Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	97.639	97.469	83.909						Continuing	Continuing
632181: Spacecraft Payloads	28.478	37.304	26.919						Continuing	Continuing
633834: Integrated Space Technology Demonstrations	32.107	29.208	29.168						Continuing	Continuing
634400: Space Systems Protection	4.001	7.841	8.118						Continuing	Continuing
635021: Space Systems Survivability	4.285	5.158	4.871						Continuing	Continuing
635083: Ballistic Missiles Technology	5.907	5.630	5.982						Continuing	Continuing
63682J: Spacecraft Vehicles	22.861	12.328	8.851						Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft and launch vehicles, ballistic missiles, space systems survivability, and development of advanced laser communications technologies to support next generation satellite communication systems. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing space system upgrades and/or new space system developments that have military utility and address warfighter needs.

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
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B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	100.600	80.958	84.853	
Current BES/President's Budget	97.639	97.469	83.909	
Total Adjustments	-2.961	16.511	0.000	
Congressional Program Reductions	0.000	-0.047		
Congressional Rescissions	0.000	-0.264		
Total Congressional Increases	0.000	17.622		
Total Reprogrammings	-1.009	-0.800		
SBIR/STTR Transfer	-1.952	0.000		

Change Summary Explanation

Changes to this PE since the previous President's Budget are due to higher Air Force priorities.

Note: In FY 2009, Congress added $1.6 million for Small Low Cost Reconnaissance Spacecraft Components; $1.2 million for Space Situational Awareness; $2.2 million for Semiconductor Optical Amplifier for Responsive Space MPOI; $1.6 million for Integrated Spacecraft Engineering Tool (ISET); $2.4 million for Micromachined Switches for Next Generation Modular Satellites; $1.75 million for Satellite Coherent Optical Receiver (SCORE); $1.272 million for Operational Responsive Space Architecture for Dual Use Applications; $1.6 million for Thin Film Amorphous Solar Arrays, and $3.2 million for Ultra Low Power Electronics. Congress also added $0.8 million for Hybrid Sounding Rocket Propulsion that has been moved to PE 0603216F, Aerospace Propulsion and Power Technology, Project 10SP, for execution.

