

**UNCLASSIFIED**

PE NUMBER: 0603605F  
 PE TITLE: Advanced Weapons Technology

<b>Exhibit R-2, RDT&amp;E Budget Item Justification</b>	DATE <b>February 2008</b>
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<b>BUDGET ACTIVITY</b> <b>03 Advanced Technology Development (ATD)</b>	<b>PE NUMBER AND TITLE</b> <b>0603605F Advanced Weapons Technology</b>
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Cost (\$ in Millions)	FY 2007 Actual	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	74.683	74.383	44.507	48.530	43.000	48.961	56.415	Continuing	TBD
11SP Advanced Optics and Laser Space Tech	20.598	38.243	16.586	17.053	16.591	16.641	16.684	Continuing	TBD
3150 Advanced Optics Technology	11.690	11.524	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
3151 High Power Solid State Laser Technology	26.206	14.186	19.623	15.003	10.681	19.264	26.954	Continuing	TBD
3152 High Power Microwave Technology	12.551	10.430	8.298	16.474	15.728	13.056	12.777	Continuing	TBD
3647 High Energy Laser Technology	3.638	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 transferred 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 components/techniques are also demonstrated. In high power microwaves, technologies such as narrowband and wideband devices and antennas are demonstrated. Note: In FY 2008, Congress added \$1.9 million for All Electric Laser, \$8.4 million for Applications of LIDAR to Vehicles with Analysis (ALVA), \$1.6 million for Real-time Optical Surveillance Applications, \$2.4 million for the Satellite Active Imaging National Testbed Program, \$15.0 million for Space Situational Awareness Research, and \$1.6 million for Compound Zoom for Airborne Reconnaissance (CZAR). 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 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Previous President's Budget	76.733	43.999	38.877
(U) Current PBR/President's Budget	74.683	74.383	44.507
(U) Total Adjustments	-2.050	30.384	
(U) Congressional Program Reductions		-0.026	
Congressional Rescissions		-0.490	
Congressional Increases		30.900	
Reprogrammings	-0.347		
SBIR/STTR Transfer	-1.703		

(U) **Significant Program Changes:**

Funding was increased in FY 2009 for additional demonstrations leading to an earlier transition of tactical directed energy weapon technologies.

C. Performance Metrics

Under Development.

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

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Cost (\$ in Millions)	FY 2007 Actual	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	20.598	38.243	16.586	17.053	16.591	16.641	16.684	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts transferred 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 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 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.	1.186	1.060	0.937
(U) In FY 2007: Performed cost trade studies and commenced design of integrated testbed. Developed laboratory setup to test performance of a deformable mirror system.			
(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.	5.453	4.317	3.322
(U) In FY 2007: Demonstrated detection and discrimination of small, non-resolved space objects. Demonstrated visible and near-infrared imaging of satellites too small or dim for present systems. Began detailed design, simulation, and component specification of high efficiency adaptive optics system for compensated visible imaging and detection of very dim space objects. Demonstrated phased array imaging for large aperture high resolution telescopes.			
(U) In FY 2008: Continue design and begin subsystem integration of high efficiency adaptive optics system for compensated imaging and detection of very dim space objects at visible and near infrared 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 telescope. Perform system tests and prepare for demonstrations of high resolution compensated imaging and detection of very dim space objects at visible and infrared wavelengths. Conclude phased array imaging experiments.			

