgrounds clutter code, spectral signature libraries, target detection techniques, and decision aids for application to space-based surveillance, laser weapons, and countermeasure systems, including detection of low-observable targets. Technologies lead to increased surveillance capability and to more effective operation of laser weapons and countermeasures systems. Develop global clutter specification model and dim-target detection techniques for advanced space-based surveillance systems. Incorporate global clutter model into all-altitude background prediction code and validate model with space-based data. Conduct field measurements to validate candidate concepts for earliest detection of theater ballistic missiles in boost phase. Test and validate decision aids and performance prediction tools for turbulence effects on laser weapon system performance. Validate global spectral signature libraries created from Warfighter-1 data, and develop a modeling and simulation capability to predict the performance of surveillance functions under specified scene and atmospheric conditions.

(U) $6,295 Develop artificial intelligence techniques, forecasting tools, and sensors for improved ionospheric specification and forecasting, including communications/navigation outage forecasting and space-based geolocation demonstrations. This forecasting capability will support the warfighter through situational awareness, allowing operators to use alternate links or systems in times of outages. Integrate and validate the suite of ionospheric specification and forecast models for the Communications/Navigation Outage Forecast System (C/NOFS) Advanced Concept Technology Demonstration (ACTD). Assemble the models with data-handling systems to construct the C/NOFS data center. Provide reliable error maps for geolocation requirements. Expand the ground-based network of ultra high frequency and L-band satellite links to provide worldwide outage specification and enhance the ground-based component of C/NOFS. Establish high latitude sites to monitor formation and motion of polar ionospheric patches.

(U) $1,390 Develop key satellite threat warning technologies and tools for on-board satellite use that detect, geolocate, and characterize acquired intentional and unintentional ground-based radio frequency and laser signals. Satellite threat warning technologies enable the warfighter to increase knowledge of possible hostile acts directed at mission critical satellites and aid in satellite anomaly resolution. Complete miniaturization of radio frequency attack reporting receiver. Incorporate results of risk reduction space flight test into attack reporting system hardware and software and

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology
PROJECT: 1010	

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

begin system integration for year-long space flight demonstration. Investigate integrated attack reporting approaches.

(U) $18,430 Total

(U) B. Project Change Summary

Not Applicable.

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

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602601F Space Technology

PROJECT: 1011

COST ($ in Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
1011 Rocket Propulsion Technology	40,553	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2001, efforts in this project were transferred to PE 0602203F, Project 4847.

(U) A. Mission Description

The Rocket Propulsion Technology project pursues advances in rocket technologies for space access, maneuver, and for tactical and strategic missiles. Analytical and experimental areas of emphasis are propellants, combustion, rocket materials, strategic sustainment, and novel space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of future space and missile subsystems. Technologies are developed to reduce the weight and cost of components using new materials, and improved designs and manufacturing techniques. All efforts in this project are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program; a joint Department of Defense, National Aeronautics and Space Administration (NASA), and industry effort to focus rocket propulsion technology on national needs.

(U) FY 2000 ($ in Thousands)

(U) $4,815 Continued to develop high-energy density and non-toxic propellants for increased payload capability. Continued to develop promising propellants to transition into future high-performance boost and orbit transfer propulsion systems. Optimized source for producing high-energy density additives and developed techniques to accurately measure concentrations of these additives. The goal is to achieve cryogenic propellants that maximize future propulsion system performance. Continued preparation for demonstrations and transitioned additives into system-ready applications.

(U) $2,731 Developed advanced liquid engine combustion technology for improved performance while preserving chamber lifetime and reliability needs for engines used in heavy lift space vehicles. These efforts were accomplished by full-scale single element cold flow injector testing in windowed pressure vessels, using laser diagnostics. Characterized injector performance and reliability at high pressures. Developed a sub-scale hot fire experiment apparatus. The result of these efforts will be a flexible, low-cost subscale screening of candidate injector designs while preserving chamber lifetime and reliability requirements and goals, thereby reducing the cost of injector development to industry and government by two times. Continued to characterize, study, and evaluate injector performance with application to combustor chamber/injector compatibility to prevent damage to test and operational combustion.