C. Performance Metrics
(U) Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					PROJECT NUMBER 632181	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
632181: Spacecraft Payloads	28.478	37.304	26.919						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the development, demonstration, and evaluation of radiation-hardened space electronic hardware, satellite control hardware and software for advanced satellite surveillance operations, and development of advanced laser communications technologies to support next generation satellite communications systems. Improved space-qualifiable electronics and software for data and signal processing will be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (i.e., radiation-hardening) commercial data and signal processor technologies for use in Air Force space systems. For mid-term applications, the Improved Space Computer Program will merge advanced, radiation-hardened space processor, memory, and interconnect technologies with commercially-derived, open system architectures to develop and demonstrate robust, on-board processing capabilities for 21st century Department of Defense satellites. In the long-term, this project area focuses on developing low-cost, easily modifiable software and hardware architectures for fully autonomous constellations of intelligent satellites capable of performing all mission related functions without operator intervention.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop spacecraft microelectronic devices, including radiation-hardened data processors and ultra-high density strategically hardened memories, space-qualifiable, high density advanced packaging technology, and micro-electro-mechanical systems (MEMS) components and applications. Note: In FY 2009, decreased emphasis on conventional radiation-hardened electronics. In FY 2008: Developed capabilities to the current Satellite Design Automation software to evolve a logical sequence to form a "push-button toolflow" satellite builder. Developed radiation-hardened space sensor interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators. In FY 2009: Complete capabilities to the current Satellite Design Automation software to evolve a logical sequence to form a "push-button toolflow" satellite builder. Demonstrate radiation-hardened space sensor interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators.	10.047	8.680	8.529	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Demonstrate improved radiation-hardened space sensor interface modules allocating standardized data messages protocols from sensors for ease device control of sensors and actuators. Continue development of high-density volatile memory. Initiate multiprocessor architecture development.					
MAJOR THRUST: Develop intelligent satellite system technologies for responsive spacecraft operations and for satellite control, precision navigation, formation flying, and proximity operations technologies for spacecraft constellations. Note: In FY 2010, increased emphasis on responsive space technologies. In FY 2008: Refined command, control, guidance, and navigational capabilities for space superiority. Integrated autonomous flight software technologies with command, control, guidance, and navigation technologies. Extended hardware-in-the-loop testbed, spacecraft command and telemetry simulations, and mission ops centers. Explored development of modeling command, control, and communications systems, conducted engineering trades, and performed military utility analysis. In FY 2009: Complete development of command, control, guidance, and navigational capabilities for space superiority. Complete integration of autonomous flight software technologies with command, control, guidance, and navigation technologies. Complete extension of hardware-in-the-loop testbed, spacecraft command and telemetry simulations, and mission ops centers. Continue to model command, control, and communications systems, conduct engineering trades, and perform military utility analysis. In FY 2010: Continue to model command, control, and communications systems, conduct engineering trades, and perform military utility analysis for space superiority. Initiate rapid spacecraft development processes to include automated spacecraft design, rapid assembly, automated flight and ground software configuration, and expedited integration and test.		2.324	2.574	4.072	
MAJOR THRUST: Develop modeling, simulation, and analysis tools and data exploitation methodologies for space-based surveillance systems, space capability protection technologies, access/mobility technologies, and		0.618	5.954	6.840	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
