PE NUMBER: 0602601F
PE TITLE: Space Technology

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BUDGET ACTIVITY: 02 Applied Research

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	Cost ($ in Millions)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	100.608	107.419	84.540	92.178	112.361	127.242	125.580	127.000	Continuing	TBD
1010	Space Survivability & Surveillance	43.023	51.742	42.085	43.849	44.162	47.291	48.843	49.346	Continuing	TBD
4846	Spacecraft Payload Technologies	22.608	19.319	16.161	17.149	24.597	29.900	28.943	29.349	Continuing	TBD
5018	Spacecraft Protection Technology	3.943	2.607	2.401	2.219	2.346	2.473	2.503	2.526	Continuing	TBD
8809	Spacecraft Vehicle Technologies	31.034	33.751	23.893	28.961	41.256	47.578	45.291	45.779	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This PE focuses on four major areas. First, space environmental 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 operations by investigating advanced component and subsystem capabilities. Third, spacecraft protection develops technologies for protecting U.S. space assets in potential hostile settings. The last major area, spacecraft vehicles focuses on spacecraft platform, payload, and control technologies, and their interactions. Note: In FY 2005, Congress added $2.0 million for Elastic Memory Composites, $2.0 million for Integrated Control for Autonomous Space Systems (ICASS), $1.5 million for Converted Silicon Carbide for High Performance Optic Structures, $2.8 million for Electromagnetic (EM) Gradiometer for the Detection and Confirmation of Underground Hiding Places and Passageways, $1.0 million for Toughened Silicone Substrates for Flexible Solar Cells, $3.4 million for Lightweight and Novel Structures for Space Program, $1.1 million for USAF Center for National Security Research--Signature Exploitation, $5.5 million for High-frequency Active Auroral Research Program (HAARP), $1.5 million for Foldable Articulated Structures for Next Generation Spacecraft, and $2.8 million for Seismic Monitoring Program. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary space technologies.

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

		FY 2004	FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	101.539	88.909	89.644	97.609
(U)	Current PBR/President's Budget	100.608	107.419	84.540	92.178
(U)	Total Adjustments	-0.931	18.510		
(U)	Congressional Program Reductions		-4.131		
	Congressional Rescissions		-0.959		
	Congressional Increases		23.600		
	Reprogrammings				
	SBIR/STTR Transfer	-0.931			
(U)	Significant Program Changes:				
	Not Applicable.				

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C. Performance Metrics

(U) Under Development.

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Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
1010	Space Survivability & Surveillance	43.023	51.742	42.085	43.849	44.162	47.291	48.843	49.346	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops the technologies to exploit the space environment for warfighter's future capabilities. The project focuses on characterizing and forecasting the battlespace environment for realistic space system design, modeling, and simulation, as well as the battlespace environment's effect on space systems' performance. It includes technologies to specify and forecast the environment from "mud to sun" for planning operations and ensuring uninterrupted system performance, optimize space-based surveillance operations, and allow the opportunity to mitigate or exploit the space environment for both offensive and defensive operations. Finally, this project includes the seismic research program that supports national requirements for monitoring nuclear explosions.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop technologies for specifying, monitoring, predicting, and controlling space environmental conditions hazardous to Department of Defense (DoD) operational space systems in order to improve performance, reduce cost, and increase operational lifetimes.	3.113	4.124	4.182	4.995

(U) In FY 2004: Developed advanced space weather forecasting models combining remote sensing of interplanetary clouds with in situ plasma and fields data. Validated dynamic radiation belt model for satellite hazard forecasts with newly acquired data sets from operational DoD satellites. Developed advanced technology solar telescope for detecting and forecasting explosive solar events that generate spacecraft-damaging energetic particle events and initiate plasma clouds responsible for adverse communication and navigation effects. Developed capability to test sub-micron and nano-scale technology concepts for extremely small space hazard detectors.

(U) In FY 2005: Upgrade initial version of dynamic radiation belt specification and forecast model to include extreme solar shock events responsible for the worst radiation conditions. Complete conceptual design of advanced, high-resolution solar telescope and begin fabrication of next-generation solar hazard forecasting tool. Test novel concepts to detect high-energy space particles using micro- and nano-technology based sensors suitable for inclusion in microsatellite constellations to specify space weather. Build empirical solar flare forecast algorithms and initiate physics based model development to improve accuracy and lead-times for prediction of debilitating explosive events.

(U) In FY 2006: Initiate development of multi-sensor global data assimilation models for real-time situational awareness of energetic electron hazards to space systems. Validate dynamic radiation belt specification and forecast model with data from geosynchronous and low-Earth orbit DoD satellites. Complete physical design and accomplish Program Design Review of next generation, high-resolution solar telescope. Develop autonomous procedures to cross calibrate, quality control, and validate solar

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magnetic field data from disparate network of ground-based telescopes for use in kinematic, MagnetoHydroDynamics, and hybrid solar wind models. Complete analysis of promising micro- and nano-technology space plasma and energetic particle sensor concepts and transition into spaceflight hardware development programs.

(U) In FY 2007: Continue development of energetic electron data assimilation models for real-time situational awareness by coupling to dynamic radiation belt model to provide data-driven specification and forecast capability. Initiate coupling of radiation belt model to global geospace environment models to increase accuracy and lead time. Complete initial predictive model of solar explosive events, including flares, bursts, and coronal mass ejections. Develop concepts for active beam and wave probes of radiation belt dynamics.

