

UNCLASSIFIED

PE NUMBER: 0603605F

PE TITLE: Advanced Weapons Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE

February 2006

BUDGET ACTIVITY

03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE

0603605F Advanced Weapons Technology

Cost (\$ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	49.782	49.821	51.336	51.057	53.351	60.190	61.282	Continuing	TBD
11SP Advanced Optics and Laser Space Tech	0.000	0.000	21.410	22.516	22.391	28.620	29.152	0.000	0.000
3150 Advanced Optics Technology	17.250	10.449	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
3151 High Power Solid State Laser Technology	17.419	21.997	15.055	15.296	16.594	16.935	17.248	Continuing	TBD
3152 High Power Microwave Technology	7.904	10.526	12.941	11.285	12.252	12.505	12.738	Continuing	TBD
3647 High Energy Laser Technology	7.209	6.849	1.930	1.960	2.114	2.130	2.144	Continuing	TBD

Note: Funds for the FY 2006 Congressionally-directed Aerospace Relay Mirror System in the amount of \$2.100 million are in the process of being moved to PE 0603605F, Advanced Weapons Technology, from PE 0603500F, Multi-Disciplinary Advanced Development, for execution.

(U) A. Mission Description and Budget Item Justification

This program provides for the development and demonstration of advanced directed energy and optical concepts that are not space unique. In solid state lasers, compact, reliable, relatively high power, cost-effective single electric laser devices and arrays of electric laser devices are demonstrated. In high power microwaves, technologies such as narrowband and wideband devices and antennas are demonstrated. In high energy lasers, technologies such as high power chemical lasers and beam control technologies are demonstrated. Note: In FY 2006, Congress added \$1.1 million for the Satellite Active Imaging National Testbed Program, \$6.0 million for Applications of LIDAR to Vehicles with Analysis (ALVA), \$3.4 million for the Low Speed Airspeed System, \$1.8 million for the Near Earth Space Surveillance Initiative, \$3.0 million for the Wafer Integrated Semiconductor Laser, \$1.7 million for Mobile Active Targeting Resource for Integrated Experiments, \$5.1 million Laser Spark Countermeasure Program, and \$2.5 million for High Brightness Laser Diode for Fiber Laser Pumps. 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 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) Previous President's Budget	56.877	26.955	29.542
(U) Current PBR/President's Budget	49.782	49.821	51.336
(U) Total Adjustments	-7.095	22.866	
(U) Congressional Program Reductions		-0.014	
Congressional Rescissions	-0.048	-0.720	
Congressional Increases		23.600	
Reprogrammings	-5.818		
SBIR/STTR Transfer	-1.229		

(U) **Significant Program Changes:**

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.

C. Performance Metrics

Under Development.

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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		
Cost (\$ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
11SP Advanced Optics and Laser Space Tech	0.000	0.000	21.410	22.516	22.391	28.620	29.152	0.000	0.000
Quantity of RDT&E Articles	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 systems and high-energy laser weapons.

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

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) MAJOR THRUST: Develop and demonstrate advanced, long-range relay mirror optical technologies such as advanced adaptive optics, beam control, large lightweight optics, optical coatings, throughput, dual line-of-sight control, spacecraft, and optical control integration, beam stabilization, and jitter control.	0.000	0.000	0.796
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Investigate a high power demonstration to kill ground/airborne targets through a relay mirror. Apply a dielectric coating on and test a high energy laser, meter-class, silicon carbide primary mirror. Complete the initial closed-loop performance of selected advanced wavefront control devices for imaging and beam control from space.			
(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for application including antisatellite weapons, relay mirror systems, satellite tests and diagnostics, and high-resolution satellite imaging.	0.000	0.000	5.713
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Demonstrate fully compensated laser propagation to low earth orbit satellites; measure beam profile and intensity on target. Begin development of precision aimpoint stabilization through turbulence.			
(U) MAJOR THRUST: Develop and demonstrate advanced optical beam control technologies for laser propagation through severe and/or extended atmospheric turbulence.	0.000	0.000	14.901
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Integrate advanced ground test system for characterization of laser propagation through atmospheric turbulence. Demonstrate and characterize operation of advanced adaptive optical and tracking technologies for laser			

