Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	57.612	67.894	69.026	-	69.026	60.110	66.427	64.627	64.336	Continuing	Continuing
632181: *Spacecraft Payloads*	-	15.194	16.458	12.685	-	12.685	17.333	18.164	16.113	13.202	Continuing	Continuing
633834: *Integrated Space Technology Demonstrations*	-	10.416	11.789	18.378	-	18.378	17.838	20.737	22.463	22.336	Continuing	Continuing
634400: *Space Systems Protection*	-	5.142	5.591	3.881	-	3.881	3.657	4.654	4.723	4.741	Continuing	Continuing
634950: *Space Demonstration*	-	14.223	14.968	11.757	-	11.757	-	-	-	-	Continuing	Continuing
635021: *Space Systems Survivability*	-	3.689	3.344	3.081	-	3.081	2.805	4.469	3.878	4.853	Continuing	Continuing
635083: *Ballistic Missiles Technology*	-	3.320	5.467	7.747	-	7.747	9.708	9.880	9.344	9.433	Continuing	Continuing
63682J: *Spacecraft Vehicles*	-	5.628	10.277	11.497	-	11.497	8.769	8.523	8.106	9.771	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft vehicles, ballistic missiles, and space systems survivability. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. 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, RDT&E Budget Item Justification: PB 2015 Air Force					Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*			R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*		
B. Program Change Summary ($ in Millions)	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO**	**FY 2015 Total**
Previous President's Budget	64.557	68.071	69.975	-	69.975
Current President's Budget	57.612	67.894	69.026	-	69.026
Total Adjustments	-6.945	-0.177	-0.949	-	-0.949
• Congressional General Reductions	-0.086	-0.177			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.441	-			
• Other Adjustments	-5.418	-	-0.949	-	-0.949

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 632181 / *Spacecraft Payloads*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
632181: *Spacecraft Payloads*	-	15.194	16.458	12.685	-	12.685	17.333	18.164	16.113	13.202	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

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. Future 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, this project merges 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 (DoD) 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 Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Advanced Space Electronics	6.657	5.284	4.351
Description: Develop microelectronic devices, including radiation-hardened data processors and high-density hardened memories, advanced packaging technologies, and micro-electro-mechanical system components and applications. ***FY 2013 Accomplishments:*** Developed multiprocessor components to increase on-orbit processing capability. Developed high-density volatile and non-volatile memory for increased on-orbit storage capability. Completed digital structured application specific integrated circuits for affordable space electronics. ***FY 2014 Plans:*** Focus development of multiprocessor components to reduce power required for on-orbit processing capability. Develop volatile memory for satellite high-density data storage capability. Begin to develop analog structured application specific integrated circuits for affordable space electronic support logic. ***FY 2015 Plans:*** Continue development of multi-processor components to provide extremely-high-performance, low-power on-orbit processing capability. Continue to develop high-density volatile memory devices. Continue structured application specific circuits development to include development of reconfigurable or structured analog array integrated circuits to meet growing need for mixed-signal space electronics.			
Title: Spacecraft Design Tools	2.168	0.998	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 632181 / *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Develop satellite system technologies for spacecraft operations and for satellite control, precision navigation, formation flying, and proximity operations technologies. ***FY 2013 Accomplishments:*** Developed second-generation plug-and-play ground testbed to fully test and demonstrate end-to-end flight ready spacecraft plug-and-play software and hardware. Supported transition of spacecraft modular component technology to large spacecraft. Assisted space acquisitions with modular space component technology assessment. Supported Air Force development of a modular component-based space vehicle. ***FY 2014 Plans:*** Complete development, refinement and use of modular space component ground testbed. Mature plug-and-play standards and structure. Finish supporting Air Force development of a plug-and-play based space vehicle. ***FY 2015 Plans:*** Effort completed in FY 2014.			
Title: Advanced Space Modeling and Simulation Tools ***Description:*** Develop modeling, simulation, and analysis tools for space-based surveillance systems, space capability protection technologies, access/mobility technologies, and flight experiments. ***FY 2013 Accomplishments:*** Validated the guidance, navigation, and control aspects of the autonomous flight software using the mission simulator flight software. Provided engineering to engagement level models for systems engineering and trades, mission planning, and utility analysis to flight experiments and research areas. ***FY 2014 Plans:*** Validate system to mission-level modeling and simulation tools for flight program mission planning. Finalize data requirements for upcoming flight programs to gather critical validation data on orbit to enhance previously developed modeling and simulation tools. Evaluate the military and technical utility of emerging space vehicle technologies and associated software algorithms. ***FY 2015 Plans:*** Update modeling and simulation tools for flight programs using data sets from recent missions. Continue evaluating the military and technical utility of emerging space vehicle technologies and associated software algorithms.	2.882	2.858	0.899
Title: Advanced Space Sensors	3.487	3.326	2.596