(U)

(U)	MAJOR THRUST: 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.	9.902	12.772	14.148	16.887

(U) In FY 2004: Developed all-altitude, infrared background radiance model for atmospheric transmission of extended radiance sources such as missile hard bodies and plumes. Incorporated spectral signature variability into simulation codes to improve performance predictions. Collected high quality spectral data from existing systems and evaluated system requirements for theater surveillance and area search missions. Developed and demonstrated sensors, algorithms, and clutter removal techniques for space-based hypertemporal imaging sensor. Tested, validated, and improved decision aids and turbulence performance predictions tools to be used for theater ballistic missile boost phase negation test for an airborne laser platform. Expanded models for other high-energy laser systems and explored a forecasting capability for high altitude turbulence effects on aircraft platforms.

(U) In FY 2005: Validate and deliver all-altitude, infrared background radiance model for extended radiance sources. Upgrade and improve atmospheric turbulence models for use in decision aids for tactical high-energy laser systems. Improve turbulence forecast technology for a turbulence decision aid for high altitude air vehicles. Develop advanced on-chip digital signal processing technologies for real-time hypertemporal detection. Validate day/night spectral exploitation algorithms and related signature databases for specific environments such as littoral, agricultural, desert, and woodlands. Use validated simulations to evaluate candidate technologies for spectral theater surveillance and area search missions.

(U) In FY 2006: Develop infrared background radiance model capturing full range of background variability. Develop model for visible to infrared wavelength spatially and temporally structured backgrounds required for space-to-space resident space object characterization and environmental monitoring. Using available airborne and spaceborne data, validate daytime spectral processing algorithms and related

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signature databases for remaining terrain classes. Use test data and validated simulations to evaluate candidate sensor technologies for spectral theater surveillance and area search missions. Refine real-time hypertemporal processing algorithms and continue determination of optimal parameters for operational system. Improve turbulence forecasting skill, as required, and assist in transition of airborne laser decision aid for testing to operational decision aid status. Perform case studies on existing and improved stratospheric clear air turbulence forecast tools. Address decision aid requirements for tactical high-energy lasers and laser communication systems.

(U) In FY 2007: Develop capability to forecast background variations required to manage assets for resident space object characterization, environmental monitoring, and missile warning/defense. Develop super-resolution techniques for space-based resident space object characterization at long stand off range and detection of foreign agent environment perturbations. Initiate transition of validated spectral processing and exploitation algorithms and related signature databases to appropriate users. With available thermal spectral sensors, validate night-time spectral processing algorithms and related signature databases for specific environments. Initiate transfer of sensor technologies and architecture concepts to acquisition and operational commands as appropriate. Develop third generation hypertemporal sensor for space. Initiate transition of improved stratospheric clear air turbulence forecast models to Air Force Weather Agency. Continue to address technology requirements for transition of operational decision aids for airborne lasers, tactical high-energy laser systems, and laser communication systems.

(U)

(U)	MAJOR THRUST: Develop artificial intelligence techniques, forecasting tools, and sensors for improved ionospheric specification and forecasting, including communications/navigation outage forecasting, space-based geolocation demonstrations, and determination and prediction of radar degradation.	6.529	5.857	6.776	5.395

(U) In FY 2004: Developed nowcasting and forecasting validation algorithms applicable to concepts such as the Communication/Navigation Outage Forecasting System (C/NOFS) Advanced Concept Technology Demonstration (ACTD). Integrated validation algorithms into ionospheric specification and forecast modeling architecture. Validated communication and navigation outage forecasts with ground-based data to demonstrate utility of outage warning due to scintillation. Integrated polar region plasma tracking models into global models of scintillation to provide seamless equator-to-pole outage specification. Validated multi-scale algorithms and data assimilation techniques to increase reliability of global ionospheric electron profile specifications and forecasts to improve radar and geolocation performance. Explored concept development of scintillation mitigation techniques to overcome satellite-to-ground link degradation in real-time.

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(U) In FY 2005: Generate communication/navigation outage nowcasts and forecasts due to ionospheric scintillation to give the warfighter improved battlefield situational awareness and operational flexibility. Develop validated ionospheric specification and forecast models and products using results from military evaluation of C/NOFS ACTD. Investigate ionospheric scintillation technologies to develop techniques for longer-term outage forecasting. Complete pole-to-equator scintillation specification model giving global real-time hazard alerts. Couple magnetospheric data assimilation and forecast models to validated ionospheric electron profile models to improve geolocation accuracy and increase forecast lead times for radar operations. Develop combined laboratory/field tests to demonstrate feasibility of receiver and transmitter technologies to mitigate hazardous scintillation conditions.

(U) In FY 2006: Generate nowcasts and forecasts of communication/navigation outages due to ionospheric scintillation using C/NOFS space and ground system to give the warfighter improved space and battlefield awareness and operational flexibility. Perform metric tests making standardized comparisons between C/NOFS forecast model and product output parameters and selected available measurements to assess effectiveness of scintillation forecasting process. Develop statistical database and tools to track C/NOFS forecast metrics to assess military utility of outage warning due to scintillation. Develop technology to produce artificial ionization patches for use in over-the-horizon radar/comm applications and to mitigate scintillation conditions. Develop specification and forecast models and applications that exploit international network of ionospheric sensors.

(U) In FY 2007: Perform metric tests of C/NOFS scintillation forecasting system. Integrate C/NOFS results into ionospheric specification and forecasting algorithms and models for enhanced military utility of scintillation warning system. Investigate coupled solar-magnetospheric-ionospheric-thermospheric models to improve forecast lead times for radar operations, and communications/navigation outages. Develop portable ionospheric sensor suite for measuring total electron content and communications/navigation scintillation.

