PE NUMBER: 0603605F
PE TITLE: Advanced Weapons Technology

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2005

BUDGET ACTIVITY: 03 Advanced Technology Development (ATD)

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

	Cost ($ in Millions)	FY 2004 Actual	FY 2005 Estimate	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	59.529	56.877	26.955	29.542	28.150	30.483	31.085	31.624	Continuing	TBD
3150	Advanced Optics Technology	24.418	17.645	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
3151	High Power Solid State Laser Technology	19.001	23.376	14.423	14.879	15.074	16.339	16.678	16.983	Continuing	TBD
3152	High Power Microwave Technology	8.058	11.402	10.684	12.795	11.118	12.063	12.316	12.544	Continuing	TBD
3647	High Energy Laser Technology	8.052	4.454	1.848	1.868	1.958	2.081	2.091	2.097	Continuing	TBD

(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 2005, Congress added $4.9 million for Geo Light Imaging National Testbed (GLINT), $2.1 million for Advanced Technology for Infrared Countermeasure Component Improvement, $8.0 million for Applications of Lidar to Vehicles with Analysis, $2.1 million for Laser Illuminated Viewing and Ranging Sensor Development, $3.4 million for the Low Speed Air Data Sensor for Special Operations Aircraft, $2.8 million for the Near Earth Space Initiative, and $3.0 million for the Wafer Integrated Semiconductor Laser.

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.

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

		FY 2004	FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	61.221	31.103	29.168	31.667
(U)	Current PBR/President's Budget	59.529	56.877	26.955	29.542
(U)	Total Adjustments	-1.692	25.774		
(U)	Congressional Program Reductions		-0.020		
	Congressional Rescissions		-0.506		
	Congressional Increases		26.300		
	Reprogrammings	-0.783			
	SBIR/STTR Transfer	-0.909			

(U) Significant Program Changes:

Not Applicable.

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C. Performance Metrics
Under Development.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

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 2004 Actual	FY 2005 Estimate	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	24.418	17.645	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)	FY 2004	FY 2005	FY 2006	FY 2007
(U) CONGRESSIONAL ADD: Aerospace Relay Mirror System Demonstration.	2.437	0.000	0.000	0.000
(U) In FY 2004: Acquired initial components and software build to investigate using high altitude relay mirrors to greatly extend the range of various optical systems including high energy laser weapons. Tested and integrated components into a laboratory demonstration that will verify scaleable system performance. Determined platform integration costs and identified potential field demonstration options. The cost, applicability, and manufacturability of lightweight telescopes and high energy optics was researched for future testbed upgrades.				
(U) In FY 2005: Not Applicable.				
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Mobile Active Tracking Resource for Integrated Experiments (MATRIX).	4.191	0.000	0.000	0.000
(U) In FY 2004: Developed/enhanced ground-based and airborne beam control and fire control testbeds to demonstrate various active and passive sensors for high energy laser beam control. Concentrated on beam control and fire control enhancements for the Advanced Tactical Laser, but also supported risk reduction decisions for other future laser weapons. Performed ground testing in New Mexico and Hawaii.				
(U) In FY 2005: Not Applicable.				
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Not Applicable.				
(U) CONGRESSIONAL ADD: Applications of Lidar to Vehicles with Analysis.	8.286	7.930	0.000	0.000
(U) In FY 2004: Demonstrated tracking ability 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. Investigated novel concepts for using laser radars to provide detailed information on satellites. Investigated laser radars to provide a range of battlefield information such as battle damage assessment and camouflage penetration. Investigated the ability of eye-safe airborne laser				

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radars to provide battlefield information such as combat identification, battle damage assessment, and camouflage penetration.

(U) In FY 2005: Develop use of vibrometry for space situational awareness. Upgrade 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. Demonstrate novel concepts that use laser radars to increase information gathering capability. Demonstrate laser radars capability to provide a range of battlefield information such as battle damage assessment and camouflage penetration. Investigate eye-safe laser radars and show increased battlefield information in combat identification, battle damage assessment, and camouflage penetration. Integrate an laser radar and sensors into an operational airborne turret ball for transition to the warfighter.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U)

(U) CONGRESSIONAL ADD: Laser Illuminated Viewing and Ranging Sensor Development.	3.899	2.082	0.000	0.000

(U) In FY 2004: Developed eye-safe laser sensors and subsystems technologies and demonstrated the subsystems utility for obtaining battlefield intelligence such as target imagery, target identification, and battle damage assessment. Completed development of a gated electron bombarded active pixel sensor mated with an advanced imaging chip. Completed design of a sensor subsystem (sensor and optics) for applications to an unmanned air vehicle ball turret imaging system.