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 632181 / *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Develop space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot targets, as well as "cold body" objects. ***FY 2013 Accomplishments:*** Developed large focal plane array for exquisite imaging for adaptive, comprehensive Space Situational Awareness (SSA). Developed higher operating temperature, large format medium wavelength infrared sensors for wide area, global access detection and tracking. ***FY 2014 Plans:*** Continue developing wide field of view large focal plane array for theater missile warning, missile detection, and battlespace awareness. Initiate radiation hardened visible scanning effort to improve sensor capabilities for comprehensive SSA. ***FY 2015 Plans:*** Investigate material system alternative to mercury cadmium telluride for use in wide field of view applications in support of classic intelligence, surveillance, and reconnaissance missile warning applications. Continue to mature radiation hardened visible starrers and/or scanners as well as long wavelength infrared detection in support of SSA missions.			
Title: Positioning, Navigation, and Timing (PNT) Space Payload Technologies ***Description:*** Develop, validate, and transition technologies that: enable new, or enhance existing, U.S. PNT satellite capabilities by increasing resiliency and availability of accuracy; and/or increase the affordability of providing current capabilities. Develop validate, and transition technologies to meet identified Air Force Space Command/Space and Missile Systems Center PNT space payload technology needs. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** Initiate acquisition of advanced on-orbit reprogrammable digital waveform generator technology for application to future satellites in the Global Positioning System (GPS) system to enable after-launch modification of the GPS signals or the implementation of new signals and signal combining/synthesis techniques over the on-orbit life of the satellite. Enable increased flexibility and resiliency of the GPS system. Conduct system engineering and initiate designs of advanced technology space qualifiable L-band radio frequency (RF) amplifier(s) for PNT/GPS. ***FY 2015 Plans:***	-	3.992	4.839

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 632181 / *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Finalize design and begin performance evaluation of advanced technology space qualifiable L-band RF amplifier(s) for PNT/GPS. Begin system engineering tasks and initiate designs of on-orbit reprogrammable digital waveform generator.			
Accomplishments/Planned Programs Subtotals	15.194	16.458	12.685

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 633834 / *Integrated Space Technology Demonstrations*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
633834: *Integrated Space Technology Demonstrations*	-	10.416	11.789	18.378	-	18.378	17.838	20.737	22.463	22.336	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

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 a relevant environment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Integrated Satellite Demonstrations	10.416	11.789	18.378
Description: Develop satellite technologies for integrated, robust, flexible, satellite demonstrations building on previous work and leveraging investments by other organizations. ***FY 2013 Accomplishments:*** Completed satellite integration to the launch vehicle. Completed satellite flight software and orbit analysis tools for commanding satellite. Completed final testing of the satellite before it is put in storage to await a launch. Designed next geosynchronous space flight demonstration. ***FY 2014 Plans:*** Begin space flight operations of geosynchronous orbit satellite demonstrating advanced autonomy technologies. Continue maintenance and debugging of geosynchronous orbit experimental satellite flight software and orbit analysis tools. Procure long-lead components, the platform, and Air Force payloads for planned demonstration of an augmented Evolved Expendable Launch Vehicle Secondary Payload Adaptor (ESPA) geosynchronous orbit experiment. ***FY 2015 Plans:*** Continue one year of experimental flight operations. Begin analyzing science and health and status data. Verify maneuverable geosynchronous experimental platform design. Verify spacecraft subsystem and payload hardware and software after component/subsystem delivery. Prepare for component/subsystem tests.			
Accomplishments/Planned Programs Subtotals	10.416	11.789	18.378

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 633834 / *Integrated Space Technology Demonstrations*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

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, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 634400 / *Space Systems Protection*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
634400: *Space Systems Protection*	-	5.142	5.591	3.881	-	3.881	3.657	4.654	4.723	4.741	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