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<b>03 Advanced Technology Development (ATD)</b>	<b>0603605F Advanced Weapons Technology</b>	<b>11SP Advanced Optics and Laser Space Tech</b>		
(U) <b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Develop and demonstrate advanced optical beam control technologies for laser propagation through severe and/or extended atmospheric turbulence.		13.959	15.580	12.327
(U) In FY 2007: Began integration of advanced ground diagnostic system for characterization of laser propagation through atmospheric turbulence. Demonstrated and characterized 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 design and begin to build advanced ground diagnostic system performance of laser propagation through atmospheric turbulence in a variety of atmospheric conditions. Conduct brassboard integration of advanced sensing and wavefront control technologies.				
(U) CONGRESSIONAL ADD: Space Situational Awareness.		0.000	14.902	0.000
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Develop, integrate, and test component and system level technologies to advance space situational awareness. Improve the performance of current collection, analysis, fusion, and dissemination capabilities. Develop technologies for satellite modeling and assessment. Develop tools for analysis, modeling, and simulation. Develop and demonstrate resolved and non-resolved satellite imaging concepts. Develop and demonstrate passive and active imaging concepts. Develop and demonstrate space-object identification techniques. Develop image processing algorithms.				
(U) In FY 2009: Not Applicable.				
(U) CONGRESSIONAL ADD: Satellite Active Imaging National Testbed (formerly GEO Light Imaging National Testbed (GLINT)).		0.000	2.384	0.000
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Develop active imaging technologies for meeting space active awareness spatial resolution goals from user community.				
(U) In FY 2009: Not Applicable.				
(U) Total Cost		20.598	38.243	16.586

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11SP Advanced Optics and Laser Space Tech

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

	<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>Complete</u>	
(U) PE 0602605F, Directed Energy Technology									
(U) PE 0603444F, Maui Space Surveillance System									
(U) PE 0601108F, High Energy Laser Research Initiatives.									
(U) PE 0602890F, High Energy Laser Research.									
(U) PE 0603924F, High Energy Laser 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 0602702E, Tactical Technology.									
(U) PE 0603175C, Ballistic Missile Defense Technology.									
(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment									
(U) PE 0602651M, Joint Non-Lethal									

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**11SP Advanced Optics and Laser  
Space Tech****(U) C. Other Program Funding Summary (\$ in Millions)**

Weapons Applied Research.

**(U) PE 0603651M, Joint Non-Lethal**Weapons Technology  
Development.**(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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Cost (\$ in Millions)	FY 2007 Actual	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	11.690	11.524	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 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) CONGRESSIONAL ADD: Near Earth Space Surveillance Initiative (NESSI).	1.559	0.000	0.000
(U) In FY 2007: Continued development of the wide field corrector, the prime focus instrument package, and the tracker system.			
(U) In FY 2008: Not Applicable.			
(U) In FY 2009: Not Applicable.			
(U) CONGRESSIONAL ADD: Mobile Active Targeting Resource for Integrated Experiments.	0.974	0.000	0.000
(U) In FY 2007: Successfully completed missile detection and tracking at Tonopah Test Range. Designed, fabricated and integrated system upgrades to improve performance against man portable air defense systems (MANPADS). Demonstrated performance improvements.			
(U) In FY 2008: Not Applicable.			
(U) In FY 2009: Not Applicable.			
(U) CONGRESSIONAL ADD: Hyper/multispectral Data Reduction and Archiving (HyDRA) Project.	0.974	0.000	0.000
(U) In FY 2007: Developed advanced change and anomaly detection algorithms to significantly enhance targeting capability of tactical laser weapons. Developed system requirements and plans for integration to legacy systems. Demonstrated ability to automatically extracted target signatures from background clutter.			
(U) In FY 2008: Not Applicable.			
(U) In FY 2009: Not Applicable.			
(U) CONGRESSIONAL ADD: Applications of LIDAR to Vehicles with Analysis (ALVA).	6.624	8.346	0.000
(U) In FY 2007: ALVA consists of two efforts: Standoff Intelligence Designator (SID) and Hi-Class. SID: Developed airborne night-time imaging to support missions such as counter-improvised explosive device detection. Demonstrated military utility of lasers for night-time video including flight testing, integrating state-of-the-art sensors into real-world air frames. Conducted proof of concept demonstrations for communications networks and			

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3150 Advanced Optics Technology