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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 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
propagation to space targets in stressing atmospheric conditions.			
(U) Total Cost	0.000	0.000	21.410

(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>	<u>FY 2005</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>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>Complete</u>	

- (U) PE 0602500F,
Multi-Disciplinary Space
Technology
- (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
process to harmonize efforts and
eliminate duplication.
- (U) **D. Acquisition Strategy**
Not Applicable.

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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)				PE NUMBER AND TITLE 0603605F Advanced Weapons Technology			PROJECT NUMBER AND TITLE 3150 Advanced Optics Technology		
Cost (\$ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3150 Advanced Optics Technology	17.250	10.449	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	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 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) CONGRESSIONAL ADD: Applications of LIDAR to Vehicles with Analysis (ALVA).	7.753	5.915	0.000
(U) In FY 2005: Developed use of vibrometry for space situational awareness. Upgraded tracking ability by a factor of three using the Field Laser Demonstrator's Hi-Class laser radar for deep space metric and space object identification missions, microsatellite tracking, and ballistic missile defense discrimination. Demonstrated novel concepts that use laser radars to increase information gathering capability. Demonstrated laser radars capability to provide a range of battlefield information such as battle damage assessment and camouflage penetration. Investigated eye-safe laser radars and showed increased battlefield information in combat identification, battle damage assessment, and camouflage penetration. Integrated an laser radar and sensors into an operational airborne turret ball for transition to the warfighter.			
(U) In FY 2006: Conduct Congressionally-directed effort for ALVA.			
(U) In FY 2007: Not Applicable.			
(U) CONGRESSIONAL ADD: Laser Illuminated Viewing and Ranging Sensor Development.	2.035	0.000	0.000
(U) In FY 2005: Developed full wafer eye-safe laser sensors and integrated and tested in field demonstrations to show applicability to Air Force programs for obtaining battlefield intelligence. Refined and improved the current airborne gated electron bombarded active pixel sensor and mate it with an advanced processing chip to form a laser-sensing imaging subsystem. Demonstrated the achieved weight and power improvement of this delivered sensor subsystem, followed by preliminary integration of the new sensor subsystem into an operational imaging system.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U) CONGRESSIONAL ADD: Near Earth Space Surveillance Initiative.	2.714	1.774	0.000
(U) In FY 2005: Completed designs and initial fabrication of a second generation prime focus spectrograph. Formulated detailed designs and costs of the complete spectrograph. Completed improvements to the high resolution spectrograph of the Hobby-Eberly Telescope. Installed mirror coating facility and continuous cleaner to support			

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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 3150 Advanced Optics Technology
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	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>			
fabrication efforts.			
(U) In FY 2006: Conduct Congressionally-directed effort for the Near Earth Space Surveillance Initiative.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: Satellite Active Imaging National Testbed Program. Note: In FY2005 this add was titled Geosynchronous Light Imaging National Testbed (GLINT).	4.748	1.084	0.000
(U) In FY 2005: Completed partial ground field demonstration of the GLINT imaging technique to test optical components. Completed an analytical and simulation based assessment of the viability of using the GLINT imaging technique on low earth orbit satellites and compare estimated performance with other low earth orbit active imaging techniques. Developed, and/or modified, and tested optical transmitting and receiving components in the laboratory and in the field, traceable to a low earth orbit imaging system and a geosynchronous earth orbit system in the out years. Explored methods for enhanced characterization of space targets, including microsats, using advanced concepts for laser illumination and sensing.			
(U) In FY 2006: Conduct Congressionally-directed effort for Satellite Active Imaging National Testbed Program.			
(U) In FY 2007: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: Mobile Active Targeting Resource for Integrated Experiments.	0.000	1.676	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct Congressionally-directed effort for Mobile Active Targeting Resource for Integrated Experiments.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	17.250	10.449	0.000

	<u>FY 2005</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>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>Complete</u>	
(U) Related Activities:									
(U) PE 0603444F, Maui Space Surveillance Systems.									
(U) PE 0602102F, Materials.									
(U) PE 0602605F, Directed Energy Technology.									