(U) In FY 2005: Develop full wafer eye-safe laser sensors and integrate and test in field demonstrations to show applicability to Air Force programs for obtaining battlefield intelligence. Refine and improve the current airborne gated electron bombarded active pixel sensor and mate it with an advanced processing chip to form a laser-sensing imaging subsystem. Demonstrate 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)

(U) CONGRESSIONAL ADD: Texas-New Mexico Sky Survey/Near Earth Space Initiative.	3.168	2.776	0.000	0.000

(U) In FY 2004: Developed technologies to enhance the ability to detect, track, and characterize Earth orbiting satellites. Redesigned the prime focus corrector of the Hobby-Eberly Telescope. Completed the optical design for a wide-field search telescope.

(U) In FY 2005: Complete designs and initial fabrication of a second generation prime focus spectrograph. Formulate detailed designs and costs of the complete spectrograph. Complete improvements to the high

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
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resolution spectrograph of the Hobby-Eberly Telescope. Install mirror coating facility and continuous cleaner to support fabrication efforts.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U)

(U)	CONGRESSIONAL ADD: Geosynchronous Light Imaging National Testbed (GLINT).	2.437	4.857	0.000	0.000

(U) In FY 2004: Evaluated and demonstrated concepts and components for active imaging of space objects with continued development and integration of hardware. Built one heliostat demonstration unit and one mini-receiver. Performed a field experiment to test hardware performance and demonstrated imaging concept under controlled conditions.

(U) In FY 2005: Complete partial ground field demonstration of the GLINT imaging technique to test optical components. Complete 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. Develop, and/or modify, and test 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. Continue exploration of methods for enhanced characterization of space targets, including microsats, using advanced concepts for laser illumination and sensing.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U)	Total Cost	24.418	17.645	0.000	0.000

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

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0603444F, Maui Space Surveillance Systems.

(U) PE 0602102F, Materials.

(U) PE 0602605F, Directed Energy Technology.

(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.

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

(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.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

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 2004 Actual	FY 2005 Estimate	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	19.001	23.376	14.423	14.879	15.074	16.339	16.678	16.983	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 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)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Demonstrate scalability of solid state laser architectures for high power tactical directed energy applications such as next generation weapon components for applications such as advanced gunship weapons and long range airborne laser illuminators.	7.793	8.664	10.622	10.770

(U) In FY 2004: As part of the Joint High Power Solid State Laser program, demonstrated 10 kilowatts using a modular approach. Began design for 25 kilowatt demonstrator laser. Investigated systems-level issues such as weight and volume.

(U) In FY 2005: As part of the Joint High Power Solid State Laser program, demonstrate 25 kilowatts using a modular slab approach that has scalability to 100 kilowatts. Address 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 a solid state laser that is scalable to the weapons-class level.

(U) In FY 2007: Continue scaling solid state lasers with a goal of reaching the weapons-class power, beam

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	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.				
(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.	2.567	6.208	3.801	4.109
(U)	In FY 2004: Investigated technologies such as lasers for long-range detection of targets in clutter; efficient compact lasers; and associated beam control to compensate for platform vibration, atmospheric jitter, and aero-optic effects. Completed laser effects testing using surrogate laser sources. Completed development and began installation of a multi-kilowatt solid state laser testbed to confirm previous test results at appropriate power levels and wavelengths.				
(U)	In FY 2005: Investigate technologies to detect and track tactical targets in clutter. Demonstrate scalable efficient compact lasers and associated beam control to control platform vibration, atmospheric jitter, and aero-optic effects. Perform laser effects testing to determine required energy levels for tactical applications that address defeating next generation air-to-air threats. Build and test a pulsed laser with a wavelength of one micron against surrogate optics. Design and build an optical system incorporating lasers operating at several wavelengths. Design and build laser source and laboratory 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, thermal management, avionics, sensors, and fire control to increase the potential for successful transition. Evaluate high-power ultra-short laser technologies developed for long-range tactical applications.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate laser source technologies needed to counter current air-to-air and surface-to-air missile threats.	3.279	0.079	0.000	0.000
(U)	In FY 2004: Completed demonstration of a low-cost, reliable, and compact multispectral (bands I, II, and IV) solid state laser brassboard for future integration into large aircraft platforms.				
(U)	In FY 2005: Finalize technology for transition to warfighters.				

