

UNCLASSIFIED

PE NUMBER: 0603605F

PE TITLE: Advanced Weapons Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE

February 2007

BUDGET ACTIVITY

03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE

0603605F Advanced Weapons Technology

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	42.124	76.733	43.999	38.877	72.809	57.427	64.922	76.273	Continuing	TBD
11SP Advanced Optics and Laser Space Tech	0.000	21.323	21.107	18.296	27.505	27.982	28.011	28.875	0.000	0.000
3150 Advanced Optics Technology	10.226	11.955	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
3151 High Power Solid State Laser Technology	13.240	26.650	12.388	11.428	21.669	16.932	23.569	32.552	Continuing	TBD
3152 High Power Microwave Technology	10.170	12.890	10.504	9.153	23.635	12.513	13.342	14.846	Continuing	TBD
3647 High Energy Laser Technology	8.488	3.915	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2007, Project 11SP, Advanced Optics and Laser Space Technology, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5031, 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 program provides for the development and demonstration of advanced directed energy and optical concepts. In solid state lasers, compact, reliable, relatively high power, cost-effective single electric laser devices and arrays of electric laser devices are demonstrated. Technologies such as high power chemical lasers and beam control are also demonstrated. In high power microwaves, technologies such as narrowband and wideband devices and antennas are demonstrated. Note: In FY 2007, Congress added \$6.8 million for Applications of LIDAR to Vehicles with Analysis (ALVA), \$1.6 million for the Near Earth Space Surveillance Initiative, \$1.0 million for Mobile Active Targeting Resource for Integrated Experiments, \$2.0 million Laser Spark System Integration, \$1.7 million for Mid-Infrared Semiconductor Laser Technology, \$2.4 million for High Energy Laser - Directed Energy Weapon (HEL-DEW) Scaling Optimization, \$1.0 million for the Hyper/multispectral Data Reduction and Archiving (HyDRA) Project, \$2.6 million for Advanced Weapons and Laser Diode Development, \$5.0 million for Lightweight Multi-purpose Laser, and \$1.6 million for Real-time Optical Surveillance Applications. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new 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	49.821	51.336	51.057	53.351
(U) Current PBR/President's Budget	42.124	76.733	43.999	38.877
(U) Total Adjustments	-7.697			
(U) Congressional Program Reductions		-0.012		
Congressional Rescissions	-0.032	-0.291		
Congressional Increases		25.700		
Reprogrammings	-6.629			
SBIR/STTR Transfer	-1.036			

(U) **Significant Program Changes:**

In FY 2006, \$4.284 million was reprogrammed into PE 0602890F, High Energy Laser Research, as the Air Force contribution to the Joint High Power Solid State Laser program.

C. Performance Metrics

Under Development.

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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
11SP Advanced Optics and Laser Space Tech	0.000	21.323	21.107	18.296	27.505	27.982	28.011	28.875	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5031, Advanced Optics and Laser Space Tech, to this project 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 and laser systems.

(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 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.	0.000	1.186	1.060	1.137
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Perform cost trade studies and begin design of integrated testbed.				
(U) In FY 2008: Begin integration of advanced optical technologies in an optical testbed and design sub-systems such as power, advanced thermal management, signal processing, sensors, and optical mounting and vibration control.				
(U) In FY 2009: Continue integration of testbed and begin testing of sub-systems.				
(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for space situational awareness applications using large aperture telescopes, including high-resolution satellite imaging, detection and characterization of small/dim space objects, and high accuracy space object tracking.	0.000	5.578	4.317	3.822
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Demonstrate detection and discrimination of small, non-resolved space objects. Demonstrate near-infrared imaging of satellites too small or dim for present systems. Begin integration of high efficiency adaptive optics system for compensated visible imaging and detection of very dim space objects. Demonstrate phased array imaging for large aperture high resolution telescopes.				
(U) In FY 2008: Continue integration of high efficiency adaptive optics system for compensated imaging and detection of very dim space objects at visible wavelengths. Perform laboratory tests to validate the performance of lightweight mirrors				
(U) In FY 2009: Integrate high efficiency adaptive optics system on large aperture high resolution				