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**0603605F Advanced Weapons
Technology**

PROJECT NUMBER AND TITLE

3150 Advanced Optics Technology**(U) C. Other Program Funding Summary (\$ in Millions)**

- (U) PE 0603883C, Ballistic Missile
Defense Boost Phase Segment.
- (U) PE 0602500F,
Multi-Disciplinary Space
Technology.
- (U) PE 0603500F,
Multi-Disciplinary Advanced
Development Space Technology.
- (U) This project has been
coordinated through the Reliance
process to harmonize efforts and
eliminate duplication.
- (U) **D. Acquisition Strategy**
Not Applicable.

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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)				PE NUMBER AND TITLE 0603605F Advanced Weapons Technology			PROJECT NUMBER AND TITLE 3151 High Power Solid State Laser Technology		
Cost (\$ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3151 High Power Solid State Laser Technology	17.419	21.997	15.055	15.296	16.594	16.935	17.248	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project provides revolutionary breakthroughs in efficient, robust, and affordable solid state laser technologies for a wide range of military applications requiring small, high power laser sources. This includes slab, semiconductor, fiber, ceramic, disk, and ultra-short pulse lasers. This is a long-term technology development project with both near-term and long-term payoffs. Near-term goals include developing compact, reliable infrared sources that can be used for a range of applications including night vision systems, landing zone markers, remote sensing, and covert communication systems. Longer-term goals focus on producing compact, significantly higher power sources that could be applied to military weapons-type applications including aircraft self-protection. This project leads the development of, and builds upon, a wide range of commercial advancements. Commercially available solid state lasers are widely used due to their low-cost, small size and weight, high reliability, and high efficiency in converting electricity to laser energy. This project preserves these attractive features while continually scaling output to higher powers and efficiencies and to military application-specific wavelengths. This project is divided into two technology areas. The first area investigates methods to develop low-cost, scalable, high power solid state lasers. This effort builds upon a strong industrial technology base. The second area develops wavelength specific solid state lasers for military applications such as infrared countermeasures.

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

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) MAJOR THRUST: Demonstrate scalability of high-power electric laser architectures for tactical directed energy applications such as aerial vehicle target designators/imagers and next generation weapon components for applications such as advanced gunship weapons and long range airborne laser illuminators.	4.387	10.466	13.434
(U) In FY 2005: As part of the Joint High Power Solid State Laser program, demonstrated several kilowatts using a modular approach that has scalability to 100 kilowatts. Addressed systems-level issues such as weight, volume, power, and thermal management requirements between various approaches funded by the Army, Air Force, and High Energy Laser Joint Technology Office to determine the next step for the Air Force.			
(U) In FY 2006: Benchmark 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. Begin development of an electric laser that is scalable to the weapons-class level.			
(U) In FY 2007: Continue scaling solid state and electric lasers with a goal of reaching the weapons-class power, beam quality, run time, etc., levels. Focus on architectures that are favorable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness for tactical weapon applications.			