flight experiments. Note: In FY 2009 and out, increased emphasis on space superiority and responsive space technologies. In FY 2008: Developed space-based communications models for blue force situational awareness, communications on the move, and data exfiltration. Completed development of models of responsive or reconfigurable technologies. Applied physics-to-engineering-to-engagement level models for systems engineering, tech trades, mission planning and operations, and utility analysis to flight experiments in tactical and responsive satellites. In FY 2009: Continue to develop space-based communications models for blue force situational awareness, communications on the move, and data exfiltration. Apply additional physics-to-engineering-to-engagement level models for systems engineering, technology trades, mission planning and operations, and utility analysis to autonomous rendezvous/ proximity operations flight experiments for space situational awareness, tactical satellites for Intelligence, Surveillance, and Reconnaissance (ISR) and responsive space, and defensive space control technology experiment/demonstration. Integrate previously developed military utility analysis tools into systems-level analysis tools. In FY 2010: Continue physics-to-engineering-to-engagement level models for systems engineering, technology trades, mission planning and operations, and utility analysis for systems-level analysis, experimental support, and concept of operations of flight programs. Complete integration of tools to model detection, identification, and characterization technologies for situational awareness. Refine and validate military utility and sensor analysis tools for external organizations. Perform military utility analyses for flight programs.					
MAJOR THRUST: Develop advanced space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot targets, as well as "cold body" targets such as decoys, satellites, and midcourse warheads.		4.270	5.580	5.895	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Performed studies for detectors and readouts needed for exquisite imaging. Increased size/speed of Radiation Hardened by Design Readout Integrated Circuits (RHBD ROICs). Folded radiation hardness improvement of visible sensor with RHBD ROIC into full focal plane array. In FY 2009: Begin full focal plane array for exquisite imaging. Develop visible sensor for potential transition. In FY 2010: Continue full focal plane array for exquisite imaging. Complete visible sensor development. Develop higher operating temperature sensors. Develop large format infrared sensors.				
MAJOR THRUST: Develop technologies for multi-access laser communications space terminals with reduced weight, power, and cost for transformational communications. Note: In FY 2009, efforts for multi-access laser communications are complete. In FY 2008: Completed multi-access laser communications terminal form-fit-function development. Completed environmental testing of multi-access laser communications terminal components and subsystems in relevant laboratory environment. In FY 2009: Develop key scientific performance parameters appropriate for future space communications needs. In FY 2010: Not Applicable.	0.916	0.801	0.000	
MAJOR THRUST: Develop spectral/polarimetric sensing and data exploitation demonstrations for military imaging and remote sensing applications. Note: Beginning in FY 2009, increased emphasis on space situational awareness technologies. In FY 2008: Collected laboratory data of satellites using spectral/polarimetric sensing and demonstrated applicability of techniques for space situational awareness.	0.172	1.326	1.583	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Compare measurements of satellites to predictive models and determine the feasibility of model based exploitation for space situational awareness. In FY 2010: Initiate studies and analyses of integrated RF/optical/polarimetric sensing techniques.				
CONGRESSIONAL ADD: Systemic Hierarchical Approach to Radiation Hardened Electronics. In FY 2008: Conducted Congressionally-directed effort for Systemic Hierarchical Approach to Radiation Hardened Electronics. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	2.338	0.000	0.000	
CONGRESSIONAL ADD: Intelligent Free Space Optical Satellite Communications Node. In FY 2008: Conducted Congressionally-directed effort for Intelligent Free Space Optical Satellite Communications Node. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	1.558	0.000	0.000	
CONGRESSIONAL ADD: COTS Technology for Situational Space Awareness.	1.949	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Conducted Congressionally-directed effort for COTS Technology for Situational Space Awareness. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Satellite Coherent Optical Receiver (SCORE). In FY 2008: Conducted Congressionally-directed effort for Satellite Coherent Optical Receiver (SCORE). In FY 2009: Conduct Congressionally-directed effort for Satellite Coherent Optical Receiver (SCORE). In FY 2010: Not Applicable.		1.948	1.745	0.000	
CONGRESSIONAL ADD: Micromachined Switches for Next-Generation Modular Satellites. In FY 2008: Conducted Congressionally-directed effort for Micromachined Switches for Next-Generation Modular Satellites. In FY 2009: Conduct Congressionally-directed effort for Micromachined Switches for Next-Generation Modular Satellites. In FY 2010: Not Applicable.		2.338	2.394	0.000	
CONGRESSIONAL ADD: Integrated Spacecraft Engineering Tool (ISET).		0.000	1.596	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Integrated Spacecraft Engineering Tool (ISET). In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Operational Responsive Space Architecture for Dual Use Applications. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Operational Responsive Space Architecture for Dual Use Applications. In FY 2010: Not Applicable.		0.000	1.269	0.000	
CONGRESSIONAL ADD: Semiconductor Optical Amplifier for Responsive space MPOI. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Semiconductor Optical Amplifier for Responsive space MPOI. In FY 2010: Not Applicable.		0.000	2.194	0.000	
CONGRESSIONAL ADD: Ultra Low Power Electronics.		0.000	3.191	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Ultra Low Power Electronics. In FY 2010: Not Applicable.				