(U)

(U) MAJOR THRUST: Develop High-frequency Active Auroral Research Program site transmitting and diagnostic instrument infrastructure.	10.021	9.911	10.000	9.757

(U) In FY 2004: Continued populating the high frequency transmitter array to its full capacity of 180 array elements and 3.6 megawatt radiated output power.

(U) In FY 2005: Continue populating the high frequency transmitter array to its full capacity of 180 array elements and 3.6 megawatt radiated output power.

(U) In FY 2006: Complete 180-element high frequency transmitter array with 3.6 megawatt radiated power capacity.

(U) In FY 2007: Validate performance of 3.6 megawatt transmitting array in Extremely Low Frequency/Very

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	Low Frequency wave generation and optical emissions research programs.				
(U)					
(U)	MAJOR THRUST: Develop basic seismic technologies to support national requirements for monitoring nuclear explosions with special focus on regional distances less than 2,000 kilometers from the sensors.	6.476	6.985	6.979	6.815
(U)	In FY 2004: Conducted seismic research such as seismic energy partitions for local and regional events, magnitudes, and source physics; seismic calibration and ground truth collection; and seismic detection, location, and discrimination technologies. Performed observational studies of seismic wave propagation and collect seismic propagation characteristics of the Eurasian landmass.				
(U)	In FY 2005: Provide updated seismic codes for operational use. Continue efforts on seismic energy partition (shifting focus towards in situ measurements below the source), magnitudes, and source physics; seismic calibration; seismic detection, location, and discrimination; and observational studies of seismic wave propagation, including propagation in Eurasia. Assess future direction of seismic research based on results obtained so far and continue to conduct seismic research on these and other topics of interest to the Air Force.				
(U)	In FY 2006: Provide further updated seismic codes for operational use. Focus on seismic energy partition, magnitudes, and source physics moves from hypothesis development towards major hypothesis flyoff. Continue efforts on seismic calibration; seismic detection, location, and discrimination; and observational studies of seismic wave propagation, including propagation in Eurasia. Initiate focus on transition between local and regional seismic wave propagation and implications for all topics above. Continue assessment future directions based on results obtained so far.				
(U)	In FY 2007: Continue to update seismic codes for operational use. Develop hypothesis test results into potential discrimination and yield estimation techniques, while addressing unresolved hypothesis issues for seismic energy partition, magnitudes, and source physics. Incorporate seismic energy partition effects into implications for local and regional seismic wave propagation. Continue efforts on seismic calibration; seismic detection, location, and discrimination; and observational studies of seismic wave propagation, including propagation in Eurasia. Continue assessment future directions based on results obtained so far.				
(U)					
(U)	CONGRESSIONAL ADD: High-frequency Active Auroral Research Program (HAARP).	4.918	5.452	0.000	0.000
(U)	In FY 2004: Developed planned diagnostic infrastructure at the HAARP site. Provided facility management and environmental oversight functions. Conducted research programs concentrating on the generation of Extremely Low Frequency/Very Low Frequency (ELF/VLF) waves in the ionosphere and their applications to subsurface communications, the detection of underground structures, and the reduction of charged particle populations in the earth's radiation belts.				

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(U)	In FY 2005: Develop Ultra High Frequency radar and optical diagnostic infrastructure at the HAARP site. Provide facility management and environmental oversight functions. Conduct research programs to develop key engineering parameters related to exploiting ELF/VLF waves generated in space for subsurface communications, the imaging of underground structures, and the reduction of charged particle concentrations in the earth's radiation belts.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Electromagnetic Gradiometer (EM) Gradiometer for the Detection and Confirmation of Underground Hiding Places & Passageways.	2.064	2.775	0.000	0.000
(U)	In FY 2004: Miniaturized a recently developed, rugged, man-portable hardware system. Assessed the viability of an unmanned ground-based, randomly distributed-array detection concept. Assessed viability of an airborne application.				
(U)	In FY 2005: Develop covert man portable hardware system using remote Very Low Frequency illumination. Access the viability of a small, low-flying Unmanned Aerial Vehicle based system using a higher frequency local illuminator for detection of detonation wires on Improvised Explosive Devices. Initiate development of demonstration system for unmanned, randomly distributed array and begin preliminary field-testing of system concept.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Seismic Monitoring Program.	0.000	2.775	0.000	0.000
(U)	In FY 2004: Not Applicable.				
(U)	In FY 2005: Perform academic and industry research that will enable operational monitoring of high priority areas of U.S. national concern that would be otherwise inadequately monitored in the near-term. This research supports the Air Force Technical Application Center mission of global nuclear explosion monitoring.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: USAF Center for National Security Research - Signature Exploitation.	0.000	1.091	0.000	0.000
(U)	In FY 2004: Not Applicable.				
(U)	In FY 2005: Develop engineering model smart single detectors and small smart detector arrays with very large dynamic range, broad range of integration times, very large frame rates, local data storage, and				

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in-line processing for each detector element. Ground tests will be done on the first generation.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U) Total Cost	43.023	51.742	42.085	43.849

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

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0305160F, Defense Meteorological Satellite Program.										
(U) PE 0601102F, Defense Research Sciences.										
(U) PE 0602204F, Aerospace Sensors.										
(U) PE 0305111F, Weather Systems.										
(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 NUMBER AND TITLE: 4846 Spacecraft Payload Technologies

Cost ($ in Millions)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
4846 Spacecraft Payload Technologies	22.608	19.319	16.161	17.149	24.597	29.900	28.943	29.349	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2006, decrease in funding is due to higher Air Force priorities.