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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		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) MAJOR THRUST: Develop and demonstrate solid state laser technologies for moderate power airborne tactical applications, focusing on aircraft self-defense with integrated detection and tracking of targets in clutter.		4.548	3.745	1.621
(U) In FY 2005: Developed laser source and associated beam control to control platform vibration, atmospheric jitter, and aero-optic effects. Investigated technologies to detect and track tactical targets. Performed laser effects testing to determine required energy levels for tactical applications that address defeating next generation air-to-air threats. Designed and built a laser system capable of emitting multi-wavelengths. Designed laser source and tested hardware to evaluate ultra-short pulse laser technology.				
(U) In FY 2006: Enhance laser sources to detect and track tactical targets. Begin development of a laser for eventual use on an airborne tactical platform to defeat next generation air-to-air threats. Demonstrate a beam director that has the capability of handling a sensor-killer laser, while retaining all of the functions of infrared countermeasures and search functions. Prepare lasers and their gimbal for a day-night electro-optical tracker countermeasures advanced technology demonstration.				
(U) In FY 2007: 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 tactical laser applications. Prove tactical laser utility through field demonstrations and customer interaction.				
(U) MAJOR THRUST: Develop and demonstrate laser source technologies needed to counter current air-to-air and surface-to-air missile threats.		0.059	0.000	0.000
(U) In FY 2005: Finalized laser source technology for transition to warfighters.				
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Not Applicable.				
(U) CONGRESSIONAL ADD: Low Speed Airspeed System. Note: In FY 2005, this Add was titled Low Speed Air Data Sensor for Special Operations Aircraft.		3.370	3.351	0.000
(U) In FY 2005: Developed mature technology, which will provide fiber optic laser-based rotorcraft airspeed data. This advanced technology will increase the operational safety of fixed wing and rotary aircraft during hovering maneuvers and landing.				
(U) In FY 2006: Conduct Congressionally-directed effort for a Low Speed Airspeed System.				
(U) In FY 2007: Not Applicable.				
(U)				

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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 3151 High Power Solid State Laser Technology
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(U) B. Accomplishments/Planned Program (\$ in Millions)	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) CONGRESSIONAL ADD: Advanced Technology for Infrared Countermeasures Component Improvement.	2.081	0.000	0.000
(U) In FY 2005: Matured mid-infrared semiconductor laser for infrared countermeasures applications with demonstration of laser performance in operational military environments. Conducted testing with the pointer/tracker to validate integration with infrared countermeasures system. Conducted reliability engineering and component testing to quantify the reliability and lifetime of the technology.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U) CONGRESSIONAL ADD: Wafer Integrated Semiconductor Laser.	2.974	1.971	0.000
(U) In FY 2005: Developed novel surface emitting structures for semiconductor laser arrays. Refined the basic technology developed in the previous year using 45-degree turning mirrors by testing and improving reliability, and improving yield to reduce overall cost. Etched integrated fast-axis collimation lenses into the semiconductor material. Explored other technologies for producing surface emitting semiconductor laser arrays.			
(U) In FY 2006: Conduct Congressionally-directed effort for Wafer Integrated Semiconductor Lasers.			
(U) In FY 2007: Not Applicable.			
(U) CONGRESSIONAL ADD: High Brightness Laser Diode Source for Fiber Laser Pumps.	0.000	2.464	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct Congressionally-directed effort for High Brightness Laser Diode Source for Fiber Laser Pumps.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	17.419	21.997	15.055

(U) C. Other Program Funding Summary (\$ in Millions)		<u>FY 2005</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>Cost to Complete</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) Related Activities:										
(U) PE 0602102F, Materials.										
(U) PE 0603270F, Electronic Combat Technology.										
(U) PE 0602605F, Directed Energy Technology.										

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PROJECT NUMBER AND TITLE

3151 High Power Solid State Laser
Technology

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

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Acquisition Strategy**

Not Applicable.