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0303601F/ MILSTAR Satellite Communications System.	0.000	0.000							Continuing	Continuing
PE 0305160F/ Defense Meteorological Satellite Program (DMSP).	0.000	0.000							Continuing	Continuing
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603311F/ Ballistic Missile Technology.	0.000	0.000							Continuing	Continuing
PE 0603215C/ Limited Defense System.	0.000	0.000							Continuing	Continuing
PE 0603218C/ Research and Support.	0.000	0.000							Continuing	Continuing
PE 0603226E/ Experimental Evaluation of Major Innovative Technologies.	0.000	0.000							Continuing	Continuing
PE 0604609F/ Reliability and Maintainability Technology Insertion Program (RAMTIP).	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to	0.000	0.000							Continuing	Continuing

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harmonize efforts and
eliminate

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
633834: Integrated Space Technology Demonstrations	32.107	29.208	29.168						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project is a series of advanced technology demonstrations designed to address mission needs by applying emerging technologies from the Air Force Research Laboratory, other U.S. Government laboratories, and industry. These technologies are integrated into system-level demonstrations that are used to test, evaluate, and validate the technologies in an relevant environment.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop microsatellite (10-100Kg) technologies for integrated, robust, flexible, microsatellite demonstrations building on previous work and leveraging investments by other organizations. Applications include space-based space situational awareness and/or tactical satellite concepts. In FY 2008: Completed system level integration of payload and microsatellite and complete functional and environmental tests of integrated system. Integrated with launch vehicle. Integrated ground control system and satellite software simulations. Performed simulated mission operations for missions operations training. In FY 2009: Launch and complete autonomous flight demonstration. Develop next in the series of satellite design(s). Initiate procurement of bus and payload hardware. In FY 2010: Complete lightweight visible and infrared sensors calibration and integration. Complete all integration for experimental microsatellite for geosynchronous orbit. Complete microsatellite-launch vehicle integration. Design and complete flight rehearsals prior to launch.	30.549	29.208	29.168	
CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.	1.558	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction. In FY 2009: Not Applicable. In FY 2010: Not Applicable.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
634400: Space Systems Protection	4.001	7.841	8.118						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates tools, instruments, and mitigation techniques required to assure operation of U.S. space assets in potentially hostile warfighting environments. The project performs assessments of critical components and subsystems, and evaluates susceptibility and vulnerability to radio frequency (RF) and laser threats. This project also develops technologies that mitigate identified vulnerabilities. Technologies are developed and demonstrated to support balanced satellite protection strategies for detecting, avoiding, and operating in a hostile space environment.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Use multi-threat assessment tools to assess space-based electro-optical, communication, and other responses to various candidate RF and laser countermeasures and directed energy threats. In FY 2008: Conducted laboratory testing of candidate RF and laser countermeasures and validated multi-threat assessment tool. In FY 2009: Conduct demonstrations illustrating effects and meditation analysis. Identify technology transition opportunities and report findings to major commands. In FY 2010: Build and demonstrate additional subsystem performance in laboratory. Identify additional transition opportunities and prepare engineering models to assess performance.	0.961	1.883	2.199	
MAJOR THRUST: Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites. Note: In FY 2009, increased emphasis on space superiority technologies. In FY 2008: Selected the most promising detection and defensive technology and begin integration. Conducted demonstrations of systems integration and performance.	2.120	4.155	2.086	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Conduct mitigation technology space demonstration and post flight analysis. In FY 2010: Demonstrate enhanced subsystems performance through laboratory testing. Identify transition opportunities and prepare engineering models to assess of performance.				
MAJOR THRUST: Develop visible and near-infrared laser protection technologies. In FY 2008: Developed selected protection techniques and coordinated space simulation testing of prospective protection technology. Qualified technology for application on space experiment for orbital demonstration. In FY 2009: Nominate "space qualified" technology and provide test unit to experimental satellite for integration. In FY 2010: Build candidate systems and conduct space qualification testing. Identify transition opportunities and prepare engineering models of performance.	0.920	1.803	2.038	
MAJOR THRUST: Develop active satellite local space awareness technologies and exploitation tools for satellite systems. Note: In FY 2010, emphasis is placed on space superiority technologies. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct in-depth study of current capabilities and analysis of data available to satellite operators. Demonstrate active subsystems through laboratory testing. Prepare engineering performance models.	0.000	0.000	1.795	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602102F/ Materials.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603605F/ Advanced Weapons Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635021: Space Systems Survivability	4.285	5.158	4.871						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates technologies to improve space system survivability and reliability of current and future Department of Defense space systems that must continue operation despite natural space hazards. It develops and demonstrates cost-effective solutions to mitigate hazardous space environmental interactions including electrical charge buildup and electronics failures due to both single radiation events and long-term radiation doses.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop sensors to specify and forecast conditions in the space environment that degrade the operation of satellite, communication, navigation, and surveillance systems. Support integration, launch, validation, and operation of instrumentation to provide improved space radiation and ionospheric hazard specification and forecasting. In FY 2008: Partially constructed joint agency coronagraph and heliospheric imager for solar hazard detection. Developed miniaturized space weather sensor engineering models. Initiated program to test and evaluate empirical flare prediction models based on synoptic data from Air Force and national observatory assets. In FY 2009: Complete development of miniaturized space weather sensor engineering models. Identify space test opportunity for miniaturized solar hazard sensors. Initiate development of a new standard model of the radiation belts. Co-operatively operate existing first generation heliospheric imagers in coordinated joint-agency campaign, exploiting unique three vantage point configuration. Develop and evaluate concepts for second-generation joint-agency heliospheric imager(s). In FY 2010: Continue development of new standard model of radiation belts to specify space hazards for spacecraft design. Design second-generation heliospheric imager as joint agency initiative.	3.244	3.940	3.940	
	0.336	0.397	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Conduct collaborative space and laboratory experiments and develop hardware and software tools to improve the survivability of spacecraft power, communications, navigation, and surveillance systems. Note: In FY 2010, the efforts in this thrust are combined with the following thrust. In FY 2008: Completed space plasma control experiment payload and began calibration and integration onto Air Force test satellite. Completed spacecraft environment effect tool suite to include dynamic space particle climatologies and forecast models. Released tool suite to DoD community. Completed radiation belt remediation payload calibration and complete integration onto Air Force test satellite. In FY 2009: Launch space plasma control experiment payload on Air Force test satellite into orbit. Begin on-orbit checkout and in-flight calibration. Begin development of new medium earth orbit radiation belt model. Launch radiation belt remediation payload on Air Force test satellite into orbit. Begin on-orbit checkout and in-flight calibration. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop technology to warn of spacecraft radiation, charging, and kinetic impact hazards and to provide space environment situational awareness and anomaly resolution capability for Department of Defense space systems. Note: In FY 2010, this thrust is combined with the previous thrust. In FY 2008: Analyzed data from compact environment anomaly sensor data bases and continue anomaly resolution for space system design. Constructed hardware for space demonstration of the distributed anomaly resolution sensor. Integrated compact environment anomaly sensor for diagnosing severe radiation environment on Air Force test satellite. In FY 2009: Continue construction of hardware for space demonstration of the distributed anomaly resolution sensor. Perform verification and validation of compact environment anomaly sensor for diagnosing- severe radiation environment.		0.705	0.821	0.931	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 635021