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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 11SP Advanced Optics and Laser Space Tech
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(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
telescope. Demonstrate compensated imaging and detection of very dim space objects at visible wavelengths. Conclude phased array imaging experiments.				
(U) MAJOR THRUST: Develop and demonstrate advanced optical beam control technologies for laser propagation through severe and/or extended atmospheric turbulence.	0.000	14.559	15.730	13.337
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Begin integration of advanced ground diagnostic system for characterization of laser propagation through atmospheric turbulence. Demonstrate and characterize operation of advanced adaptive optics and tracking technologies in stressing atmospheric conditions.				
(U) In FY 2008: Continue integration of advanced ground diagnostic system for characterization of laser propagation through stressing atmospheric turbulence. Perform laboratory characterization on components for sensing and wavefront control technologies.				
(U) In FY 2009: Complete integration of advanced ground diagnostic system performance in a variety of atmospheric conditions. Complete characterizat on and demonstration of advanced sensing and wavefront control technologies.				
(U) Total Cost	0.000	21.323	21.107	18.296

(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>	<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 0602605F, Directed Energy Technology										
(U) PE 0603444F, Maui Space Surveillance System										
(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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PROJECT NUMBER AND TITLE

11SP Advanced Optics and Laser
Space Tech

(U) D. Acquisition Strategy

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	
3150 Advanced Optics Technology	10.226	11.955	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			

(U) A. Mission Description and Budget Item Justification

This project develops advanced optical technologies for various strategic and tactical beam control applications.

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

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) CONGRESSIONAL ADD: Satellite Active Imaging National Testbed Program.	1.061	0.000	0.000	0.000
(U) In FY 2006: Demonstrated the beam rotator, a key transmitter component; performed piston jitter measurements for the telescope design; demonstrated and characterized a 50 watt fiber laser; performed detector characterizations for receiver development; and analyzed initial results for a 22-channel beam combiner.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U) CONGRESSIONAL ADD: Near Earth Space Surveillance Initiative (NESSI).	1.736	1.594	0.000	0.000
(U) In FY 2006: Began development of the Visible Integrated-field Replicable Unit Spectrograph. Continued sensing and optical design work as well as structural and optical refurbishment for the Charge Coupled Device/Transit Instrument-II system. Continued design of the focal plane mosaic.				
(U) In FY 2007: Complete design and fabricate the Wide Field Corrector. Conduct design studies for the Prime Focus Instrument Package and the Tracker. Complete Charge Coupled Device/Transit Instrument-II system site determination and fabricate of the lens and dome.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U) CONGRESSIONAL ADD: Applications of LIDAR to Vehicles with Analysis (ALVA).	5.789	6.775	0.000	0.000
(U) In FY 2006: Designed a three-dimensional capability for imaging/detection of small/dim targets. Designed and built a sensor for first kilowatt-class laser radar system on Maui for space situational awareness and missile tracking applications. Demonstrated precision satellite handover capability using high-accuracy metrics. Demonstrated the improved laser radar for deep space metric and space object identification missions, microsat tracking, and ballistic missile defense discrimination. Investigated				

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE			
03 Advanced Technology Development (ATD)	0603605F Advanced Weapons Technology	3150 Advanced Optics Technology			
(U) B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
eye-safe laser radars and showed increased battlefield information in combat identification, battle damage assessment, and camouflage penetration. Integrated laser radar and sensors into an operational airborne turret ball for transition to the warfighter.					
(U) In FY 2007: Develop airborne night-time imaging for counter-improvised explosive device (IED) and operational intelligence and targeting. Integrate, flight test, and evaluate military utility lasers for nighttime video. Develop low-power photon-counting laser radar for small and/or dim object tracking, characterization, and imaging. Develop high-speed ranging and radiometry capabilities.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
(U) CONGRESSIONAL ADD: Mobile Active Targeting Resource for Integrated Experiments.		1.640	0.996	0.000	0.000
(U) In FY 2006: Completed wavefront measurement preparations. Obtained aero-optics aircraft measurement hardware; began preparations for use of software and hardware on test aircraft. Began integration of Hemispherical Optical Sensing and Tracking system.					
(U) In FY 2007: Demonstrate self-contained capability to optically acquire and track man portable air defense system (MANPADS) missiles. Provide testbed and risk reduction capabilities at low power for force protection applications. Measure and analyze aircraft platform vibration disturbances for future integration of high-energy laser weapons.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
(U) CONGRESSIONAL ADD: Real-time Optical Surveillance Applications.		0.000	1.594	0.000	0.000
(U) In FY 2006: Not Applicable.					
(U) In FY 2007: Conduct Congressionally-directed effort for Real-time Optical Surveillance Applications.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
(U) CONGRESSIONAL ADD: Hyper/multispectral Data Reduction and Archiving (HyDRA) Project.		0.000	0.996	0.000	0.000
(U) In FY 2006: Not Applicable.					
(U) In FY 2007: Conduct Congressionally-directed effort for the HyDRA Project.					
(U) In FY 2008: Not Applicable.					