(U) <b>B. Accomplishments/Planned Program (\$ in Millions)</b>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
evaluation studies. Hi-Class: Conducted initial testing of the three-dimensional sensor in a two-dimensional mode for imaging/detection of small/dim space objects for space situational awareness and missile tracking applications. Altered the Hi-Class laser setup to ensure better reliability, maintainability, and support to customers.			
(U) In FY 2008: SID: Complete testing of active nighttime imagers and prepare to transition technology to customers. Develop smaller, lighter laser imagers for new customers. Evaluate potential for using continuous-wave laser sensors for different applications. Hi-Class: Continue integration and undertake testing of the three-dimensional capability for imaging/detection of small/dim space objects. Integrate a hyperspectral imager into the Hi-Class system.			
(U) In FY 2009: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: Real-time Optical Surveillance Applications (ROSA).	1.559	1.589	0.000
(U) In FY 2007: Developed detailed simulations involving physics-based model for time-resolved photon counter sensor to study the benefits and limitations of the sensor in potential space situational awareness applications. Developed advanced observatory control architecture for maximum reliability yet flexible enough to accommodate diverse missions and compliant with security requirements.			
(U) In FY 2008: Leverage previously developed models to exploit unique capabilities of time-resolved photon counter for detection of extremely small or faint objects. Conduct modeling and simulation studies to push current capabilities in change detection with optical sensors. Pursue artificial intelligence paradigm in automation of telescope networks for space situational awareness mission.			
(U) In FY 2009: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: Compound Zoom for Airborne Reconnaissance (CZAR).	0.000	1.589	0.000
(U) In FY 2007: Not Applicable.			
(U) In FY 2008: Develop requirements and provide designs for all hardware and software modifications to adapt and demonstrate a commercial high quality compact compound zoom lens for application on an Air Force gunship. Conduct a study to evaluate multiple sensors (cameras). Use modeling and simulation to develop robust stabilization control.			
(U) In FY 2009: Not Applicable.			
(U) Total Cost	11.690	11.524	0.000

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

	<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>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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<b>BUDGET ACTIVITY</b> <b>03 Advanced Technology Development (ATD)</b>				<b>PE NUMBER AND TITLE</b> <b>0603605F Advanced Weapons Technology</b>			<b>PROJECT NUMBER AND TITLE</b> <b>3151 High Power Solid State Laser Technology</b>		
Cost (\$ in Millions)	FY 2007 Actual	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	26.206	14.186	19.623	15.003	10.681	19.264	26.954	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 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 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Develop, integrate, and demonstrate solid state, chemical, gas, and hybrid laser technologies for scalable, high energy laser devices for insertion into airborne tactical and strategic applications and ground-based laser system concepts.	3.789	1.022	2.315
(U) In FY 2007: Scaled solid state lasers with a goal of reaching weapons-class parameters including power, beam quality, and run time. Investigated 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. Investigated tactical laser applications. Demonstrated tactical laser utility through field experiments and customer interaction.			
(U) In FY 2008: Develop solid state lasers for a wide set of applications including tactical weapons, self-defense, and space situational awareness (e.g. active tracking and imaging) with a goal of exceeding the thresholds for weapons-class power, beam quality, and run time capabilities. Develop technologies to support solid state laser technology insertion in airborne systems. These technologies will reduce laser size and weight, as well as increase efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness. Investigate integrating laser device 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.			
(U) In FY 2009: Continue to simulate, build, and evaluate solid state lasers for a variety of applications such as airborne tactical weapons and space situational awareness applications (i.e. active track, active imaging, illumination).			