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 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 and avoiding threats and operating in a hostile space environment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Space Situational Awareness Capability Development	1.467	2.501	2.690
Description: Develop tools and technologies that advance space-based proximity awareness capabilities and enable protection and countermeasure courses of action. Efforts will assess a variety of phenomenologies and concepts in response to multiple threat classes and scenarios. ***FY 2013 Accomplishments:*** Used results from deep-space imaging experiments to develop a brass board system traceable to a potential space-based capability. Repeated developmental performance tests on brass board hardware and software to verify expected performance. Conducted experiments to verify performance of predictive signature efforts. ***FY 2014 Plans:*** Using experimental test results from deep-space imaging experiments, conduct an engineering trade study for a space-based concept. ***FY 2015 Plans:*** Initiate hardware development on space-based imaging concepts that show viability under the feasibility study. Complete data analysis from the joint threat scenario study to quantify technology return-on-investment metrics. Initiate concept development, modeling, and simulations.			
Title: Space Indicators and Warning Research	2.166	2.745	0.296
Description: Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites. ***FY 2013 Accomplishments:***			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 634400 / *Space Systems Protection*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Initiated local area sensor for indication and warnings engineering unit development. Designed concept for integrated sensor suite and response system for automated response options. Identified future flight opportunity. ***FY 2014 Plans:*** Continue local area sensor for indication and warning engineering unit development. Continue design concept for integrated sensor suite and response system for automated response options. ***FY 2015 Plans:*** Continue updating sensor specifications and evaluating additional sensors to compare attributes (size, weight, power, performance, maturity, etc.) of sensor technologies against case uses/scenarios/missions.			
Title: Spacecraft Threat Detection ***Description:*** Develop active satellite local space awareness technologies and exploitation tools for satellite systems. ***FY 2013 Accomplishments:*** Demonstrated a modular satellite autonomy flight architecture with responsive action to a selected directed energy threat to a hypothetical friendly satellite. This included the capability to detect threats on-board and provide autonomous potential courses of action to mitigate the postulated threat. ***FY 2014 Plans:*** Expand satellite autonomy architecture and demonstrate threat/anomaly detection and response with real-time sensor processing and control. ***FY 2015 Plans:*** Develop components to enable on-board detection, assessment, and resolution of spacecraft anomalies to include co-orbital and directed energy threats. Employ system levels concepts to enable cross queuing of assets both on-orbit and on the ground.	1.220	0.345	0.895
Title: Satellite RF Characterization ***Description:*** Develop RF characterization methods and performance analysis technology. ***FY 2013 Accomplishments:*** Developed engineering model sensor sub-systems for active and/or passive threat detection and tracking capabilities. Initiated technology risk reduction for U.S. satellite vulnerability mitigation. ***FY 2014 Plans:***	0.289	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 634400 / *Space Systems Protection*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
This thrust has been combined with the Space Indicators and Warning Research thrust in the same project in order to better align counterspace science and technology efforts. ***FY 2015 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	5.142	5.591	3.881

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 634950 / *Space Demonstration*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
634950: *Space Demonstration*	-	14.223	14.968	11.757	-	11.757	-	-	-	-	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project will provide mission design and development, payload integration, launch support, operations planning, and one-year of on-orbit operations for a science and technology space-launch mission. The project will provide a launch opportunity in support of the multi-agency "new entrant" certification strategy and the Air Force Launch Services New Entrant Certification Guide.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: S&T Space Launch Integration and Test	14.223	14.968	11.757
Description: Provide mission design and development, payload integration, launch support, operations planning, and one-year of on-orbit operations for a science and technology space-launch mission while supporting the multi-agency "new entrant" certification strategy. ***FY 2013 Accomplishments:*** Provided mission definition, design, development, and operations planning. Selected and refined satellite and payload manifest. Initiated planning and integration of satellites and payloads onto launch vehicle. ***FY 2014 Plans:*** Provide mission definition, design, development, and operations planning. Refine satellite and payload manifest. Continue planning and integration of satellites and payloads onto launch vehicle. ***FY 2015 Plans:*** Finalize satellite and payload manifest. Complete payload/satellite/launch vehicle integration.			
Accomplishments/Planned Programs Subtotals	14.223	14.968	11.757