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(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2009: Not Applicable.				
(U) Total Cost	10.226	11.955	0.000	0.000

(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>	<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) Related Activities:
- (U) PE 0603444F, Maui Space Surveillance Systems.
- (U) PE 0602605F, Directed Energy Technology.
- (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.
- (U) **D. Acquisition Strategy**
Not Applicable.

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BUDGET ACTIVITY		PE NUMBER AND TITLE						PROJECT NUMBER AND TITLE		
03 Advanced Technology Development (ATD)		0603605F Advanced Weapons Technology						3151 High Power Solid State Laser Technology		
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
3151 High Power Solid State Laser Technology	13.240	26.650	12.388	11.428	21.669	16.932	23.569	32.552	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

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

This project provides for the development, integration, demonstration, and detailed assessment of low to high power laser and beam control technologies needed for aircraft protection, force protection, force application, precision engagement, and Global War on Terrorism missions. Critical technologies developed and demonstrated include: (1) compact, reliable, and affordable laser devices with good beam quality and scalability to high power; (2) advanced optics and laser beam control components to effectively compensate and propagate laser radiation through the atmosphere to a target. Emphasis will be on demonstrating the ability to meet key system concept performance parameters, reliability, affordability, and packaging requirements unique to potential applications. Perform laser system concept assessments to include vulnerability assessments and target effect testing. Identify critical design data for laser system concepts. Develop high energy laser system concepts and identify issues relating to system concept architectures, technology readiness, technology tradeoffs, mission effectiveness, and military utility.

(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, integrate, and demonstrate solid state, advanced chemical, gas, and hybrid laser technology for scalable, high energy laser devices for insertion into airborne tactical and strategic applications and ground-based laser system concepts.	3.042	3.789	1.022	0.315
(U) In FY 2006: Benchmarked technologies in an effort to obtain architectures that are favorable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, environmental acceptability (air, land, and maritime), and ruggedness for tactical weapon applications. Began development of a solid state laser that is scalable to the weapons-class level. Enhanced laser sources to detect, track, and classify tactical targets. Began development of a laser for eventual use on an airborne tactical platform to defeat next generation air-to-air threats. Developed a beam director that has the capability of handling a sensor-killer laser, while retaining all of the infrared countermeasures and search functions.				
(U) In FY 2007: Continue scaling solid state lasers with a goal of reaching weapons-class power, beam quality, run time, etc. levels. Complete development of a laser for eventual use on an airborne tactical platform. Investigate integrating the laser technology with tactical platform sub-systems such as power, advanced thermal management systems, avionics, sensors, and fire control to increase the potential for successful transition. Continue investigating tactical laser applications. Demonstrate tactical laser utility through field experiments and customer interaction.				
(U) In FY 2008: Scale solid state lasers for tactical weapons and defense, with a goal of exceeding the				

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(U) B. Accomplishments/Planned Program (\$ in Millions)	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<p>thresholds for weapons-class power, beam quality, and run time capabilities. Focus on reduction of size and weight, as well as increase in efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness. Continue integrating laser technology with tactical platform sub-systems such as power, advanced thermal management systems, avionics, sensors, and fire control to increase the potential for successful transition. Test overall chemical laser device-level performance and work issues based on the integration of the ejector nozzle concepts, increased mass flow singlet-oxygen generators, and advanced fuels into a laser device.</p>					
<p>(U) In FY 2009: Build and evaluate solid state lasers for tactical weapons and defense that exceed the thresholds for weapons-class power, beam quality, and run time capabilities. Continue to focus on reducing size and weight, as well as increasing efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness. Further integrate laser technology with tactical platform sub-systems such as power, advanced thermal management systems, avionics, sensors, and fire control to increase the potential for successful transition. Continue to evaluate overall chemical laser device-level performance and issues based on the integration of improved ejector nozzle concepts, increased mass flow singlet-oxygen generators, and advanced fuels into a laser device.</p>					
<p>(U) MAJOR THRUST: Develop, integrate, and demonstrate advanced optical and imaging technologies for advanced systems concepts. Technologies include optical components, optical coatings, advanced beam control, atmospheric compensation, and pointing and tracking. Develop and analyze system concepts and perform advanced critical experiments integrating laser and beam control technologies.</p>	2.506	11.464	11.366	11.113	
<p>(U) In FY 2006: Prepared lasers and their gimbals for day-night electro-optical tracker countermeasures advanced technology demonstration. Perform assessments to determine laser and support requirements for integrated high energy laser.</p>					
<p>(U) In FY 2007: Begin integration experiments to focus on architectures favorable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness for tactical weapon applications. Begin facility and support equipment modifications for integrated high energy laser.</p>					
<p>(U) In FY 2008: Begin acquisition of a solid state laser to meet program specifications for integrated high energy laser testbed. Begin to upgrade existing facilities, integrate device and conduct initial testbed checkout. Demonstrate advanced tactical beam control hardware components in the laboratory.</p>					