(U) A. Mission Description and Budget Item Justification

This project develops advanced technologies that enhance spacecraft payload operations by improving component and subsystem capabilities. The project focuses on four primary areas: (1) 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; (3) development of high-fidelity space simulation models that support space-based surveillance and space asset protection research and development for the warfighter; and (4) development of advanced networking, radio frequency, and laser communications technologies to support next generation satellite communication systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced infrared device technologies for space applications that enable hardened space detector arrays with improved detection, to perform acquisition, tracking, and discrimination of bodies such as decoys, satellites, and warheads throughout their trajectory.	2.822	4.067	3.693	3.762

(U) In FY 2004: Fabricated and characterized strained-layer superlattice detectors and used results to modify designs to improve absorption efficiency and eliminate manufacturing or operationally induced defects. Worked the two-dimensional focal plane array development effort by identifying, designing, and fabricating the appropriate cryogenic detector multiplexers required for transitioning the technology. Began development of infrared detector and detector read-out circuit technologies for next generation surveillance systems with projected requirements for adaptive, re-configurable, and polarimetric capabilities.

(U) In FY 2005: Incorporate design changes into the fabrication process and continue wafer growth of strained-layer superlattice detector structures and other promising technologies. Continue wafer growth of strained-layer superlattice detector structures and other promising technologies as alternatives to mercury cadmium telluride developing both improved performance at a given operating temperature and comparable performance at higher operating temperatures. Evaluate promising "on-focal plane array polarimetric" concepts developed to meet projected capability requirements of the next generation space systems. Investigate wavelength agility in detectors. Further investigation of proton-damage in long wavelength infrared focal plane arrays in the space-relative environment

(U) In FY 2006: Continue studies in metal films. Demonstrate two-layer single-pixel polarimeter. Improve quantum dot detector responsivity. Continue characterizing superlattice detectors. Continue

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	investigating magnetic and electric field tuning of detector wavelength responsivity ("wavelength agility"). Perform comparisons of emerging detector technologies for transfer to applied research. Characterize and assess performance of long wavelength infrared focal plane arrays developed with radiation hardened-by-design process.				
(U)	In FY 2007: Pursue detector response tunability. Complete assessment of quantum interference towards amplification of incoming weak signals.				
(U)					
(U)	MAJOR THRUST: Develop spectral sensing and data exploitation methodologies for military imaging and remote sensing applications.	0.749	0.994	1.003	1.019
(U)	In FY 2004: Completed initial assessment of technology and modeling for understanding the electro-optical/infrared spectral polarimetric phenomenology. Demonstrated partially validated polarimetric signature model capability and continued validation with measured data from on-going field collects. Integrated initial polarimetric models into modeling, simulation, and analysis architecture for space-based surveillance applications.				
(U)	In FY 2005: Complete assessment and documentation of electro-optical/infrared spectral polarimetric phenomenology understanding. Demonstrate validated polarimetric signature model capability and develop new code upgrades and validation with measured data from on-going field collections. Demonstrate integration of spectral polarimetric models into scene simulation architecture for space-based surveillance applications.				
(U)	In FY 2006: Complete development and continue validation of polarimetric scene modeling capability for space-based surveillance applications. Integrate additional models for accurate prediction of satellite materials signatures and compare with available laboratory and field data. Complete development of instrument models for staring polarimetric surveillance systems. Develop polarimetric and spectral measurement and database of relevant materials for inclusion in the model.				
(U)	In FY 2007: Complete validation of polarimetric scene and signature modeling capability, comparing simulated data to measured field data. Complete initial polarimetric database of materials for use in signature and scene modeling. Define concepts for polarimetric or multi-band imaging sensors for space-based space surveillance applications.				
(U)					
(U)	MAJOR THRUST: Develop technologies for space-based payload components such as low power, high performance, radiation-hardened electronic devices, micro-electro-mechanical system devices, and advanced electronics packaging for next generation high performance space electronics.	3.708	3.905	3.784	3.939
(U)	In FY 2004: Researched radiation effects in electronics components based on emerging silicon-on-insulator, sapphire, or other radio frequency (RF) and analog technology compatible				

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substrates. Evaluated monolithically integrated low power, silicon-based quantum-sized devices for system-on-a-chip applications. Developed radiation hardening design techniques to enable fabrication of electronics on commercial lines. Evaluate architecture and components supporting analog memory. Built micro-electro-mechanical system based switches supporting complex switching harnesses in support of self-adaptable spacecraft hardware. Developed architectures and packaging approaches in support of reconfigurable space systems.

(U) In FY 2005: Research radiation effects in electronics built with hardness by design methods at state-of-the-art manufacturing plants. Evaluate chalcogenide-based reconfigurable electronics providing ten-fold performance improvement and self-repair capabilities. Build monolithically integrated low-power, silicon-based quantum-sized devices for system-on-a-chip applications. Establish tools for hardness-by-design part manufacture and demonstrate ten-fold decrease in manufacturing cost. Design switches on chip, board, and intra-board level supporting self-adaptable, self-healing spacecraft hardware. Develop and evaluate architectures and packaging approaches in support of reconfigurable space systems.

(U) In FY 2006: Design new chalcogenide materials for reconfigurable RF circuits and for reconfigurable wiring. Develop fundamental understanding of exotic high-dielectric constant materials and predict candidate materials for insertion into aggressively scaled electronic devices for space electronics. Research radiation effects in highly integrated microelectronics employing the most recent techniques in power management, clock domain partitioning, and monolithic integration of multiple radio frequency, analog, and digital functions. Identify and evaluate radiation hardening techniques for enhancing immunity to single event and other radiation effects arising from the natural space environment, as well as nuclear events. Develop a "liquid manifold" approach based on combining micro-electromechanical switches and reconfigurable wiring and demonstrate operation.