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
• 0: *N/A*	-	-	-	-	-	-	-	-	-	-	-

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 634950 / *Space Demonstration*

D. Acquisition Strategy

N/A

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, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 635021 / *Space Systems Survivability*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635021: *Space Systems Survivability*	-	3.689	3.344	3.081	-	3.081	2.805	4.469	3.878	4.853	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

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 Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Spacecraft Survivability/Reliability	3.689	3.344	3.081
Description: Develop technologies to provide improved space radiation and ionospheric hazard specification and forecasting. ***FY 2013 Accomplishments:*** Improved software tools to model surface and deep charging, radiation dose rate to spacecraft in real-time for evaluation of spacecraft anomalies. Developed an engineering model of an improved instrument to measure high-energy electrons and protons that contribute to radiation dose and spacecraft charging. Advanced development of concepts and technology for an operational capability in heliospheric imaging. ***FY 2014 Plans:*** Exploit on-orbit data to improve accuracy of standard radiation belt model for satellite design. Continue development of advanced data and modeling techniques to increase accuracy of spacecraft anomaly attribution. Complete engineering model and begin construction of compact space environment sensor flight unit. Implement material aging models into spacecraft charging design tool. Develop technologies supporting next-generation upgrades to the Air Force's solar optical, radio, and imaging network. ***FY 2015 Plans:*** Expand initial capabilities to new orbital and frequency domains, and incorporate improved data and modeling. Continue developing models of spacecraft material aging and implement into spacecraft charging design tool. Continue exploitation of on-orbit data to improve understanding of system-specific space environment effects. Continue support to next-generation upgrades to the Air Force solar optical and radio-frequency monitoring networks, with emphasis on specification and forecast of solar radio-frequency interference affecting Air Force communications and satellite systems.			
Accomplishments/Planned Programs Subtotals	3.689	3.344	3.081

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 635021 / *Space Systems Survivability*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 635083 / *Ballistic Missiles Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635083: *Ballistic Missiles Technology*	-	3.320	5.467	7.747	-	7.747	9.708	9.880	9.344	9.433	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

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 Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Advanced Navigation Instruments	3.320	5.467	7.747
Description: Develop, integrate, and demonstrate advanced navigation instrumentation applied to emerging vehicle designs and other technologies that support warfighter needs for a safe, secure, and reliable strategic deterrence. ***FY 2013 Accomplishments:*** Improved Advanced Inertial Measurement Unit (AIMU) design based on engineering model testing. Initiated engineering model build of AIMU for validation of performance in a sled test. Initiated preliminary design for hardening of AIMU to weapons level radiation hardness. Initiated development of technologies for next generation strategic weapons requirements. ***FY 2014 Plans:*** Continue design and build of fully weapons hardened AIMU design to meet Minuteman III requirements. Continue ground testing to include component testing and sled test of prototype AIMU to validate performance. ***FY 2015 Plans:*** Continue weapons hardening of critical technology elements of AIMU system. Build two ground test units with improved design updates for additional testing and integration planning. Investigate and implement multipath mitigation improvements. Incorporate in militarily relevant hardware and conduct field testing.			
Accomplishments/Planned Programs Subtotals	3.320	5.467	7.747

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 635083 / *Ballistic Missiles Technology*