(U) $3,450 Continued to develop advanced material technology for lightweight components and material property enhancements for use in launch and space systems. Completed development of low-cost, high temperature, non-erosive, lightweight, coated carbon-carbon ceramic and hybrid polymer components for use in solid rocket space launch and missile motors. Developed processes required to apply the materials to liquid-propellant rocket production for dramatic weight reductions and transition design and processing techniques for high-strength, low-weight engine and motor

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602601F Space Technology
PROJECT 1011	

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

components (metal and non-metal).

(U) $13,818 Continued to develop propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems. Continued developing and demonstrating advanced materials for rocket engine components and continued to develop turbomachinery, combustion devices, and propellant management devices for solid and liquid rockets. Began development of high temperature oxygen rich turbine materials for applications to oxidizer rich turbomachinery. Began application of advanced Aluminum Metal Matrix Composite Materials to rocket turbomachinery housings and rocket structural hardware. Completed testing of a high-performance, low-cost cryogenic upper stage combustion chamber for an expander cycle application. Completed the testing of a high performance hydrostatically supported liquid hydrogen. Continued characterizing new refractory combustion materials and devices to apply to liquid-propellant rocket engines with dramatic weight reductions. Continued to develop design and processing techniques for high-strength, low-weight engine and motor components (metals and non-metals). Initiated development of advanced lightweight rocket engine nozzle for upper stage and space booster applications. Verified performance and weight improvements of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles. Continued to develop liquid oxidizer for hybrid propulsion technologies for space boosters and air launched missiles.

(U) $3,748 Continued developing solar electric propulsion technologies for stationkeeping, repositioning, and orbit transfer appropriate for large communication satellites and satellite constellations. Continued Hall thruster development to higher powers to meet Air Force need for Low Earth Orbit/Geosynchronous Orbit orbit transfers using electric propulsion. Completed development of propulsion for Air Force small satellites (~100 kg). Continued development of propulsion systems for micro-satellites (<25 kg) needed for advanced Air Force imaging missions. Continued the design and test of solar thrusters and concentrators for future orbit transfer systems and satellite propulsion systems with longer life.

(U) $2,242 Continued the development of analytical tools for prediction of propellant life. Completed development of tools to increase the capability to determine the age life of strategic systems and other solid rocket motors.

(U) $1,950 Continued development of Post Boost Control Systems for sustainment of current Intercontinental Ballistic Missile (ICBM) fleet. Continued development of compatible case/liner, insulator, and case systems for higher combustion temperature propellants. Completed design and began fabrication of solid rocket motor test hardware. Fabricated and tested gas generator with non-refractory materials capable of withstanding high heat loads. Developed technologies that are readily available over the life of strategic systems, which may also be potentially advantageous to the development of the next generation strategic systems.

(U) $1,170 Continued development of missile propulsion technology for sustainment of current ICBM fleet. Completed design solid rocket motor test hardware.

(U) $2,730 Continued the development of propulsion technologies for the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program.

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BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology
PROJECT: 1011	

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

Completed the design efforts to minimize weight while significantly improving the heat transfer capability of a high pressure thrust chamber assembly.

(U) $2,242 Continued development of tactical missile propulsion systems. Completed fabrication of hybrid tactical oxider system for integration into test hardware. The fuel system was developed in coordination with Japan.

(U) $1,657 Continued the development of advanced upperstage and orbit transfer propulsion. Completed the design and fabrication of advanced solar thermal propulsion test hardware. Integrated propulsion components with system level components in preparation for space flight.

(U) $40,553 Total

(U) FY 2001 ($ in Thousands)

(U) $0 Efforts transferred to PE 0602203F, Project 4847.

(U) $0 Total

(U) FY 2002 ($ in Thousands)

(U) $0 Efforts transferred to PE 0602203F, Project 624847.

(U) $0 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.

(U) PE 0602303A, Missile Technology.

(U) PE 0603302F, Space and Missile Launch Technology.