(U) In FY 2007: Complete study of dynamics of phase change materials, and of their interactions with pertinent technological materials. Explore use of polymers in reconfigurable electronics. Continue study of alternative dielectrics for advanced electronics, especially the nitrided oxides. Initiate a nanotechnology collaboration with the Air Force Research Laboratory Materials Directorate. Research radiation effects mitigation schemes using best commercial practices in design and manufacturing to identify new methods for creating radiation hardened, long-lifetime, commodity and custom mixed signal microcircuits for next generation space and missile systems. Evaluate devices using advanced hardening techniques to determine robustness and compatibility with state of the art design and fabrication technology. Develop morphable electronic panels suitable for demonstration in a relevant environment.

(U)

(U) MAJOR THRUST: Develop modeling, simulation, and analysis tools for space-based surveillance	1.247	3.300	2.479	2.516

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	systems, rendezvous and proximity operations, optical/infrared imaging space systems, and distributed satellite architecture payloads.				
(U)	In FY 2004: Extended simulation architecture to support flight experiment ground-to-space segment simulation. Extended the architecture for use in objective system-of-systems, military utility assessment. Developed extensions to the simulation architecture to address missions associated with responsive space and space capability protection.				
(U)	In FY 2005: Ready the simulation architecture to support flight experiment simulation and data validation for experiments on deployable structure technology, autonomous command/control software, and responsive space technologies. Continue to develop extensions to the simulation architecture to address missions associated with responsive space, space capability protection, and counterspace. Develop enhancements to optical/infrared imaging system simulation to include polarimetric and hyperspectral effects.				
(U)	In FY 2006: Support autonomous and responsive space flight experiments with simulations and data validation. Extend the simulation architecture to feed engineering-level data to mission/campaign models. Extend the architecture to address missions associated with space situational awareness and tactical surveillance. Continue to develop enhancements to imaging system simulations to include polarimetric and hyperspectral effects. Tailor toolset and methodology developed for the multi-aperture strategic system feasibility study for tactical applications				
(U)	In FY 2007: Continue to support autonomous and responsive space flight experiments with simulations and data validation. Continue to extend the simulation architecture to feed engineering-level data to mission/campaign models. Ready the simulation architecture to support flight experiment simulation and data validation for experiments on space situational awareness and tactical surveillance. Complete evaluation of the technical feasibility and cost-effectiveness of a multi-aperture system to meet future space-based tactical intelligence, surveillance and reconnaissance needs.				
(U)					
(U)	MAJOR THRUST: Develop advanced architectures and performance characterization tools for future large, lightweight, modular space antennas. Note: In FY 2005, work terminated due to higher Air Force priorities.	0.951	0.000	0.000	0.000
(U)	In FY 2004: Refined transmit/receive testbed, enhancing the performance of the phased-array antenna subsystems and integrated antenna modules using miniaturized active radio frequency components and planar wide-bandwidth radiators. Characterized performance of new wide-bandwidth antenna subsystems and correlated results to model predictions; updated models based on actual performance. Developed algorithms for performance characterization of sparse cooperating apertures and for advanced antenna array calibration.				

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(U)	In FY 2005: Not Applicable.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop bandwidth efficient modulation and high bandwidth communications technologies to support next generation satellite communication systems. Note: In FY 2006, efforts terminated due to higher Air Force priorities.	1.935	1.783	0.000	0.000
(U)	In FY 2004: Explored architecture studies and guided technology investment in support of satellite communications roadmap. Developed technology standards and system designs for integrating multiple airborne intelligence, surveillance, and reconnaissance assets into single space platforms.				
(U)	In FY 2005: Further explore architecture studies and guide technology investment in support of satellite communications roadmap. Expand development of technology standards and system designs for integrating multiple airborne intelligence, surveillance, and reconnaissance assets into single space platforms.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop technologies for multi-access laser communications terminals. Assess the maturity of single access terminal components and their applicability to a multi-access terminal design.	9.426	5.270	5.202	5.913
(U)	In FY 2004: Developed standards for combining multiple airborne intelligence, surveillance, and reconnaissance and space asset feeds into a single optical data path. Designed a laboratory multi-access terminal testbed.				
(U)	In FY 2005: Further develop standards for combining multiple airborne intelligence, surveillance, and reconnaissance and space asset feeds into a single optical data path. Continue design of a laboratory multi-access terminal testbed.				
(U)	In FY 2006: Start verification of standards of combining multiple airborne intelligence, surveillance and reconnaissance and space asset feeds into a single optical data path. Perform component testing using laboratory testbed.				
(U)	In FY 2007: Finish verification of standards of multiple airborne intelligence, surveillance and reconnaissance and space asset feeds into a single optical data path. Perform system testing using laboratory testbed.				
(U)					
(U)	CONGRESSIONAL ADD: Mixed Signal Very Large Scale Integrated (VLSI) [Circuits] for Space Vehicle Communication Subsystems.	1.770	0.000	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **4846 Spacecraft Payload Technologies**

(U) In FY 2004: Developed improved, radiation-hard, analog circuit elements for mixed-signal VLSI circuits. Refined and employed results from radiation testing and characterization of commercial state-of-the-art mixed-signal components to improve designs using commercial foundry technologies for space applications. Designed and fabricated innovative circuit configurations and test devices using new radiation-hard analog elements and circuit architectures.