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2010: Develop engineering model of micrometeoroid impact detector as a component of a spacecraft anomaly resolution system. Initiate development of radiation dosimeter, spacecraft charge sensors, and common satellite interface architecture for spacecraft protection.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					PROJECT NUMBER 635083	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
635083: Ballistic Missiles Technology	5.907	5.630	5.982						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops, integrates, and demonstrates advanced technologies for sustainment and modernization of strategic ballistic missiles. The project focuses on developing robust, low maintenance inertial navigation instruments to sustain current ballistic missile systems, as well as provide new, small, low-powered, high precision instrumentation for next generation missile systems.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop, integrate, and demonstrate advanced navigation instrumentation applied to emerging vehicle designs and other technologies that sustain current strategic missile systems. Provide critical missile technology concepts to support future space force application and strategic systems. In FY 2008: Performed next generation missile navigation system engineering development, design, and ground test in relevant strategic environments, and evaluated design improvements against established performance goals. Conducted flight test demonstration planning. Initiated engineering system design verification and testing. In FY 2009: Continue engineering system development design verification and testing to incorporate performance improvements. Conduct flight qualification testing and evaluation of candidate demonstration flight units. Initiate system integration of flight demonstration units with emerging vehicle designs. In FY 2010: Continue performance verification and integration of demonstration units. Begin advanced navigation instrument engineering model designs with common mission requirements for better accuracy, lower cost, increased robustness, and smaller size. Initiate planning for advanced guidance risk reduction ground and flight demonstrations.	2.953	2.816	2.991	
	2.954	2.814	2.991	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop, integrate, and demonstrate advanced navigation technologies with new vehicle designs to provide robust, flexible, lower cost solutions for sustaining current strategic missile systems. In FY 2008: Completed test planning, integration, and conduct sled testing of high-gravitational force tolerant navigational instrumentation and range safety devices in preparation for future flight test demonstrations. Evaluated performance navigation instrumentation and range safety devices with associated hardware and software interfaces in relevant dynamic and hostile environments. Validated system design refinements and initiated long-term plan for flight testing advanced navigational instrumentation and range safety devices with new vehicle designs. In FY 2009: Measure and evaluate performance of advanced navigation instrumentation and range safety devices from experimental test bed and sled testing. Continue long-term planning and initiate long-lead hardware acquisition for flight testing advanced navigational instrumentation and range safety devices with new vehicle design interfaces. Initiate qualification testing of designs against validated system level interfaces. In FY 2010: Complete hardware procurement and initiate the build and test of advanced navigation instrumentation and range safety devices with new vehicle design interfaces. Continue qualification testing of designs against validated system level interfaces. Begin dynamic and hostile environments analysis and testing of common advanced navigation instrumentation in support of strategic missile system development.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601102F/ Defense Research Sciences.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Space Technology.	0.000	0.000							Continuing	Continuing
PE 0603311F/ Ballistic Missile Technology.	0.000	0.000							Continuing	Continuing
PE 0603601F/ Conventional Weapons Technology.	0.000	0.000							Continuing	Continuing
PE 0603851F/ Intercontinental Ballistic Missile-Dem/Val.	0.000	0.000							Continuing	Continuing
PE 0604851F/ Intercontinental Ballistic Missile-EMD.	0.000	0.000							Continuing	Continuing
PE 0605860F/ Rocket System Launch Program-Space.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 635083