(U) PE 0603311F, Ballistic Missile Technology.

(U) PE 0603401F, Advanced Spacecraft Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

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PROJECT: 1011	

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology	PROJECT: 3326

COST ($ in Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3326 Lasers and Imaging Technology	17,279	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2001, this project was transferred to PE 0602605F, Project 4866.

(U) A. Mission Description

This project examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. Technologies researched include advanced, short-wavelength laser devices for application as illuminators and imaging sources as well as advanced optical imagers for target identification and assessment. Laser technologies are studied for their utility in aimpoint selection, target maintenance, and damage assessment. Additionally, high power solid state and chemical laser devices, optical components, advanced beam control and atmospheric compensation technologies, techniques for laser target vulnerability assessments, and nonlinear optical processes and techniques are developed.

(U) FY 2000 ($ in Thousands)

(U) $1,602 Developed long-range optical technologies for increased resolution characterization and data fusion applications. Lightweight deployable mirrors that are the critical basis for these applications were demonstrated at the one-meter class size in the laboratory with holographic correction integrated into the test system. Issues associated with deployment schemes for the membrane mirrors were addressed.

(U) $449 Continued development of nonlinear optics technologies to support imaging and beam projection applications such as relay mirrors. Nonlinear optics allows non-mechanical beam cleanup and mirror corrections with greatly decreased complexity. Laboratory efforts concentrated on component development to obtain increased efficiency and resolution for scaling to large and higher power devices. Small scale tests and demonstrations of relay mirror components were performed.

(U) $3,458 Developed high power chemical and all-gas phase iodine laser technologies for applications such as directed energy weapons and illuminators. Demonstrated high energy, frequency conversion of chemical oxygen iodine laser (COIL) for potential airborne laser illuminator applications. Completed parallel technology efforts for the repetitively pulsed COIL illuminator. Evaluated these results and assess the potential of this technology for an alternate, scalable airborne laser illuminator. Improved efficiency and reduce weight of COIL devices for airborne laser missions. Developed with proof of principle experiments advanced COIL technologies which include iodine atom production with electric discharges and iodine atom production through chemical reactions. Evaluated, theoretically and experimentally, advanced ejector nozzle concepts which improve the pressure recovery potential of COIL devices. Demonstrated a 100-watt subsonic all-gas phase chemical iodine laser.

(U) $4,070 Developed laser source, beam control, and target coupling technologies to counter current and next generation air-to-air and surface-to-air missile threats to aircraft platforms. Developed compact, reliable, high-power, solid state laser technologies at mid-infrared wavelengths. Investigated new laser materials needed to reduce the size and weight (currently 40 pounds, one cubic foot) of solid state laser-based infrared countermeasure

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BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT 3326

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

demonstrator. Developed a mid-infrared laser with the beam brightness needed for platforms with high infrared signatures. Investigated novel materials effects associated with plasma/spark and ultra-fast lasers for countering focal plane array seekers. Investigated propagation, beam control, and imaging technologies related to ultra-fast lasers.

(U) $5,773 Developed low-cost, scalable, high power solid state laser architectures by integrating doped fiber lasers with diode-laser pump sources for directed energy applications such as unmanned aerial vehicle designators/imagers and next generation weapons applications such as space-based lasers and airborne lasers. Developed promising fiber laser technologies exhibiting attributes that will enable applications that require laser mobility such as low-cost, high efficiency (approaching 25%), compactness (10 milliwatts per cubic centimeter), and scalability. Developed integration technologies necessary for demonstration of power at 100s of Watts.

(U) $770 Developed relay mirror concepts and pursued development of large optics and their optical compensation for large mirror space-based applications.

(U) $1,157 Developed advanced laser remote optical sensing technology to support advanced standoff detection requirements for measurement and signature intelligence (MASINT), bomb damage assessment, target characterization, weapons of mass destruction, and theater intelligence, surveillance, and reconnaissance. Completed Phase I experiments for frequency agile heterodyne receiver development. Established transmitter/receiver requirements for unmanned aerial vehicle applications.