(U) In FY 2005: Not Applicable.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U) Total Cost	22.608	19.319	16.161	17.149

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

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

(U) Related Activities:

(U) PE 0603401F, Advanced Spacecraft Technology. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602601F Space Technology

PROJECT NUMBER AND TITLE: 5018 Spacecraft Protection Technology

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
5018	Spacecraft Protection Technology	3.943	2.607	2.401	2.219	2.346	2.473	2.503	2.526	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops the technologies for protecting U.S. space assets in potential hostile environments to assure continued space system operation without performance loss in support of warfighter requirements. The project focuses on identifying and assessing spacecraft system vulnerabilities, developing threat warning technologies, and developing technologies to mitigate the effects of both intentional and unintentional threats.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop key satellite threat warning technologies and tools for high value satellite asset defense.	1.256	0.899	0.911	0.977
(U) In FY 2004: Investigated opportunities for development of proximity and threat warning sensor systems. Explored reconfigurable processor electronics capability and build test bed in support of multi-threat warning sensors. Analyzed light, adaptable single antenna performance for threat detection and geo-location applications. Completed false alarm research for relevant threats. Selected antenna technology for wide-band and narrow-band threat detectors for multi-threat capability space experiment.				
(U) In FY 2005: Update micro-satellite threat characteristics. Select most promising proximity sensor technology and initiate development of an experimental proximity sensor. Design and develop ground demonstration plan for the purpose of confirming proximity sensor performance.				
(U) In FY 2006: Begin process of integrating most promising proximity or threat warning sensor into a space experiment. Identify potential of multiple usage of sensor to detect threats and measure environmental phenomenon associated with space flight (weather experiments, debris analysis, assist in navigation, etc.).				
(U) In FY 2007: Conduct sensor space flight experiment and analysis. Identify technology transfer opportunities and report findings to major commands.				
(U)				
(U) MAJOR THRUST: Develop high value space asset defensive capabilities.	0.830	0.581	0.597	0.631
(U) In FY 2004: Designed and fabricated miniaturized narrowband radio frequency attack reporting receiver with of goal of five times reduction in power and size.				
(U) In FY 2005: Select most promising defensive technologies and begin development of experimental defensive capabilities. Design and report ground and space demonstration plan for the purpose of confirming defensive capability performance.				
(U) In FY 2006: Select the most promising defensive technology and begin space experiment planning and				

Exhibit R-2a, RDT&E Project Justification			DATE February 2005
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602601F Space Technology**	PROJECT NUMBER AND TITLE **5018 Spacecraft Protection Technology**	

	integration. Identify potential of multiple use technology to detect threats and measure environmental phenomenon associated with space flight (weather experiments, analysis debris, assist in navigation, etc.).				
(U)	In FY 2007: Conduct defensive technology space demonstration and post flight analysis. Identify technology transfer opportunities and report findings to major commands.				
(U)					
(U)	MAJOR THRUST: Develop techniques to exploit existing on-board inherent satellite resources, satellite-as-a-sensor, and self-aware satellite technologies as a first-line threat detection system.	0.816	0.576	0.588	0.611
(U)	In FY 2004: Developed technology for currently fielded or launch-ready satellites to detect anomalies that result from radio frequency/laser illumination or kinetic impact. Explored use of on board resources such as telemetry or state-of-health data for anomaly determination as a zero added power/weight solution and assess the limits of this technique.				
(U)	In FY 2005: Conduct laboratory proof-of-concept for selected subsystems with ground simulation demonstration of a combined satellite-as-a-sensor system. The simulation includes data fusion, unique radio frequency location tool, simulated laser sensor, simulated proximity sensor, and satellite as a sensor test bed.				
(U)	In FY 2006: Develop space experiment of existing cooperative onboard system or develop proof of concept space experiment to validate concept.				
(U)	In FY 2007: Transition technology to other compatible space systems for multiple use protection.				
(U)					
(U)	MAJOR THRUST: Develop techniques for monitoring and assessing electromagnetic interference and compatibility between ultra-sensitive payload sensors for space systems that support space weather forecasting. Note: In FY 2007, effort is complete.	1.041	0.551	0.305	0.000
(U)	In FY 2004: Continued integration of space experiment demonstration of C/NOFS.				
(U)	In FY 2005: Conduct space experiment demonstration of C/NOFS. Perform measurements of key ionospheric and scintillation parameters needed for input to ionospheric specification and forecast models. Assess data for electromagnetic interference effects on ultra-sensitive payload sensors. Assess payload performance in measuring ionospheric and scintillation parameters needed for space weather support in theater and for mission planners and other users.				
(U)	In FY 2006: Analyze military utility of C/NOFS demonstration. Develop and integrate selected enhancements to C/NOFS scintillation warning and forecasting system for warfighter space and battlefield situational awareness and operational flexibility.				
(U)	In FY 2007: Not Applicable.				
(U)	Total Cost	3.943	2.607	2.401	2.219

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 5018 Spacecraft Protection Technology

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

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) PE 0603401F, Advanced Spacecraft Technology. This project has been coordinated through the (U) Reliance process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602601F Space Technology

PROJECT NUMBER AND TITLE: 8809 Spacecraft Vehicle Technologies

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
8809	Spacecraft Vehicle Technologies	31.034	33.751	23.893	28.961	41.256	47.578	45.291	45.779	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project 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 space experiments of maturing technologies for space qualification.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop technologies for advanced space platform subsystems such as cryocoolers, compact, high efficiency solar power cells and arrays, and innovative power generation concepts.	3.947	4.089	3.640	3.827

(U) In FY 2004: Completed identification of mechanical and long-term failure mechanisms for assessing cryocooler performance and reliability. Built first generation analytical performance prediction models, empirical measurements, and thermophysical fluid flow and heat transfer models for low-temperature cryocooler regenerator performance. Investigated technology development to improve cryocooler capability and performance for regenerative and recuperative cycle cryocoolers. Fabricated multi-junction solar cells using lattice-mismatch technology with efficiencies that break even with the efficiency of current production multi-junction 28% Germanium solar cells. Demonstrated 10% efficient thin-film solar cells on polymer substrates.

