

**UNCLASSIFIED**

PE NUMBER: 0603500F

PE TITLE: MULTI-DISCIPLINARY ADV DEV SPACE TEC

<b>Exhibit R-2, RDT&amp;E Budget Item Justification</b>	<b>DATE</b> <b>February 2007</b>
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<b>BUDGET ACTIVITY</b> <b>03 Advanced Technology Development (ATD)</b>	<b>PE NUMBER AND TITLE</b> <b>0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC</b>
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Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	51.929	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5031 Advanced Optics & Laser Space Tech	19.938	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5033 Rocket Propulsion Demonstration	25.066	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5034 Advanced Space Sensors	6.925	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2007, Project 635031 efforts transfer to PE 0603605F, Project 6311SP, Advanced Optics and Laser Space Technology; Project 635032 efforts transfer to PE 0603112F, Advanced Materials for Weapons Systems, Project 6377SP, Advanced Space Materials; Project 635033 efforts transfer to PE 0603216F, Aerospace Propulsion and Power Technology, Project 6310SP, Space Rocket Propulsion Demonstration; Project 635034 efforts transfer to PE 0602203F, Advanced Aerospace Sensors, Project 6388SP, Advanced Space Sensors; and Project 635062 efforts transfer to PE 0603211F, Aerospace Technology Development/Demonstration, Project 6399SP, Advanced Structures Space Vehicles, in order to more effectively manage and provide oversight of the efforts.

(U) **A. Mission Description and Budget Item Justification**

This program develops and demonstrates multi-disciplinary space technologies focusing on separate technology areas including: 1) advanced optics and laser space technology demonstrates and assesses space unique advanced optics and high energy laser weapon systems capabilities; 2) advanced space materials develop and demonstrate materials and processing technologies for future space vehicle components and protection of space sensors from a variety of laser threats; 3) rocket propulsion develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques for launch and spacecraft applications; 4) advanced space sensors develops and demonstrates sensor technologies for intelligence, surveillance, and reconnaissance, communications, targeting, and electronic counter-countermeasures for spacecraft applications; and 5) advanced structures for space vehicles develop space unique requirements for a horizontally launched transatmospheric vehicle operating in an extreme environment. 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.

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

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Previous President's Budget	55.732	0.000	0.000	0.000
(U) Current PBR/President's Budget	51.929	0.000	0.000	0.000
(U) Total Adjustments	-3.803			
(U) Congressional Program Reductions				
Congressional Rescissions	0.028			
Congressional Increases				
Reprogrammings	-2.595			
SBIR/STTR Transfer	-1.236			

(U) **Significant Program Changes:**

Efforts transfer to other programs in FY 2007 and out to more effectively manage and provide oversight of the efforts. Other changes to this PE since the Previous President's Budget are due to higher Air Force priorities.

C. Performance Metrics

(U) Under Development.

**Exhibit R-2a, RDT&E Project Justification**

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BUDGET ACTIVITY <b>03 Advanced Technology Development (ATD)</b>				PE NUMBER AND TITLE <b>0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC</b>				PROJECT NUMBER AND TITLE <b>5031 Advanced Optics &amp; Laser Space Tech</b>		
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5031 Advanced Optics & Laser Space Tech	19.938	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0603605F, Advanced Weapons Technology, Project 631 ISP, Advanced Optics and Laser Space Technology, in order to more effectively manage and provide oversight of the efforts.

**(U) A. Mission Description and Budget Item Justification**

This project provides for the demonstration and detailed assessment of space unique technologies needed for advanced optical systems and high-energy laser weapons.

**(U) B. Accomplishments/Planned Program (\$ in Millions)**

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Develop advanced, long-range, optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large, lightweight optics; and optical coatings that support relay mirror systems. Relay mirror systems can greatly extend the range of high-power laser weapons, as well as low-power imaging systems. .	2.916	0.000	0.000	0.000
(U) In FY 2006: Planned a demonstration to actively track a cruise missile by relaying both the illuminator and the scoring beam through the relay and differentially pointing them at the output. Demonstrated the ability to apply advanced high energy laser optical coatings on a three-meter diameter substrate such as lightweight silicon carbide primary mirrors. Designed and built a lightweight mirror/micro electro-mechanical system integration testbed for the evaluation of advanced optical components.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for applications including relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imaging.	4.707	0.000	0.000	0.000
(U) In FY 2006: Tested advanced laser-beacon adaptive optics system on Starfire Optical Range 3.5 meter telescope to increase imaging resolution/laser beam control. Performed high-resolution satellite imaging at short wavelengths. Demonstrated and characterized performance of point-ahead compensated laser propagation to low-earth-orbit (LEO) satellites using sodium-beacon adaptive optics.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				