(U) $17,279 Total

(U) FY 2001 ($ in Thousands)

(U) $0 Program transferred to PE 0602605, Project 4866.

(U) $0 Total

(U) FY 2002 ($ in Thousands)

(U) $0 Program transferred to PE 0602605, Project 624866.

(U) $0 Total

(U) B. Project Change Summary

Not Applicable.

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PROJECT: 3326	

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

(U) Related Activities:

(U) PE 0603319F, Airborne Laser Demonstrator.

(U) PE 0603605F, Advanced Weapons Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602601F Space Technology

PROJECT: 4846

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4846	Spacecraft Payload Technologies	0	8,318	11,734	10,308	9,752	13,830	14,217	14,651	Continuing	TBD

Note: In FY 2001, spacecraft payload technology efforts have been split from Project 8809 and moved into Project 4846.

(U) A. Mission Description

This project develops advanced technologies that enhance spacecraft payload operations by improving component and subsystem capabilities. The project focuses on three primary areas: (1) the development of advanced, space-qualified, survivable electronics, and electronics packaging technologies; (2) development of advanced space data generation and exploitation technologies, including infrared, Fourier Transform hyperspectral imaging, polarimetric sensing, and satellite antenna subsystem technologies; and (3) development of high-fidelity space simulation models that support space-based surveillance and space asset protection research and development for the warfighter.

(U) FY 2000 ($ in Thousands)

(U) $0 Previously accomplished in Project 8809.

(U) $0 Total

(U) FY 2001 ($ in Thousands)

(U) $2,846 Develop advanced space infrared technologies, hardened focal plane detector arrays, and quantum well infrared photodetectors (QWIPs) to enable acquisition, tracking, and discrimination of hot targets, as well as 'cold body' targets such as decoys, satellites, and midcourse warheads. Design low temperature multi-color and low background infrared detectors and QWIPs, higher temperature infrared detectors, and higher performance radiation-hardened detectors. Continue experimental investigation of two-, three-, and multi-color detectors, and tunable and broadband gratings. Investigate future concepts for longer wavelength infrared detectors, mid-wavelength infrared detectors for higher temperature operation, and infrared detectors with optimal background-limited performance for stressing, low photon noise, and space backgrounds.

(U) $806 Develop hyperspectral imaging data exploitation methodologies for military remote sensing applications with the Fourier Transform HyperSpectral Imager (FTHSI). The FTHSI payload will demonstrate the capability of providing the warfighter data concerning terrain categorization, feature extraction, geological formation mapping, and trafficability within an area observed from space. Complete analysis of the hyperspectral imaging data received from the FTHSI payload. Complete assembly of data images for target identification and image evaluation for commercial and military purposes.

(U) $3,841 Develop technologies for space-based payload components such as low power, high performance, radiation-hardened electronic devices, micro-electro-mechanical system (MEMS) devices, and advanced electronics packaging for next generation high performance space electronics.

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

Goals are decreased feature size, improved scalability, decreased size/weight/power, and radiation-hardness. Continue characterizing microelectronic materials and internal structures and apply results to improve fabrication processes. Design next-generation low-power, quantum-sized devices such as high-speed, radiation-hardened, low-power alternatives for space applications. Fabricate improved radiation-hardened nonvolatile memories, Fast Fourier Transform (FFT) processors, optical sensors, and analog devices. Fabricate ultra-high density, low-power micro-electro-mechanical system (MEMS) device for evaluation in space environment. Fabricate smaller, lighter, lower power electronics packaging.

(U) $825 Develop modeling, simulation, and analysis (MS&A) tools for space-based surveillance systems, optical/infrared imaging space systems, large deployable space optics, and distributed satellite architecture payloads. MS&A tools provide data to validate research and development systems engineering level technology trade off decisions for space-based missions/campaign level assessments and for intelligent satellite system test beds. Integrate simulation architecture models using visual programming codes and commercial-off-the-shelf software to enhance fidelity of satellite constellation-level modeling. Interconnect satellite toolkit, spacecraft simulation toolkit, and weather and space simulation software into one framework. Demonstrate multi-satellite constellations and distributed satellite cluster models in simulation test bed.