(U) In FY 2005: Build second-generation empirically verified thermo-physical performance models for cryocooler regenerators. Further investigate technology development to improve cryocooler capability and performance for regenerative and recuperative cycle cryocoolers. Build modeling and simulation capability for complex thermodynamic cycle coolers. Develop a 30% efficient crystalline multi-junction solar cell based on lattice-mismatch technology. Fabricate 10% efficient thin-film, monolithically integrated solar cell.

(U) In FY 2006: Build experimental capabilities for flow field measurements in pulse tube cryocoolers. Refine and validate cryocooler component and system models with experimental data. Investigate thermodynamic loss mechanisms in regenerative cycle cryocoolers through computational fluid dynamics models. Demonstrate 12% efficient thin-film solar cell on polymer substrate. Demonstrate five- or six-junction solar cell.

(U) In FY 2007: Develop component-based system model of pulse tube cryocoolers for parametric optimization of cryocooler system design. Design an ultra low-temperature (10 degrees Kelvin), low

Exhibit R-2a, RDT&E Project Justification			DATE February 2005
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mass and high efficiency advanced engineering model cryocooler. Transition optimal design methodologies to cryocooler industry. Demonstrate greater than 33% efficient solar cell using either lattice mismatch or five- or six- junction solar cell technology. Develop a greater than 12% efficient thin-film solar cell on a polymer substrate at least 20 square centimeters in area.

(U)

(U)	MAJOR THRUST: Develop technologies for advanced space platform structures such as structural controls for vibration suppression, multi-functional structures, deployable large aperture optical arrays, and lightweight composite satellite and launch vehicle structures.	7.798	7.074	6.462	6.869

(U) In FY 2004: Completed characterization of multi-functional small spacecraft bus. Developed tunable nanotechnology-enhanced lightweight space structures. Developed lightweight structures and precision structural controls for large-aperture space optics. Developed low-shock and precision deployment mechanisms.

(U) In FY 2005: Perform material characterization of tunable nanotechnology-enhanced lightweight space structures. Fabricate and test engineering concepts for lightweight structures and precision structural controls for large-aperture space optics. Fabricate and test low-shock and precision deployment mechanisms for satellite separation and subsystem deployment.

(U) In FY 2006: Develop advanced mechanisms and guidance strategies for capture and servicing of disabled (non-cooperative) spacecraft. Develop high-temperature, long-soak time thermal re-entry structures.

(U) In FY 2007: Characterize thermal protection structural performance in reentry environment. Develop autonomy concepts to support defensive/protection actions by spacecraft.

(U)

(U)	MAJOR THRUST: Develop microsatellite (10-100kg) technologies and integrated microsatellite technology concepts. The innovative microsatellite architectures and advanced satellite bus technologies could enable applications such as space protection, counterspace capabilities, sparse aperture sensing, on-orbit formation flying, inter-satellite communications, distributed processing, and responsive payloads. Note: In FY 2006, efforts move to Project 4846 in this PE and to PE 0603401F, Project 2181.	2.768	1.082	0.000	0.000

(U) In FY 2004: Applied modeling and simulation techniques to evaluation of technical feasibility and cost-effectiveness of multi-aperture systems to meet future space-based radio frequency intelligence, surveillance, and reconnaissance needs.

(U) In FY 2005: Complete evaluation of the technical feasibility and cost-effectiveness of a multi-aperture system to meet future space-based radio frequency intelligence, surveillance and reconnaissance needs.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

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(U)					
(U)	MAJOR THRUST: Develop flight experiments to address key scientific and technological problems in order to improve the capabilities of existing operational space systems and to enable new transformational space capabilities.	4.425	10.207	13.791	18.265
(U)	In FY 2004: Designed a space flight experiment with the goal of significantly reducing power, aperture, and the mid-earth-orbit environment as constraints to DoD space capability. Selected and matured the best technologies in the areas of advanced structures, controls, power-generation, space weather sensors and radiation-belt remediation to design spacecraft. Developed concept design for all experimental payloads, define requirements and interfaces, and complete spacecraft design. Performed modeling and simulation to quantify benefits towards enhancing DoD warfighter capability for surveillance, space capability protection from natural and man-made threats, high-rate communication to the battlefield, and space access and mobility.				
(U)	In FY 2005: Mature space flight experiment design. Develop breadboard hardware for all experimental payloads. Build engineering model for the core spacecraft. Close design trades and advance all designs to a Preliminary Design Review level. Design interfaces to launch vehicle and co-manifested spacecraft needed to secure launch manifest. Continue modeling and simulation to quantify benefit to DoD warfighter capability.				
(U)	In FY 2006: Build and test core spacecraft and experimental payloads. Complete mission planning and on-orbit operations guide.				
(U)	In FY 2007: Complete fabrication and test of spacecraft and individual payloads. Deliver flight payloads for integration to spacecraft. Assemble and test integrated spacecraft.				
(U)					
(U)	CONGRESSIONAL ADD: Technology Satellite of the 21st Century (TechSat-21).	2.951	0.000	0.000	0.000
(U)	In FY 2004: Developed and ground tested advanced subsystem flight units that demonstrated responsive microsatellite bus technologies. Key advances in microsatellite bus technologies included high power density batteries, lightweight thin-film solar arrays with micro-gimbals, and a modular large capacity non-volatile mass memory subsystem. These microsatellite bus technologies support mission applications ranging from distributed aperture formations to space surveillance, threat warning, and protection.				
(U)	In FY 2005: Not Applicable.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Affordable Multi-Junction Solar Cells.	2.261	0.000	0.000	0.000