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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)				PE NUMBER AND TITLE 0603605F Advanced Weapons Technology			PROJECT NUMBER AND TITLE 3152 High Power Microwave Technology		
Cost (\$ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3152 High Power Microwave Technology	7.904	10.526	12.941	11.285	12.252	12.505	12.738	Continuing	TBD
Quantity of RDT&E Articles	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 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) MAJOR THRUST: Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems.	0.916	1.236	1.366
(U) In FY 2005: Demonstrated pulsed power and narrowband HPM source capability applicable to munitions and airborne concepts. Demonstrated a repetitively pulsed multi-gigawatt-class HPM integration experiment. Demonstrated brassboard short-range wideband hidden weapon identification concept.			
(U) In FY 2006: Integrate a repetitively pulsed gigawatt-class HPM source and antenna that will be installed into an airborne platform. Conduct integration experiments that include investigating electromagnetic interference issues. Examine the interactions of the HPM source, antenna, and pulse power to increase functionality. Demonstrate short-range wideband hidden weapon identification in a real world environment.			
(U) In FY 2007: Demonstrate the performance of the integrated repetitively pulsed gigawatt-class HPM source and antenna system. Investigate HPM system interaction with the flight controls of the airborne platform. Perform system diagnostics on integrated experiment to ensure proper source operation.			
(U) MAJOR THRUST: Conduct effects experimentation to expand and refine data library and support susceptibility predictions. Investigate and develop technologies for development of an HPM airfield defense system.	0.537	0.727	0.759
(U) In FY 2005: Provided dynamic data library to users and continue effects experimentation to populate and update the data library. Transitioned computer codes for the prediction of electromagnetic coupling on targets to users. Expanded the evaluation and quantification of HPM waveform effectiveness against new and evolving electronic targets of interest. Transitioned computer codes for calculation of probability-of-kill for representative targets.			

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		<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) B. Accomplishments/Planned Program (\$ in Millions)				
(U) In FY 2006: Transition 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: 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 mitigate additional vulnerabilities of United States infrastructure to HPM attack. Continue high power microwave effects tests to improve HPM system design and lethality. Investigate electromagnetic interference/electromagnetic compatibility sub-system and system interface issues.				
(U) MAJOR THRUST: Develop and evaluate active denial technologies for non-lethal, anti-personnel weapon applications such as ground force protection from a stand off aircraft.		3.191	4.290	6.138
(U) In FY 2005: Provided user support operation/testing/demonstration of first ground-based development spiral product. Developed and evaluated technologies for non-lethal weapons applications. Developed millimeter wave source for airborne applications. Baselined computational physics simulations of millimeter-wave sources against the draft detailed design drawings. Investigated updated subsystem approaches based on the original airborne technical feasibility study. Provided technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.				
(U) In FY 2006: Complete support of user operation/testing/demonstration of first ground-based development spiral product. Develop and evaluate technologies for non-lethal weapons applications. Continue the development of millimeter wave source for airborne applications. Complete computational physics simulations of millimeter-wave sources against the draft detailed design drawings for the coaxial source approach. Perform cold testing for conventional source hardware followed by progression towards final source assembly. Provide technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and glean data relevant to airborne applications.				
(U) In FY 2007: Develop and evaluate technologies for non-lethal weapons applications. Continue the development of millimeter wave source for airborne applications. Perform manufacturer test of first phase conventional source approach. Identify deficiencies and begin rebuild. Complete critical design review for coaxial source design. Investigate updated subsystem approaches based on the original airborne technical feasibility study. 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.				
(U)				

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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
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(U) B. Accomplishments/Planned Program (\$ in Millions)	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) MAJOR THRUST: Develop the technology to integrate HPM devices on aerial platforms and investigate specific target sets of interest. Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems.	3.260	4.273	4.678
(U) In FY 2005: Proceeded with target identification efforts to include foreign and domestic and individual and cluster targets. Performed target lethality assessments. Maintained and upgraded the test facilities. Investigated source to aircraft integration issues such as electrical and physical interface, thermal control, center of mass, antennas, and electromagnetic interference/electromagnetic compatibility. Tested determined source shielding requirements for mounting a source on an aircraft. Investigated the feasibility of using ultra-wideband HPM to geolocate and identify targets of interest and perform battle damage assessment.			
(U) In FY 2006: Proceed with maturation and miniaturization of HPM subsystem technologies, and begin their integration. Begin integration of all HPM subsystem components in preparation for stand-alone field demonstration. Refine HPM subsystem to ensure required energy levels are produced. Integrate the HPM subsystem with the command and control device to demonstrate operation at threshold operating parameters. Begin hardening of chosen platform against HPM subsystem predicted electromagnetic interference/coupling. Continue integration and test activities to determine the least risky path forward to transitioning technologies for an HPM Airborne Electronic Attack system.			
(U) In FY 2007: Continue miniaturization, integration and ruggedization of HPM system for field experimentation. Examine the interactions of the HPM source, antenna, and pulse power to increase functionality. Investigate optimal configuration for permanent magnets in relativistic magnetron, and fabricate source. Begin fabrication of subcomponents as determined by FY 2006 risk reduction exercise. Complete integration and begin HPM system testing and diagnostics on hardware developed and integrated in FY 2006 for efficiency and to determine any potential electromagnetic interference/coupling issues. Improve HPM system command and control systems for pulsed operation greater than threshold levels.			
(U) Total Cost	7.904	10.526	12.941