E. Performance Metrics

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Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology					PROJECT NUMBER 63682J	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
63682J: Spacecraft Vehicles	22.861	12.328	8.851						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates compact, low-cost, spacecraft and launch vehicle power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. Power generation activities focus on lightweight, low-cost, low-volume, and survivable solar cell arrays. Energy storage work focuses on lightweight nickel hydrogen and sodium sulfur spacecraft batteries and flywheel energy storage systems for extended (five to ten year) satellite missions. The project's power distribution efforts focus on producing lightweight, high-efficiency, standardized power busses for use on future space systems.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and evaluate performance of space conventional power generation technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible solar cell arrays, and radiation resistant solar cell modules. In FY 2008: Completed fabrication of flight hardware for Thin-Film Radiation Exposure flight experiment. Completed ground portion of on-orbit prediction model for thin-film solar cells. Developed interconnect technologies for advanced multijunction solar cell structures. In FY 2009: Demonstrate greater than 14% efficient thin-film solar cells. Begin performance optimization of greater than 40% efficient solar cell concepts. In FY 2010: Demonstrate large area solar cells based on the inverted metamorphic structure. Develop integration schemes and module technology for inverted metamorphic solar cells. Begin environmental testing of inverted metamorphic solar cells.	2.307	2.197	2.637	
MAJOR THRUST: Develop technologies for long life, efficient, low-vibration, lightweight mechanical cryocoolers and integration components for space applications.	1.304	0.940	0.835	