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03 Advanced Technology Development (ATD)	0603605F Advanced Weapons Technology	3151 High Power Solid State Laser Technology			
(U) B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Analyze advanced beam control concepts in integrated simulations.					
(U) In FY 2009: Continue integrated high energy laser component acquisition, integration and testing to evaluate testbed performance objectives against multiple applications. Initiate next spiral of system upgrades. Integrate advanced tactical beam control hardware components in the laboratory and validate performance predictions. Enhance advanced beam control system concepts and develop integrated system requirements.					
(U) CONGRESSIONAL ADD: Low Speed Airspeed System.		3.352	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Low Speed Airspeed System.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U) CONGRESSIONAL ADD: Wafer Integrated Semiconductor Laser.		1.929	0.000	0.000	0.000
(U) In FY 2006: Continued toward the goal of lower cost/watt for solid state lasers by improving growth and processing to increase yield and thus cut costs, and by enhancing device layout and packaging to improve reliability.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U) CONGRESSIONAL ADD: High Brightness Laser Diode Source for Fiber Laser Pumps.		2.411	0.000	0.000	0.000
(U) In FY 2006: Focused on further development of wavelength stabilization techniques, improved fiber-coupling packaging concepts, and refinement of manufacturing processes for better performance at lower cost.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U) CONGRESSIONAL ADD: Mid-Infrared Semiconductor Laser Technology.		0.000	1.656	0.000	0.000
(U) In FY 2006: Not Applicable.					

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(U) B. Accomplishments/Planned Program (\$ in Millions)					<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) In FY 2007: Conduct Congressionally-directed effort for Mid-Infrared Semiconductor Laser Technology.										
(U) In FY 2008: Not Applicable.										
(U) In FY 2009: Not Applicable.										
(U) CONGRESSIONAL ADD: High Energy Laser- Directed Energy Weapon (HEL-DEW) Scaling Optimization.					0.000	2.338	0.000	0.000		
(U) In FY 2006: Not Applicable.										
(U) In FY 2007; Conduct Congressionally-directed effort for HEL-DEW Scaling Optimization.										
(U) In FY 2008: Not Applicable.										
(U) In FY 2009: Not Applicable.										
(U) CONGRESSIONAL ADD: Advanced Weapons and Laser Diode Development.					0.000	2.533	0.000	0.000		
(U) In FY 2006: Not Applicable.										
(U) In FY 2007: Conduct Congressionally-directed effort for Advanced Weapons and Laser Diode Development.										
(U) In FY 2008: Not Applicable.										
(U) In FY 2009: Not Applicable.										
(U) CONGRESSIONAL ADD: Lightweight Multi-purpose Laser.					0.000	4.870	0.000	0.000		
(U) In FY 2006: Not Applicable.										
(U) In FY 2007: Conduct Congressionally-directed effort for Lightweight Multi-purpose Laser.										
(U) In FY 2008: Not Applicable.										
(U) In FY 2009: Not Applicable.										
(U) Total Cost					13.240	26.650	12.388	11.428		
(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>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	
(U) Related Activities:										
(U) PE 0602102F, Materials.										
(U) PE 0603270F, Electronic										

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Technology**

PROJECT NUMBER AND TITLE

**3151 High Power Solid State Laser
Technology****(U) C. Other Program Funding Summary (\$ in Millions)**

Combat Technology.

(U) PE 0602605F, Directed

Energy Technology.

(U) PE 0601108F, High Energy

Laser Research Initiatives.

(U) PE 0602890F, High Energy

Laser Research.