(U) $8,318 Total

(U) FY 2002 ($ in Thousands)

(U) $4,397 Develop advanced infrared device technologies for space applications that support hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of targets such as decoys, satellites, and warheads, throughout their trajectory. Develop cryogenic detector and read-out devices that will perform for extended periods of time under adverse natural and enhanced space environments. Develop and evaluate both broadband and narrow band detector devices and the appropriate low-noise, cryogenic read-out device and device architectures necessary for multi-band (2- and 3-color) detection. Enhance device architectures for future space sensor concepts that include the need for radiation-hardness, radiation tolerance, longer wavelengths, higher operating temperatures and higher frame rates. Study next generation detection requirements for space, and explore and exploit potential infrared device solutions.

(U) $987 Develop hyperspectral imaging data exploitation methodologies for military imaging and remote sensing applications. Fourier Transform HyperSpectral Imager (FTHSI) and polarimetric sensing technologies will provide enhanced surveillance capability for future space-based sensor systems by improving the ability of the systems to discriminate military targets in various scenarios. Complete evaluation of the hyperspectral imaging system performance based on data received from the Fourier FTHSI payload. Develop technology and modeling for understanding the electro-optical/infrared (EO/IR) polarimetric phenomenology.

(U) $4,398 Develop technologies for space-based payload components such as low power, high performance, radiation-hardened electronic devices,

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

micro-electro-mechanical system (MEMS) devices, and advanced electronics packaging for next generation high performance space electronics. Expand microelectronic material characterization to silicon-on-insulator (SOI) and chalcogenide materials and apply radiation research and material defect analysis to improve device design. Fabricate and test monolithically integrated low power, silicon-based quantum-sized devices. Characterize new radiation-hardened nonvolatile digital memories, Fast Fourier Transform (FFT) processors, and optical sensors. Investigate design enhancements for ten-fold performance improvement for the memories and FFT processors. Fabricate nonvolatile analog memories. Establish a MEMS reliability test device for ground and space experiments. Investigate a chip-scale packaging system with optimized confinement features and coating for MEMS devices. Establish a non-volatile analog reconfigurable packaging architecture.

(U) $965 Develop modeling, simulation, and analysis (MS&A) tools for space-based surveillance systems, rendezvous and proximity operations, optical/infrared imaging space systems, large deployable space optics, and distributed satellite architecture payloads. Complete connection of satellite toolkit and spacecraft simulation toolkit. Extend simulation architecture to support flight software development and definition and conduct near-term flight test experiment.

(U) $987 Develop advanced satellite antenna architectures and performance characterization tools for large, lightweight, modular space antennas. The advanced antenna architectures will improve the affordability and capability of antennas for space-based payload subsystems for Air Force surveillance and navigation efforts. Develop algorithms for performance characterization of modular phased-array antenna tiles. Build and test engineering models to simulate performance of phased-array antenna tiles and integrated antenna modules to include MEMS time delay units for phase control. Characterize performance of antenna tiles and modules and correlate results to model predictions; update models based on actual performance. Extend engineering models to simulate performance of the antenna tiles and integrated modules in a space environment in preparation for demonstration on a three microsatellite constellation space flight experiment.

(U) $11,734 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0603401F, Advanced Spacecraft Technology.

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

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(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602601F Space Technology

PROJECT: 5797

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5797	Advanced Weapons and Survivability Technology	18,110	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2001, this project was transferred to PE 0602605F, Project 4867.

(U) A. Mission Description

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

(U) FY 2000 ($ in Thousands)

(U) $1,453 Investigated technologies for developing innovative HPM sources to support multiple Air Force applications such as command and control warfare and suppression of enemy air defenses. Conducted field test for single shot HPM device. Designed, built, and tested candidate repetitive device. Obtained experimental data to improve anchoring of existing computer models.