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(U) In FY 2004: Developed a process for affordable production of single crystal Germanium (Ge) wafers, a key component of multi-junction solar cells on all DoD satellites, comprising approximately half the cost of the entire cell. Developed a domestic source of Ge wafers encompassing the establishment of a pilot/bench operation, including demonstration of a crystal growth and wafer fabrication capability, a plan to recycle Germanium metal, and a production scale-up plan. The bench operation will include wafer grinding, polishing, etching, characterization, and the establishment of quality control procedures.
(U) In FY 2005: Not Applicable.
(U) In FY 2005: Not Applicable.
(U) In FY 2006: Not Applicable.
(U) In FY 2007: Not Applicable.
(U)

(U) CONGRESSIONAL ADD: Toughened Silicone Substrates for Flexible Solar Cells.	1.180	0.991	0.000	0.000

(U) In FY 2004: Developed silicone resin high temperature polymer substrates for Copper-Indium-Gallium-DiSelenide (CIGS) thin film solar cells for next-generation flexible, thin film solar arrays and develop monolithic integration of CIGS solar cells on these substrates. Reduced touch labor necessary for interconnection of individual cells into solar arrays. Demonstrated the roll-to-roll deposition of CIGS solar cells on free-standing high temperature polymers and demonstrate large area monolithically-integrated CIGS modules.
(U) In FY 2005: Scale-up and transition of free standing silicone resin substrates to roll-to-roll manufacturing. Initiate transition to production for monolithic integration process of CIGS solar cells on silicone resin substrates. Optimize performance of CIGS solar cells deposited in roll-to-roll production on free standing silicone resin.
(U) In FY 2006: Not Applicable.
(U) In FY 2007: Not Applicable.
(U)

(U) CONGRESSIONAL ADD: Integrated Control for Autonomous Space Systems (ICASS).	0.984	1.982	0.000	0.000

(U) In FY 2004: Developed advanced attitude and dynamic control technologies for future space platforms to provide unprecedented levels of control over dynamic subsystem response, precision pointing, and target tracking. Fabricated the engineering models of integrated controls architecture designs, initiated laboratory validation and verification, and incorporated the engineering models into a spacecraft design.
(U) In FY 2005: Advance the spacecraft system engineering to test and validate the advanced control techniques in a flight experiment. Fabricate breadboard models of spacecraft experimental computer system, networked data acquisition sensors, and networked data interface cards. Test advanced attitude and dynamic control technologies on breadboard electronics. Close design trades, initiate mechanical

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	and electrical designs to Preliminary Design Review level.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Elastic Memory Composites and Elastic Memory Composites Materials.	3.245	1.983	0.000	0.000
(U)	In FY 2004: Developed elastic memory composite (EMC) material technologies for unconventional approaches in satellite component utility. Designed, built, and integrated elastic memory composite hinge hardware for possible on-orbit demonstration. Designed and built a composite deploying gravity gradient boom as the primary attitude-stabilizing element for a satellite. Designed and analyzed large-scale rollout flexible solar array deployment mechanism.				
(U)	In FY 2005: Improve the reliability of spacecraft deployment mechanisms. Raise the flight readiness of the EMC technology by generating material test data, creating and refining material models and engineering methods for designing EMC components, designing, fabricating, and testing structural validation models of EMC components, and performing a space flight demonstration to build flight heritage.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Converted Silicon Carbide for High Performance Optic Structures.	1.475	1.486	0.000	0.000
(U)	In FY 2004: Refined the fabrication process for converted silicon carbide for high-tolerance applications in aerospace large optical systems to shorten the overall fabrication time and improve part quality.				
(U)	In FY 2005: Apply the converted silicon carbide technology from FY 2004 efforts to Air Force systems currently under development. Identified products include the optical elements and support structure for a spaceborne optical system and optical support structures for an airborne directed energy system. Build specimens for integrated testing for potential optical space systems.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Lightweight and Novel Structures for Space Program.	0.000	3.371	0.000	0.000
(U)	In FY 2004: Not Applicable.				
(U)	In FY 2005: Review and examine new structures concepts that will enable revolutionary improvements on weight and cost of space structural systems. The most promising concepts will be identified for further research and development.				
(U)	In FY 2006: Not Applicable.				

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(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Foldable Articulated Structures for Next Generation Spacecraft.	0.000	1.486	0.000	0.000
(U)	In FY 2004: Not Applicable.				
(U)	In FY 2005: Develop advanced space boom architectures and the mechanisms that enable them to be deployed in space and to enhance the performance of lightweight deployable structures for spacecraft. Prove flight readiness of this technology by performing the following: optimization of design of a family of deployable truss structural system; develop advanced analytical tools and quantitative design methods; design, fabrication, testing and qualitative assessment of the system; integration and flight readiness testing of the deployable structure and deployment control system.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	Total Cost	31.034	33.751	23.893	28.961

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

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602203F, Aerospace Propulsion.										
(U) PE 0602102F, Materials.										
(U) PE 0603311F, Ballistic Missile Technology.										
(U) PE 0603401F, Advanced Spacecraft Technology.										
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.										
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.										

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(U) D. Acquisition Strategy

Not Applicable.