D. Acquisition Strategy

N/A

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, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 63682J / *Spacecraft Vehicles*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
63682J: *Spacecraft Vehicles*	-	5.628	10.277	11.497	-	11.497	8.769	8.523	8.106	9.771	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project develops and demonstrates compact, low-cost, spacecraft power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. This project also develops composites for spacecraft structures and technologies for spacecraft control and mechanisms.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Space Power Technologies	1.880	1.372	1.708
Description: Develop power generation space technologies such as multi-junction solar cells, thin-film solar cells, lightweight solar cell arrays, and radiation resistant solar cell modules. ***FY 2013 Accomplishments:*** Completed development of efficient 34% inverted metamorphic (IMM) solar cell. Developed 35-37% IMM and quantum-dot enhanced IMM solar cells. Matured IMM solar cell interconnection and module technologies. ***FY 2014 Plans:*** Complete development of efficient 35% IMM solar cell. Continue development of 36-37% IMM and quantum dot enhanced IMM solar cells. Complete IMM solar cell interconnection and continue maturation of module technologies. ***FY 2015 Plans:*** Continue development of approaches for greater than 35% efficient solar cells. Mature module/blanket technologies for increased reliability and resiliency. Mature flexible array technologies.			
Title: Spacecraft Thermal Technologies	0.826	0.982	1.082
Description: Develop technologies for long-life, efficient, low-vibration, lightweight mechanical cryocoolers and integration components for space applications. ***FY 2013 Accomplishments:*** Reduced size, weight, and power requirements, eased integration, and increased reliability of cryocoolers and supporting payload thermal management systems for very large format focal plane arrays for missile warning capability and for industry to significantly			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 63682J / *Spacecraft Vehicles*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
improve overall cryocooler design. Expanded computer modeling to cover additional cryocooler components, including the pulse tube, and provided correlated results to industry. ***FY 2014 Plans:*** Using correlated computer modeling results, continue to reduce size, weight, and power requirements, ease integration, and increase reliability of cryocoolers and supporting payload thermal management systems for very large format focal plane arrays for missile warning capability and for industry to significantly improve overall cryocooler design. Further expand computer modeling to additional cryocooler components, to include flow straightening effects and other refrigeration cycles (reverse Brayton), and provide correlated results to industry. ***FY 2015 Plans:*** Continue computer simulations to optimize performance of different cryogenic coolers in support of payload thermal management systems for very large format focal plane arrays for missile warning capability and for industry. Increase manufacturability of space-borne cryocoolers through the implementation of commercial, terrestrial cryocooler technologies, combined with space-like designs.			
Title: Spacecraft Structures Technologies ***Description:*** Develop composites for spacecraft structures and space applications, such as launch vehicle shrouds, thermal protection structures, and space antennas. ***FY 2013 Accomplishments:*** Developed capability for providing structural dynamics data on large, deployable apertures for space systems. Developed technologies and processes for rapid calibration of payloads for space applications. ***FY 2014 Plans:*** Perform data analysis on variable heat transfer modulation experiment aboard the International Space Station. Produce flight-representative deployable baffle and folded optics for compact star-trackers and wide-field-of-view imagers. ***FY 2015 Plans:*** Develop thermal technologies for heat dissipation of high energy density spacecraft electronics. Mature technologies for composite spacecraft deployable structures, solar arrays, electro-optical and radio-frequency apertures, and de-orbit mechanisms. Test structurally-integrated sensing technologies on samples representative of satellite structures.	1.367	1.694	2.145
Title: On-Orbit Satellite Controls ***Description:*** Develop technologies for spacecraft controls and mechanisms for on-orbit applications. ***FY 2013 Accomplishments:***	1.555	0.299	0.524

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Demonstrated and transitioned Space Situational Awareness (SSA) camera tracking software. Demonstrated momentum control systems (control moment gyroscopes) for small satellites in relevant environment; initiated advanced spacecraft guidance, navigation, and control subsystem hardware development efforts. ***FY 2014 Plans:*** Continue advanced spacecraft guidance, navigation, and control subsystem hardware development efforts. ***FY 2015 Plans:*** Initiate development of advanced low size/weight/power high-precision navigation hardware for geosynchronous SSA missions.			
Title: Space Communication and Control Technologies ***Description:*** Develop technologies for next-generation space communications terminals and equipment, along with methods/ techniques to enable future space system operational command and control concepts. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** Develop satellite communication flight experiments to support future Air Force satellite systems, particularly reconfigurable/ reprogrammable satellite transceivers, space laser communication terminals, and millimeter wave atmospheric propagation experiments. ***FY 2015 Plans:*** Continue incremental development of satellite communication flight experiments to support future Air Force satellite systems, particularly reconfigurable/reprogrammable satellite transceivers, space laser communication terminals, and millimeter wave atmospheric propagation experiments. Support Space and Missile Systems Center Low-Cost User Terminal initiatives.	-	5.930	4.449
Title: Advanced Alternative Navigation Technologies ***Description:*** Develop new atomic clock technologies and transition these technologies to industry for potential application to future positioning, navigation, and timing space considerations. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:***	-	-	1.589

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Initiate efforts to transition newly-developed atomic clock technology from laboratory experiments to industry for potential space systems application. Design and begin fabricating engineering models of these clocks to meet DoD positioning and timing requirements.			
Accomplishments/Planned Programs Subtotals	5.628	10.277	11.497

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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.