(U) $1,918 Assessed effects/lethality of directed energy weapon technologies against representative air and ground military systems. Investigated susceptibility of current fighter technologies and provide results to developers. Completed lethality assessment studies on selected military relevant targets. Continued to identify HPM protection requirements on large and small aircraft.

(U) $1,746 Developed wideband HPM technologies that support command and control warfare applications. Researched methods to enhance HPM source technology such as power throughput for solid state switches and high repetition rates for high pressure gas switches. Extended the current capabilities of electromagnetic modeling and simulation codes to better predict the electromagnetic environment induced in more complex geometric structures.

(U) $2,567 Developed narrowband HPM technologies that support suppression of enemy air defenses. Developed models of HPM effects for military electronic targets of interest. Validated and verified the models through measurement and computer simulation. Assessed predictability of models. Determined those HPM effects parameters enhanced through repetitively pulsing. Designed and developed component technologies - prime power, pulsed power, sources, and antennas - for repetitively pulsed systems.

(U) $5,544 Investigated HPM technologies that support offensive and defensive advanced airborne tactical applications made possible based on increased power available on future aircraft. Established the technical feasibility of the concepts that are emerging from the Directed Energy Applications in Tactical Aircraft Combat (DE ATAC) study by gathering the appropriate HPM effects data and investigating the feasibility of the source

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

technology specification set for each concept. Investigated a wide range of technology alternatives and lethality parameters and used this data in a trade off study to select the most promising concepts that optimizes performance, cost, and schedule.

(U) $554 Investigated Active Denial Technology applications for Agile Combat Support. Developed high specific power, millimeter-wave sources using computer simulation and experiments.

(U) $1,919 Assessed the vulnerability of six U.S., NATO, and foreign satellites to the effects of directed energy weapons, primarily high energy lasers and high power microwaves (HPMs). Previous assessments were updated, as required, based on new intelligence information. Other directed energy effects were included as appropriate.

(U) $2,409 Evaluated radio frequency threats to U.S. infrastructure.

(U) $18,110 Total

(U) FY 2001 ($ in Thousands)

(U) $0 Program transferred to PE 0602605, Project 4867.

(U) $0 Total

(U) FY 2002 ($ in Thousands)

(U) $0 Program transferred to PE 0602605, Project 4867.

(U) $0 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602202F, Human Systems Technology.

(U) PE 0603605F, Advanced Weapons Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

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(U) E. Schedule Profile Continued

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602601F Space Technology	PROJECT: 8809

	COST ($ in Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
8809	Spacecraft Vehicle Technologies	37,857	32,501	30,922	32,985	36,186	37,505	38,568	39,734	Continuing	TBD

(U) A. Mission Description

This project focuses on seven major space technology areas: spacecraft platforms (e.g., structures, controls, power, and thermal management); space-based payloads (e.g., survivable electronics); satellite control (e.g., software for autonomous distributed satellite formation flying, signal processing, and control); modeling and simulation of space-based systems; satellite protection technologies (e.g., space environment effects, debris prediction, and threat warning/attack reporting); microsatellite technologies; and integrated experiments of advanced technologies for transition to planned systems (e.g., payload/platform/launch vehicle merging). Note: In FY 2001, Congress added $6.8 million ($1.8 million for Advanced Aluminum Aerostructures, $1.0 million for Composite Cryogenic Fuel Tanks, and $4.0 million for Terabit).

(U) FY 2000 ($ in Thousands)

(U) $4,100 Developed technologies for advanced space platform subsystems such as cryocoolers, space vehicle thermal management, compact, high efficiency solar power cells, lightweight batteries, and innovative power generation and storage concepts. Advanced space platform subsystems will have more available power, longer operational lifetimes and increased operational range, and will be lighter and more affordable than current subsystems. Started development of 35 percent efficient solar cells and polymer batteries. Continued development of thin film solar cells, lithium-ion batteries, and thermal to electric conversion cells. Continued development of non-electrochemical energy storage techniques.