(U) C. Other Program Funding Summary (\$ in Millions)	<u>FY 2005</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>Cost to Complete</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) Related Activities:									
(U) PE 0602202F, Human Systems Technology.									
(U) PE 0602605F, Directed Energy									

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

Technology.

- (U) PE 0603851M, Nonlethal
Weapons -
Demonstration/Validation.

- (U) This project has been
coordinated through the Reliance
process to harmonize efforts and
eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

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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 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
3647 High Energy Laser Technology	7.209	6.849	1.930	1.960	2.114	2.130	2.144	Continuing	TBD
Quantity of RDT&E Articles	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 are in the process of being moved to PE 0603605F, Advanced Weapons Technology, from PE 0603500F, Multi-Disciplinary Advanced Development, for execution.

(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 2005</u>	<u>FY 2006</u>	<u>FY 2007</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.	4.087	1.822	1.930
(U) In FY 2005: Conducted follow-on demonstrations of advanced iodine generation, iodine injection, and chemical oxygen iodine test sequence utilizing the laboratory test stand. Integrated the best iodine generation concept into a laser device to predict overall device-level performance and identify device-level issues. Performed laboratory demonstrations of closed-cycle chemical approaches for use on tactical airborne platforms.			
(U) In FY 2006: Identify overall device-level performance and issues based on the integration of the iodine generation and ejector nozzle concept into a laser device. Perform field demonstrations of closed-cycle chemical approaches for use on tactical airborne platforms. Use deuterated chemicals to improve device performance. Begin work to extend the range of high power airborne chemical lasers.			
(U) In FY 2007: Continue working with new, advanced subsystems and technological concepts for future use on tactical and strategic platforms. Provide technical expertise and background to external organizations tailoring high energy laser concepts and capabilities to their needs. Demonstrate high-performance oxygen generator concepts for airborne laser applications. Evaluate iodine injection schemes for oxygen generators.			
(U) MAJOR THRUST: Develop and evaluate beam control and compensation techniques including correcting for atmospheric attenuation and distortion of high energy laser beams propagating from airborne platforms.	3.122	0.000	0.000
(U) In FY 2005: Completed beam control technology demonstration and transition of these technologies to the Airborne Laser (ABL) System program. Completed concept evaluations using the ABL wave optics code that includes more			

Exhibit R-2a, RDT&E Project Justification	DATE February 2006
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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 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
detailed models of the Airborne Laser beam control system. Completed field testing of advanced tracking algorithms and adaptive optics techniques at the North Oscura Peak propagation range. Matured advanced beam control technologies. Fabricated and tested low absorption deformable mirror coating and compared to existing deformable mirror coating.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Not Applicable.			
(U) CONGRESSIONAL ADD: Laser Spark Countermeasure Program.	0.000	5.027	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Conduct Congressionally-directed effort for the Laser Spark Countermeasure Program.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	7.209	6.849	1.930

(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>	<u>FY 2005</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>Cost to Complete</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) Related Activities:									
(U) PE 0602605F, Directed Energy Technology.									
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									
(U) The technology efforts in this PE									

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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)**

that are supporting future
enhancements to airborne lasers
have been coordinated with the
Airborne Laser program office.

(U) **D. Acquisition Strategy**

Not Applicable.