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(U) <b>B. Accomplishments/Planned Program (\$ in Millions)</b>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) Continue to focus on reducing size and weight, as well as increasing efficiency, affordability, reliability, maintainability, supportability, operational environmental acceptability, and ruggedness. Continue to investigate integration of 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. Prepare for integration of appropriate laser technologies for a large aircraft demonstration of solid state laser-based precision engagements.				
(U) MAJOR THRUST: Develop, integrate, and demonstrate advanced optical and imaging technologies for advanced systems concepts. Develop and demonstrate integrated tactical laser and beam control technologies. Technologies include optical components, optical coatings, advanced beam control, atmospheric compensation, and pointing and tracking. Analyze system concepts and perform critical experiments with integrated laser and beam control technologies. Funding was increased in FY 2009 for additional integrated demonstrations leading to an earlier transition of tactical airborne laser and beam control technologies.	11.020	11.276	17.308	
(U) In FY 2007: Acquired a solid state laser for an integrated high energy laser testbed that can use various beam control systems. Began 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. Began facility and support equipment modifications for integrated high energy laser testbed.				
(U) In FY 2008: Upgrade existing facility, integrate solid state laser device into facility, and conduct initial testbed checkout. Demonstrate advanced tactical beam control hardware components in the laboratory. Analyze advanced beam control concepts in integrated simulations. Begin development of the second-generation tactical relay mirror demonstrator including the telescopes, the optics, the associated gimbals, the lightweight optics bench, and electronics.				
(U) In FY 2009: Begin upgrade of the integrated high energy laser testbed and perform testing to evaluate testbed performance objectives. Demonstrate integrated tactical laser and beam control technologies. Continue integrated tactical beam control field tests to optimize advanced active tracking algorithms and advanced jitter reduction in breadth of environments for airborne tactical laser engagements. Complete the development of the second-generation relay mirror demonstrator. Demonstrate the use of the second-generation relay mirror with the solid state laser testbed in the laboratory.				
(U) CONGRESSIONAL ADD: Mid-Infrared Semiconductor Laser Technology.	1.656	0.000	0.000	
(U) In FY 2007: Provided environmental hardening for a low-cost, multi-band, compact, robust, lightweight				

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(U) <b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
semiconductor laser demonstration system capable of jamming infrared missiles with both open and closed loop capability. Incorporated and fiber-coupled the advanced high-brightness infra-red semiconductor lasers for a pod-mounted infra-red countermeasure.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: High Energy Laser- Directed Energy Weapon Scaling Optimization.		2.338	0.000	0.000
(U) In FY 2007: Performed trade studies to enhance the scalability of the ceramic solid state ThinZag laser.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Advanced Weapons and Laser Diode Development.		2.533	0.000	0.000
(U) In FY 2007: Continued to refine fiber-coupling and improved manufacturing and packaging concepts of laser diodes.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Lightweight Multi-purpose Laser.		4.870	0.000	0.000
(U) In FY 2007: Improved epitaxial growth and processing to improve yield and cut costs. Improved device layout and packaging to improve reliability. Extended high efficiency designs into additional wavelength ranges.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: All Electric Laser.		0.000	1.888	0.000
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Develop electric laser technologies for airborne applications.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) Total Cost		26.206	14.186	19.623

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**3151 High Power Solid State Laser  
Technology**

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

	<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>Complete</u>	
(U) Related Activities:									
(U) PE 0602102F, Materials.									
(U) PE 0603270F, Electronic 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 Energy Laser 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 0603883C, Ballistic Missile Defense Boost Phase Segment.									
(U) PE 0602651M, Joint Non-Lethal									

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Technology**

PROJECT NUMBER AND TITLE

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

Weapons Applied Research.

**(U)** PE 0602651M, Joint Non-Lethal  
Weapons Applied Research.**(U)** This project has been  
coordinated through the  
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.