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APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 63682J	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Completed design and developed a non moving parts compressor using proton biased membrane technology. Completed design and developed a low vibration conductance, cross gimbal 35 K cooling loop interface to support space tracking missions. Completed design and developed an improved thermal interface material doubling conductive transfer capacity in space cooling applications. Completed comprehensive study and began technology development of satellite cryogenic interface requirements and improved technologies to support space tracking applications. In FY 2009: Continue development of a non moving parts compressor using proton biased membrane technology. Continue development of a low vibration conductance, cross gimbal 35 K cooling loop interface to support space tracking missions. Continue development of an improved thermal interface material doubling conductive transfer capacity in space cooling applications. Continue technology development of satellite cryogenic interface requirements and improved technologies to support space tracking applications. In FY 2010: Continue support of missile launch detection thermal and cryogenic efforts. Continue study to determine the viability of infrared as an asset for space situational awareness missions. Continue development of a non-moving parts compressor using proton biased membrane technology. Continue development of a low vibration conductance, cross gimbal 35K cooling loop interface to support space tracking missions. Continue development of an improved thermal interface material doubling conductive transfer capacity in space cooling applications. Continue technology development of satellite cryogenic interface requirements and improved technologies to support space tracking applications.					
MAJOR THRUST: Develop composites for launch vehicle and spacecraft structures and space applications, such as launch vehicle shrouds, thermal protection structures, and space antennas. Note: In FY 2009 and out, decreases due to realignment of responsive space technologies. In FY 2008: Developed symbiotic structural technologies for large deployable structural sensors and improved thermal management sensors. Performed flight-qualification tests of novel deployable structure architectures, cryogenic tanks, and launch vehicle structural components. Developed thermal management testbed.		5.122	2.950	2.805	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER 63682J	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Fly elastically-deployed, stored strain energy, deployable structural architectures including shape memory alloy reinforced hinges. Develop and test thermal management hardware. In FY 2010: Demonstrate symbiotic structural technologies for space applications through sub-scale laboratory testing or sub-orbital launch demonstration. Continue development of thermal management testbed for space structures developed for responsive space class satellites. Continue development of low-cost demonstration launch vehicle platforms. Initiate development of rapid fabrication processes to build tailored spacecraft panels in days, rather than weeks.					
MAJOR THRUST: Develop technologies for spacecraft structural controls and mechanisms for on-orbit applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems. Note: In FY 2009: Decrease in funding due to higher Air Force priorities. In FY 2008: Implemented estimation algorithm for improved local situational awareness using on existing on-orbit asset. In FY 2009: Begin implementation of advanced estimation algorithms for improved local situational awareness onto flight hardware prototype under development. In FY 2010: Finish development and integration of advanced estimation algorithms for improved local situational awareness. Begin development of guidance, navigation and control hardware for rapid integration and test.		2.340	1.852	2.574	
CONGRESSIONAL ADD: Large Automated Production of Expendable Launch Structure (LAPELS). In FY 2008: Conducted Congressionally-directed effort for LAPELS. In FY 2009: Not Applicable.		4.189	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Microsatellite Serial Manufacturing. In FY 2008: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		1.558	0.000	0.000	
CONGRESSIONAL ADD: Thin Film Amorphous Solar Arrays. In FY 2008: Conducted Congressionally-directed effort for Thin Film Amorphous Solar Arrays. In FY 2009: Conduct Congressionally-directed effort for Thin Film Amorphous Solar Arrays. In FY 2010: Not Applicable.		3.118	1.596	0.000	
CONGRESSIONAL ADD: Small Low-Cost Reconnaissance Spacecraft/Small Low-Cost Reconnaissance Spacecraft Components. In FY 2008: Conducted Congressionally-directed effort for Small Low-Cost Reconnaissance Spacecraft. In FY 2009: Conduct Congressionally-directed effort for Small Low-Cost Reconnaissance Spacecraft Components.		1.754	1.596	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Space Situational Awareness. In FY 2008: Conducted Congressionally-directed effort for Space Situational Awareness. In FY 2009: Conduct Congressionally-directed effort for Space Situational Awareness. In FY 2010: Not Applicable.	1.169	1.197	0.000	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602203F/ Aerospace Propulsion.	0.000	0.000							Continuing	Continuing
PE 0602601F/ Spacecraft Technology.	0.000	0.000							Continuing	Continuing
PE 0603218C/ Research and Support.	0.000	0.000							Continuing	Continuing
PE 0603226E/ Experimental Evaluation of Major Innovative Technologies.	0.000	0.000							Continuing	Continuing
PE 0603500F/ Multi-Disciplinary Advanced Development Space Technology.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER 63682J

E. Performance Metrics

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