(U) PE 0603924F, High EnergyLaser Advanced Technology
Program.**(U)** PE 0602120A, Sensors and

Electronic Survivability.

(U) PE 0602307A, Advanced

Weapons Technology.

(U) PE 0602624A, Weapons and
Munitions Technology.**(U)** PE 0603004A, Weapons and
Munitions Advanced

Technology.

(U) PE 0602114N, Power

Projection Applied Research.

(U) PE 0603175C, Ballistic

Missile Defense Technology

(U) PE 0605799D8Z, Force

Transformation

(U) PE 0603941D8Z, Test andEvaluation/Science and
Technology**(U)** This project has been
coordinated through the
Reliance 21 process to

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Technology**

PROJECT NUMBER AND TITLE

**3151 High Power Solid State Laser
Technology****(U) C. Other Program Funding Summary (\$ in Millions)**

harmonize efforts and
eliminate duplication.

- (U) The technology efforts in this
PE that are supporting future
enhancements to airborne
lasers have been coordinated
with the Airborne Laser
program office.

(U) D. Acquisition Strategy

Not Applicable.

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03 Advanced Technology Development (ATD)				0603605F Advanced Weapons Technology				3152 High Power Microwave Technology		
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
3152 High Power Microwave Technology	10.170	12.890	10.504	9.153	23.635	12.513	13.342	14.846	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

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

This project develops high power microwave (HPM) generation and transmission technologies that support a wide range of Air Force missions such as the potential disruption, degradation, damage, or destruction of an adversary's electronic infrastructure and military capability. These targeted capabilities include local computer and communication systems, as well as large and small air defense and command and control systems. In many cases, this effect can be generated covertly with no collateral structural or human damage. In addition, millimeter wave force protection technologies are developed. It also develops a susceptibility, vulnerability, and lethality data base to identify potential vulnerabilities of U.S. systems to HPM threats and to provide a basis for future offensive and defensive weapon system decisions. Representative U.S. and foreign assets are tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) technologies are being developed.

(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: Conduct effects experimentation to expand and refine data library and support susceptibility predictions. Investigate and develop technologies for HPM airfield defense. Note: Due to higher Air Force priorities this thrust is being temporarily terminated in FY 2009.	0.737	0.948	0.594	0.000
(U) In FY 2006: Began transitioning HPM engagement lethality modeling and simulation capability into Air Force Standard Analysis Toolkit and to additional users. Executed high power microwave effects tests to improve HPM system design and lethality. Identified and mitigated vulnerabilities of U.S. infrastructure to HPM attack.				
(U) In FY 2007: Continue high power microwave effects tests to improve HPM system design and lethality. Model real targets and predict probability of kill for various HPM scenarios, including HPM/radio frequency airfield defense against small surface-to-air missile attack. Identify and develop techniques to mitigate vulnerabilities of U.S. infrastructure to HPM attack. Investigate electromagnetic interference/electromagnetic compatibility sub-system and system interface issues.				
(U) In FY 2008: Refine airfield defense technologies. Evaluate components as appropriate.				
(U) In FY 2009: Not Applicable.				
(U) MAJOR THRUST: Develop and evaluate millimeter-wave active denial technologies for non-lethal, anti-personnel weapon applications such as ground force protection from a stand off aircraft.	4.237	5.886	3.768	4.626
(U) In FY 2006: Completed support of user operation/testing/demonstration of first ground-based				

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Project 3152

Exhibit R-2a (PE 0603605F)

Exhibit R-2a, RDT&E Project Justification		DATE February 2007			
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE			
03 Advanced Technology Development (ATD)	0603605F Advanced Weapons Technology	3152 High Power Microwave Technology			
(U) B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<p>development spiral product. Developed and evaluated technologies for non-lethal weapons applications. Continued the development of high power millimeter-wave source for airborne applications. Completed computational physics simulations of millimeter-wave sources against the draft detailed design drawings for the coaxial source approach. Performed cold testing for conventional source hardware followed by progression towards final source assembly. Provided technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.</p> <p>(U) In FY 2007: Develop and evaluate technologies for non-lethal weapons applications. Continue the development of high power millimeter-wave source for airborne applications. Evaluate first phase conventional source approach. Identify deficiencies and evaluate need to rebuild. Complete critical design review for coaxial source design or proceed on coaxial insert risk reduction step towards coaxial approach. Begin hardware development for full power source test stand including award of test stand contract. Provide technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.</p> <p>(U) In FY 2008: Continue to develop and evaluate technologies for non-lethal weapons applications. Continue the development of high power millimeter-wave source for airborne applications. Finish rebuild and manufacturer test of the second version of the conventional gyrotron approach. Begin build of the first coaxial design gyrotron. Continue with hardware development, procurement, fabrication, and testing for the full power source test stand. Provide technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.</p> <p>(U) In FY 2009: Continue to develop and evaluate technologies for non-lethal weapons applications. Downselect from conventional or coaxial approaches arriving at best high power millimeter-wave source hardware. Complete the development of millimeter-wave source for airborne applications in ground-based demonstration form. Complete hardware development, procurement, fabrication, and testing for the full power source test stand. Begin design and development of airborne antenna demonstration hardware to include beam control. Provide technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.</p> <p>(U) MAJOR THRUST: Develop the technology to integrate HPM devices on various platforms, to include</p>					
		5.196	6.056	6.142	4.527