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03 Advanced Technology Development (ATD)				0603605F Advanced Weapons Technology			3152 High Power Microwave Technology			
Cost (\$ in Millions)	FY 2007 Actual	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	12.551	10.430	8.298	16.474	15.728	13.056	12.777	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 and demonstrates 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 covert with no collateral structural or human damage. In addition, millimeter wave force protection technologies are developed and demonstrated. 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 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.	0.948	0.594	0.000
(U) In FY 2007: Conducted high power microwave effects tests to improve HPM system design and lethality. Modeled real targets and predicted probability of kill for various HPM scenarios, including HPM/radio frequency airfield defense against small surface-to-air missile attack. Identified and developed techniques to mitigate vulnerabilities of U.S. infrastructure to HPM attack. Investigated 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.	5.747	3.768	4.429
(U) In FY 2007: Developed and evaluated technologies for non-lethal weapons applications. Continued to develop high power millimeter-wave source for airborne applications. Evaluated first phase conventional source approach. Identified deficiencies and evaluated need to rebuild. Completed critical design review for coaxial source design. Commenced hardware development for full power source test stand including award of test stand contract. Provided technical expertise and background to external organizations tailoring Active Denial concepts and capabilities to their needs and gleaned data relevant to airborne applications.			

UNCLASSIFIED

Exhibit R-2a, RDT&E Project Justification		DATE February 2008		
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE		
<b>03 Advanced Technology Development (ATD)</b>	<b>0603605F Advanced Weapons Technology</b>	<b>3152 High Power Microwave Technology</b>		
<b>(U) B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(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 testing 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.				
(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. Continue 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.				
(U) MAJOR THRUST: Develop the technology to integrate HPM devices on various platforms, to include aerial, and investigate specific target sets of interest. Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems.		5.856	6.068	3.869
(U) In FY 2007: Continued miniaturization, integration, and ruggedization of HPM testbed for field experimentation. Examined the interactions of the HPM source, antenna, and pulse power to increase functionality. Investigated enhanced configuration for permanent magnets in relativistic magnetron and fabricated source. Continued integration and began evaluating the HPM testbed to determine efficiency and potential electromagnetic interference/coupling issues. Improved HPM testbed command and control sub-systems. Demonstrated performance of the integrated gigawatt-class HPM source and antenna. Investigated HPM system interaction with airborne platforms. Performed 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. Improve HPM testbed command and control systems for pulsed operation greater than threshold levels.				
(U) In FY 2009: Conduct laboratory demonstration of the miniaturized and ruggedized HPM testbed. Enhance the system performance and address all electromagnetic interference issues. Implement the improved HPM testbed command and control systems for expanded pulsed operation. Implement subcomponent improvements as determined by FY 2007 risk reduction exercise.				
(U) Total Cost		12.551	10.430	8.298

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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)**

	<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>Complete</u>	

- (U) Related Activities:
- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0602605F, Directed Energy Technology.
- (U) PE 0602120A, Sensors and Electronic Survivability.
- (U) PE 0602624A, Weapons and Munitions Technology.
- (U) PE 0602114N, Power Projection.
- (U) PE 0602651M, Joint Non-Lethal Weapons Applied Research.
- (U) PE 0603851M, Nonlethal Weapons.
- (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) **D. Acquisition Strategy**  
Not Applicable.

**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>0603605F Advanced Weapons Technology</b>			PROJECT NUMBER AND TITLE <b>3647 High Energy Laser Technology</b>		
Cost (\$ in Millions)	FY 2007 Actual	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	3.638	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		

Note: In FY 2008, this effort moved into Project 3151 in this program element to consolidate the laser device development efforts.

**(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 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.	1.690	0.000	0.000
(U) In FY 2007: Tested overall device-level performance and issues based on the integration of the ejector nozzle concepts and increased mass flow from singlet-oxygen generators into a laser device. Tested advanced fuels and determined performance increases. Investigated systems performance of airborne chemical oxygen iodine laser systems.			
(U) In FY 2008: Not Applicable.			
(U) In FY 2009: Not Applicable.			
(U) CONGRESSIONAL ADD: Laser Spark Countermeasure Program.	1.948	0.000	0.000
(U) In FY 2007: Performed laboratory effects tests and modeling to resolve measured differences in the damage threshold of different focal plane arrays. Performed and documented a countermeasure effectiveness study for selected operational scenarios.			
(U) In FY 2008: Not Applicable.			
(U) In FY 2009: Not Applicable.			
(U) Total Cost	3.638	0.000	0.000

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)**

	<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>Complete</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 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.