(U) $5,467 Developed technologies for advanced space platform structures such as spacecraft structural controls for vibration suppression, multi-functional structures, deployable large aperture optical arrays, and lightweight composite satellite and launch vehicle structures. Whole spacecraft launch vibration suppression will enable precision pointing and sensing systems. Multi-functional and composite structures, with a higher level of integration and standardized interfaces will be reusable, lighter, and more affordable. Deployable large aperture optical arrays will enable continuous space-based battlefield surveillance. Designed vibration suppression systems for primary and secondary payloads. Continued development of design and integration techniques for multi-functional structures and integration of multi-chip modules into spacecraft bus. Developed and fabricated component subsystems for deployable large aperture optical arrays.

(U) $2,520 Developed technologies for space-based payload components such as low power, high performance, radiation-hardened electronic devices, micro-electro-mechanical system (MEMS) devices, and advanced electronics packaging for next generation high performance space electronics. Goals are decreased feature size, improved scalability, decreased size/weight/power, and radiation-hardness. Characterized microelectronic materials and internal structures to improve fabrication processes. Characterized next generation low-power, quantum-sized devices for possible space application. Designed devices such as improved radiation-hardened nonvolatile memories, processors, sensors, and analog devices.

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PROJECT 8809	

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

Designed ultra-high density, low-power micro-electro-mechanical system (MEMS) device for evaluation in space environment. Designed smaller, lighter, lower power electronics packaging.

(U) $759 Developed modeling, simulation, and analysis (MS&A) tools for space-based surveillance systems, optical/infrared imaging space systems, large deployable space optics, and distributed satellite architecture payloads. MS&A tools provide data and validate research and development systems engineering level technology trade off decisions for space-based missions/campaign level assessments and for intelligent satellite system testbeds. Continued to integrate simulation architecture models using visual programming codes and commercial-off-the-shelf software to enhance fidelity of satellite constellation-level modeling.

(U) $2,037 Developed key satellite threat warning technologies and tools for on-board satellite use to detect, geolocate, and characterize acquired intentional and unintentional ground-based radio frequency and laser signals. Satellite threat warning technologies enable the warfighter to increase knowledge of possible hostile acts directed at mission critical satellites and aid in satellite anomaly resolution. Characterized technologies to determine whether hostile acts or the space environment are affecting critical warfighter mission satellites, discriminating between environmental/radiation effects, radio frequency interference, and laser signals. Developed methodology for determining signal information necessary for source evaluation and nature.

(U) $3,791 Developed ground support and small satellite integration technologies for spaceborne platforms with advanced bus components and standardized interfaces for testing and demonstrating revolutionary high payoff mission hardware and mission-enabling technologies for space and near-space experiments. The small experimental satellites provide an affordable, adaptable space platform as an orbiting 'lab-bench' to test high payoff, high risk mission hardware and reduce risk of further development by demonstrating proof-of-concept. Launched the MightySat II.1 vehicle and demonstrated operation of the integrated platform and stand-alone experimental payloads.

(U) $9,969 Developed microsatellite (10-100kg) technologies and integrated microsatellite technology concepts. This new class of small, highly capable satellites can reduce life cycle costs by as much as 90 percent and enables new space missions and architectures such as reconfigurable, multi-mission microsatellite formations for sparse aperture sensing, precise geolocation, secure communications, near-earth object inspection, and remote satellite servicing. Completed development of first microsatellite in the series to test autonomous microsatellite operations. Initiated design of microsatellite for a three-unit flight constellation to demonstrate on-orbit formation flying, inter-satellite communications, distributed processing, and sparse aperture sensing.

(U) $4,365 Developed hyperspectral imaging technologies for space-borne assets to provide improved capabilities for the warfighter in target detection, terrain classification, and related surveillance applications. Developed Warfighter-1 target detection and terrain classification algorithms and perform on-orbit evaluation of the hyperspectral sensor and ground operations. Completed integration and testing of data processing and exploitation algorithms for the Fourier Transform Hyperspectral Imaging sensor and validate results with baseline data. Developed an advanced

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

hyperspectral processing and data exploitation center for developing and validating hyperspectral imaging algorithms.