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<b>BUDGET ACTIVITY</b> <b>03 Advanced Technology Development (ATD)</b>	<b>PE NUMBER AND TITLE</b> <b>0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC</b>	<b>PROJECT NUMBER AND TITLE</b> <b>5031 Advanced Optics &amp; Laser Space Tech</b>
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<b>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2009: Not Applicable.				
(U)				
(U) MAJOR THRUST: Develop and demonstrate advanced optical beam control technologies for laser propagation through severe and/or extended atmospheric turbulence.	12.315	0.000	0.000	0.000
(U) In FY 2006: Completed integration of first phase ground test system for characterization of laser propagation through atmospheric turbulence. Completed laboratory experiments and field tested advanced adaptive optical and tracking technologies in stressing atmospheric conditions.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) Total Cost	19.938	0.000	0.000	0.000

<b>(U) <u>C. Other Program Funding Summary (\$ in Millions)</u></b>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>Cost to Complete</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>								
(U) PE 0602605F, Directed Energy Technology.										
(U) PE 0603444F, Maui Space Surveillance System.										
(U) PE 0603605F, Advanced Weapons Technology.										
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

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DEV SPACE TEC

PROJECT NUMBER AND TITLE

5031 Advanced Optics & Laser  
Space Tech

(U) D. Acquisition Strategy

Not Applicable.

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BUDGET ACTIVITY <b>03 Advanced Technology Development (ATD)</b>					PE NUMBER AND TITLE <b>0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC</b>			PROJECT NUMBER AND TITLE <b>5033 Rocket Propulsion Demonstration</b>		
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5033 Rocket Propulsion Demonstration	25.066	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0603216F, Aerospace Propulsion and Power Technology, Project 6310SP, Space Rocket Propulsion Demonstration, in order to more effectively manage and provide oversight of the efforts.

**(U) A. Mission Description and Budget Item Justification**

This project develops and demonstrates advanced and innovative low-cost rocket turbomachinery and components, low-cost space launch propulsion system technologies, and advanced propellants for launch and orbit transfer propulsion. Additionally, this project develops technologies for the Technology for Sustainment of Strategic Systems Phase 1. Characteristics such as environmental acceptability, affordability, reliability, responsiveness, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. This project also develops chemical, electrical, and solar rocket propulsion system technologies for stationkeeping and on-orbit maneuvering applications. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances developed in this program could improve the performance of expendable systems' payload capabilities by ~20 percent, and reduce launch, operations, and support costs by ~30 percent. Responsiveness and operability of propulsion systems will be enhanced for reusable launch systems. Technology advances could also lead to seven-year increase in satellite on-orbit time, a 50 percent increase in satellite maneuvering capability, a 25 percent reduction in orbit transfer operational costs, and a 15 percent increase in satellite payload. The efforts in this project contribute to the Integrated High Payoff Rocket Propulsion Technology program, a joint Department of Defense, National Aeronautics and Space Administration, and industry effort to focus rocket propulsion technology on national space launch needs.

**(U) B. Accomplishments/Planned Program (\$ in Millions)**

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch vehicles.	13.388	0.000	0.000	0.000
(U) In FY 2006: Scaled-up and tested advanced lightweight thrust chamber and nozzle technologies. Scaled-up advanced cryogenic upper stage technologies including higher efficiency energy conversion systems.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U) MAJOR THRUST: Develop solar electric propulsion technologies for existing and future satellites, upper stages, orbit transfer vehicles, and satellite formation flying, station keeping, and repositioning.	3.588	0.000	0.000	0.000
(U) In FY 2006: Developed electric propulsion systems for orbit-transfer by developing high-power Hall				

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<b>03 Advanced Technology Development (ATD)</b>	<b>0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC</b>	<b>5033 Rocket Propulsion Demonstration</b>			
<b>(U) B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
thrusters capable of low-earth-orbit geosynchronous-earth-orbit transfer. Developed components for the high-power Hall thruster demonstration.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
(U) MAJOR THRUST: Develop missile propulsion, aging, and surveillance technology for intercontinental ballistic missiles to include demonstration of missile propulsion technology and Post Boost Control Systems. Note: Efforts completed in FY 2006.		6.321	0.000	0.000	0.000
(U) In FY 2006: Completed fabrication of final components for the final strategic sustainment demonstration motors and prepared for test. Completed assessment and fabrication of the final strategic sustainment demonstration motors.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
(U) MAJOR THRUST: Develop electric and advanced chemical based monopropellant propulsion technologies for future satellite propulsion systems.		0.806	0.000	0.000	0.000
(U) In FY 2006: Completed advanced monopropellant thruster demonstration.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
(U) CONGRESSIONAL ADD: Upper Stage Engine Technology (USET).		0.963	0.000	0.000	0.000
(U) In FY 2006: Provided additional turbo-pump cavitation modeling, simulation, and tool development for use in future liquid rocket booster and upper stage engine designs and analysis.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U) Total Cost		25.066	0.000	0.000	0.000