Exhibit R-2a, RDT&E Project Justification

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BUDGET ACTIVITY

03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE

0603605F Advanced Weapons
Technology

PROJECT NUMBER AND TITLE

3152 High Power Microwave
Technology(U) **B. Accomplishments/Planned Program (\$ in Millions)**FY 2006FY 2007FY 2008FY 2009

aerial, and investigate specific target sets of interest. Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems.

- (U) In FY 2006: Proceeded with maturation and miniaturization efforts of HPM subsystem technologies for both electronic attack and counter improvised explosive device applications. Conducted integration experiments that include investigating electromagnetic interference issues. Examined the interactions of the HPM source, antenna, and pulse power to increase functionality. Began integration efforts of all HPM subsystem components in preparation for stand-alone field demonstration. Refined HPM subsystems to ensure required energy levels are produced. Investigated optimal configuration for permanent magnets in relativistic magnetron, and fabricated source. Integrated the HPM subsystem with a command and control device to demonstrate operation at threshold operating parameters. Began defining hardening requirements of representative pallet against HPM subsystem predicted electromagnetic interference/coupling. Integrated a repetitively pulsed gigawatt-class HPM source and antenna that will be installed into an airborne platform. Conducted integration experiments that include investigating electromagnetic interference issues. Examined the interactions of the HPM source, antenna, and pulse power to increase functionality.

- (U) In FY 2007: Continue miniaturization, integration and ruggedization of HPM testbed for field experimentation. Examine the interactions of the HPM source, antenna, and pulse power to increase functionality. Investigate enhanced configuration for permanent magnets in relativistic magnetron, and fabricate source. Begin fabrication of subcomponents as determined. Continue integration and begin HPM testbed testing and diagnostics on hardware for efficiency and to determine any potential electromagnetic interference/coupling issues. Improve HPM testbed command and control sub-systems. Demonstrate the performance of the integrated gigawatt-class HPM source and antenna. Investigate HPM system interaction with the airborne platform. Perform system diagnostics on integrated experiment to ensure proper source operation.

- (U) In FY 2008: Integrate and ruggedize the HPM testbed for field experimentation. Perform HPM system testing and diagnostics on hardware developed and integrated in FY 2007 for efficiency and to determine any potential electromagnetic interference/coupling issues. Improve HPM testbed command and control systems for pulsed operation greater than threshold levels. Continue fabrication of subcomponents as determined by FY 2007 risk reduction exercise.

- (U) In FY 2009: Conduct laboratory demonstration of the miniaturized and ruggedized HPM testbed. Begin fabrication of electromagnetic interference protection system. Implement the improved HPM

Exhibit R-2a, RDT&E Project Justification		DATE February 2007			
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)		PE NUMBER AND TITLE 0603605F Advanced Weapons Technology		PROJECT NUMBER AND TITLE 3152 High Power Microwave Technology	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
testbed command and control systems for pulsed operation greater than threshold levels. Implement subcomponents as determined by FY 2007 risk reduction exercise.					
(U) Total Cost		10.170	12.890	10.504	9.153
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>					
		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
		<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
				<u>FY 2010</u>	<u>FY 2011</u>
				<u>Estimate</u>	<u>Estimate</u>
				<u>FY 2012</u>	<u>FY 2013</u>
				<u>Estimate</u>	<u>Estimate</u>
				<u>Cost to Complete</u>	<u>Total Cost</u>
(U) Related Activities:					
(U) PE 0602202F, Human Systems Technology.					
(U) PE 0602605F, Directed Energy Technology.					
(U) PE 0603851M, Nonlethal Weapons - Demonstration/Validation.					
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.					
(U) <u>D. Acquisition Strategy</u>					
Not Applicable.					