(U) $4,849 Continued the terabit technology program, focusing on increasing the channel capability and improving the bit error rate. Extended the range of the wireless 28GHz link.

(U) $37,857 Total

(U) FY 2001 ($ in Thousands)

(U) $3,559 Continue to develop technologies for advanced space platform subsystems such as cryocoolers, compact, high efficiency solar power cells, lightweight batteries, and innovative power generation and storage concepts. Continue development of 35 percent efficient solar cells and thin film solar cells. Complete development of power cells using thermal to electric conversion technology and lithium ion and polymer batteries. Improve accuracy of cryocooler modeling tools, and identify mechanisms that limit operational life and degrade cryocooler subsystem performance.

(U) $7,391 Continue to develop technologies for advanced space platform structures such as spacecraft structural controls for vibration suppression, multi-functional structures, deployable large aperture optical arrays, and lightweight composite satellite and launch vehicle structures. Develop and complete vibration suppression algorithms. Continue development of multi-functional structures and complete integration techniques. Integrate and ground test component subsystems of deployable large aperture optical arrays to identify performance of deployable optics.

(U) $2,325 Complete development of ground support and small satellite integration technologies for spaceborne platforms with advanced bus components and standardized interfaces for testing and demonstrating revolutionary high payoff mission hardware and mission-enabling technologies for space and near-space experiments. Complete MightySat II.1 mission operations and analyze platform and stand-alone experiment operations.

(U) $12,489 Continue to develop microsatellite (10-100kg) technologies and integrated microsatellite technology concepts. Fabricate components for microsatellite, and complete detailed design of a three-unit flight constellation to demonstrate on-orbit formation flying, inter-satellite communications, distributed processing, and sparse aperture sensing.

(U) $1,783 Develop and demonstrate innovative methodology for aluminum aerostructure design. Develop a technical strategy to insert aluminum processing/manufacturing capability into early design and analysis. Identify specific opportunities to employ methodology on Air Force weapon systems. Demonstrate benefits on selected parts/assemblies to minimize cost while maintaining mechanical properties.

(U) $991 Develop low-cost, lightweight, leak-proof, linerless, non-metallic composite cryogenic tanks for reusable and small expendable launch vehicle applications. Design, fabricate, and test lightweight composite end-bosses and perform studies to address problems with delamination and micro-cracking.

(U) $3,963 Further develop and evaluate the world's first optically implemented Code Division Multiple Access (CDMA) wide-band network within the

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

context of the Next Generation Internet. Assess and demonstrate the inherent security capabilities as a means of enhancing information assurance at the transmission level.

(U) $32,501 Total

(U) FY 2002 ($ in Thousands)

(U) $4,396 Develop technologies for advanced space platform subsystems, such as cryocoolers, compact, high-efficiency solar power cells and arrays, and innovative power generation concepts. Continue identification of mechanical mechanisms for assessing cryocooler reliability. Develop improved models for low-temperature cryocooler regenerator performance. Demonstrate a 32 percent efficient solar cell and a ten percent efficient thin-film solar cell.

(U) $8,898 Develop technologies for advanced space platform structures such as structural controls for vibration suppression, multifunctional structures, deployable large aperture optical arrays, and lightweight composite satellite and launch vehicle structures. Ground test payload vibration suppression systems. Fabricate and characterize performance of multi-functional structure designs. Continue integration and ground test of component subsystems of deployable large aperture optical arrays. Start development of multifunctional bus structure for small spacecraft.

(U) $17,628 Develop microsatellite (10-100kg) technologies and integrated microsatellite technology concepts. Integrate and test microsatellite engineering model, and begin component fabrication of a three-unit flight constellation to demonstrate on-orbit formation flying, inter-satellite communications, distributed processing, and sparse aperture sensing.

(U) $30,922 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602102F, Materials.

(U) PE 0603302F, Space and Missile Rocket Propulsion.

(U) PE 0603311F, Ballistic Missile Technology.

(U) PE 0603401F, Advanced Spacecraft Technology.

(U) PE 0603410F, Space Systems Environmental Interactions.

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

(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.