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

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>Cost to</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Complete</u>							
(U) PE 0602102F, Materials.										
(U) PE 0602203F, Aerospace Propulsion.										
(U) PE 0602601F, Spacecraft Technology.										
(U) PE 0603114N, Power Projection Advanced Technology.										
(U) PE 0603216F, Aerospace Propulsion Power Technology.										
(U) PE 0603401F, Advanced Spacecraft Technology.										
(U) PE 0603853F, Evolved Expendable Launch Vehicle Program.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										
(U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.										

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Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5034 Advanced Space Sensors	6.925	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transfer to PE 0603203F, Advanced Aerospace Sensors, Project 6388SP, Advanced Space Sensors, in order to more effectively manage and provide oversight of the efforts.

**(U) A. Mission Description and Budget Item Justification**

This project develops and demonstrates space sensor technologies, including radio frequency sensors; intelligence, surveillance, and reconnaissance sensors (ISR); electro-optical sensors; laser warning sensors; targeting and attack radar sensors; and electronic counter-countermeasures (ECCM) and communications. By developing multi-function radar, laser, electronic combat, and ECCM technologies for space applications, this project provides space platforms with the capability to precisely detect, track, and target air- and ground-based, high-value, time-critical targets, while remaining invulnerable to hostile and natural threats.

**(U) B. Accomplishments/Planned Program (\$ in Millions)**

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Develop and demonstrate technologies to maximize Global Positioning System jam resistance, positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities.	2.129	0.000	0.000	0.000
(U) In FY 2006: Designed space-based distributed position, navigation, and time technologies to achieve optimal sensor fusion for a Common Operation Picture. Designed multi-ship virtual flight test simulation technology to assess networked clusters of mini" unmanned aerial vehicles.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U) MAJOR THRUST: Develop space laser warning sensor technologies for timely alert to advanced laser acquisition/tracking sensors, including detecting and locating both high power (dazzle/damage) and low power (laser-guided ordnance) signals.	1.600	0.000	0.000	0.000
(U) In FY 2006: Integrated false alarm package space-flight components onto space flight host. Planned and coordinated on-orbit testing, data collection, and system evaluation. Developed risk-reduction technology for space-qualified laser warning sensors for rapid detection and characterization of laser designators, trackers, dazzlers, and weapons. Completed development of a space-based laser threat scenario testbed for satellite-as-a-sensor technology evaluations.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				

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<b>03 Advanced Technology Development (ATD)</b>	<b>0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC</b>	<b>5034 Advanced Space Sensors</b>			
<b>(U) B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2009: Not Applicable.					
(U) MAJOR THRUST: Develop advanced laser communication component and sub-system technology to support a network-level topology for Airborne Intelligence Surveillance and Reconnaissance (AISR).		2.877	0.000	0.000	0.000
(U) In FY 2006: Developed an integrated electro-optical communication terminal for evaluation and testing of AISR links between an airborne communication testbed and ground terminals. Developed shared radio frequency/electro-optical apertures to service high bandwidth communication needs. Tested applicability of shared apertures to maintaining air network link connectivity under in weather conditions. Installed aircraft optical network to switch and route high bandwidth laser communication signals to lower level radio frequency systems through a distributed fiber bus providing lower bandwidth link connectivity and redundancy. Demonstrated a combined radio frequency/ optical communication air to air to ground high bandwidth network.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U) MAJOR THRUST: Develop, demonstrate, and evaluate spectral-temporal sensing technologies for detection and identification of transient and moving targets for battlespace surveillance and space situational awareness. Note: In FY 2006, spectral sensing technology efforts from PE 0603203F, Advanced Aerospace Sensors, are extended to the space environment.		0.319	0.000	0.000	0.000
(U) In FY 2006: Designed a testbed sensor to evaluate the performance potential of spectral-temporal sensing for battlespace surveillance missions. Modeled expected performance for a variety of targets, including muzzle flashes, artillery and tank fire, and battlefield explosions.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U) Total Cost		6.925	0.000	0.000	0.000

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5034 Advanced Space Sensors

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

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>Cost to</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Complete</u>							
(U) PE 0602204F, Aerospace Sensors.										
(U) PE 0603203F, Advanced Aerospace Sensors.										
(U) PE 0603270F, Electronic Combat Technology.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) **D. Acquisition Strategy**

Not Applicable.