Exhibit R-2a, RDT&E Project Justification

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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)					PE NUMBER AND TITLE 0603605F Advanced Weapons Technology			PROJECT NUMBER AND TITLE 3647 High Energy Laser Technology		
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
3647 High Energy Laser Technology	8.488	3.915	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: Funds for the FY 2006 Congressionally-directed Aerospace Relay Mirror System in the amount of \$2.100 million were transferred to PE 0603605F, Advanced Weapons Technology, from PE 0603500F, Multi-Disciplinary Advanced Development, for execution. Also in FY 2008, this effort moves into Project 3151 in this program element.

(U) A. Mission Description and Budget Item Justification

This project provides for the development, demonstration, and detailed assessment of non-space unique technologies needed for high energy laser weapons. Near-term focus is on airborne high energy laser missions, although the technology developed for this project is directly applicable to most high energy laser applications. Critical technologies developed and demonstrated include advanced high energy laser devices and laser beam control to efficiently compensate and propagate laser radiation through the atmosphere to a target. Correcting the laser beam for distortions induced by propagation through the turbulent atmosphere is the key technology in most long-range high energy laser applications. Detailed computational models to establish high energy laser weapon effectiveness and target vulnerability are developed.

(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 the technology for scalable, high energy laser devices with improved efficiency for insertion in tactical airborne lasers and other potential weapon applications.	1.542	1.967	0.000	0.000
(U) In FY 2006: Identified overall device-level performance and issues based on the integration of the iodine generation and ejector nozzle concept into a laser device. Performed field demonstrations of closed-cycle chemical approaches for use on tactical airborne platforms. Used deuterated chemicals to improve device performance. Began work to extend the range of high power airborne chemical lasers. Tested deuterated fuels and determined performance increases. Performed basic hydrogen peroxide flowloop development and testing for tactical platforms. Tested and evaluated fuels regeneration system for reduced logistics tail for chemical oxygen iodine lasers.				
(U) In FY 2007: Test overall device-level performance and issues based on the integration of the ejector nozzle concepts and increased mass flow singlet-oxygen generators into a laser device. Test advanced fuels and determine performance increases. Investigate systems performance of airborne chemical oxygen iodine laser systems.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U) CONGRESSIONAL ADD: Aerospace Relay Mirror System	2.026	0.000	0.000	0.000
(U) In FY 2006: Developed preliminary designs for high energy laser redirection optical systems. Software				

Exhibit R-2a, RDT&E Project Justification	DATE February 2007
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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 3647 High Energy Laser Technology
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(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
and optical hardware designs were matured to the point of critical design review. Completed thermal models of optical and mechanical components in high energy laser beam director systems and relay mirror payload element.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Laser Spark Countermeasure Program.	4.920	1.948	0.000	0.000
(U) In FY 2006: Investigated Laser Spark missile infrared countermeasure technology and demonstrate the infrared countermeasures effectiveness of the multiple internal laser effects associated with plasma/sparks. Performed countermeasure effectiveness study for operational scenarios. Fabricated a brassboard countermeasure laser system. Performed demonstration testing. Modeled missile fly-out dynamics under countermeasure operation and determined effectiveness. Surveyed platform footprints available and perform packaging design.				
(U) In FY 2007: Perform laboratory effects tests and modeling to resolve measured differences in the damage threshold of different focal plane arrays. Perform and document a countermeasure effectiveness study for selected operational scenarios.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U) Total Cost	8.488	3.915	0.000	0.000

(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>	<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) Related Activities:										
(U) PE 0602605F, Directed Energy Technology.										
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.										
(U) This project has been coordinated through the										

Exhibit R-2a, RDT&E Project Justification

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BUDGET ACTIVITY

03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE

**0603605F Advanced Weapons
Technology**

PROJECT NUMBER AND TITLE

3647 High Energy Laser Technology**(U) C. Other Program Funding Summary (\$ in Millions)**

Reliance 21 process to
harmonize efforts and
eliminate duplication.

- (U) The technology efforts in this
PE that are supporting future
enhancements to airborne
lasers have been coordinated
with the Airborne Laser
program office.

(U) D. Acquisition Strategy

Not Applicable.