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(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Low Speed Air Data Sensor for Special Operations Aircraft.	3.314	3.370	0.000	0.000
(U)	In FY 2004: Developed fiber optic laser-based data technology that will provide low air speed indications down to zero knots for all fixed wing and rotary aircraft to increase safety operating in and out of landing zones.				
(U)	In FY 2005: Develop 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, such as MV/CV-22 and HH-60, during hovering maneuvers and landing.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Technology for Infrared Countermeasures Component Improvement.	0.975	2.081	0.000	0.000
(U)	In FY 2004: Accelerated the potential deployment of the previously developed mid-infrared semiconductor laser brassboard for infrared countermeasures applications. Initiated a risk reduction effort to investigate the environmental survivability issues for the laser transmitter. Demonstrated that a mid-infrared semiconductor laser transmitter can survive operational military random vibration and temperature environments. Conducted a series of rapid design/test iterations on the sub-scale demonstration unit in order to isolate the environmental impact on key subassemblies in the design such as the cryogenic cooling subassembly.				
(U)	In FY 2005: Mature mid-infrared semiconductor laser for infrared countermeasures applications with demonstration of laser performance in operational military environments. Conduct testing with the pointer/tracker to validate integration with infrared countermeasures system. Conduct 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)					
(U)	CONGRESSIONAL ADD: Wafer Integrated Semiconductor Laser.	1.073	2.974	0.000	0.000
(U)	In FY 2004: Improved the reliability and lowered the cost of high power laser diode arrays. Developed the technology for integrating turning mirrors and micro-lenses onto a laser chip, thus implementing more functions of the laser during the semiconductor manufacturing process.				
(U)	In FY 2005: Further develop novel surface emitting structures for semiconductor laser arrays. Refine the				

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basic technology developed in the previous year using 45-degree turning mirrors by testing and improving reliability, and improving yield to reduce overall cost. Etch integrated fast-axis collimation lenses into the semiconductor material. Explore other technologies for producing surface emitting semiconductor laser arrays.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U)

(U) Total Cost	19.001	23.376	14.423	14.879

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

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0603270F, Electronic Combat Technology.

(U) PE 0602605F, Directed Energy 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: 3152 High Power Microwave Technology

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	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	8.058	11.402	10.684	12.795	11.118	12.063	12.316	12.544	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/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)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop and demonstrate HPM technologies to disrupt, degrade, damage, or destroy an adversary's electronic systems.	3.346	1.321	1.255	1.309

(U) In FY 2004: Demonstrated an integrated repetitively pulsed gigawatt-class HPM breadboard. Conducted wideband field experiments with integrated compact devices to demonstrate effectiveness of wideband HPM for munitions and airborne electronic attack. Conducted additional ground-based, field experiments demonstrating effectiveness of air-delivered HPM munitions. Conducted an integrated short-range wideband hidden weapon identification experiment.

(U) In FY 2005: Demonstrate pulsed power and narrowband HPM source capability applicable to munitions and airborne concepts. Demonstrate a repetitively pulsed multi-gigawatt-class HPM integration experiment. Demonstrate 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. Demonstrate that the HPM system does not interfere with the flight controls of the airborne platform. Perform system diagnostics on integrated platform to ensure proper source operation. Demonstrate enhanced portable short-range wideband hidden weapon identification.

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(U)					
(U)	MAJOR THRUST: Conduct effects experimentation to expand and refine data library and support susceptibility predictions.	1.315	0.775	0.738	0.834
(U)	In FY 2004: Predicted high power microwave (HPM) coupling to targets with enhanced computer codes and validated code prediction accuracy. Further refined models to quantify the effectiveness of HPM waveforms against electronic targets of interest applicable to munitions or airborne applications. Enhanced the ability to calculate probability of kill for additional representative targets.				
(U)	In FY 2005: Provide dynamic data library to users and continue effects experimentation to populate and update the data library. Transition computer codes for the prediction of electromagnetic coupling on targets to users. Expand the evaluation and quantification of HPM waveform effectiveness against new and evolving electronic targets of interest. Transition computer codes for calculation of probability-of-kill for representative targets.				
(U)	In FY 2006: Transition HPM engagement lethality modeling and simulation capability into Air Force Standard Analysis Toolkit and to additional users. Execute high power microwave effects tests to improve HPM system design and lethality. Identify and mitigate vulnerabilities of US infrastructure to HPM attack.				
(U)	In FY 2007: Model real targets and predict probability of kill for various HPM scenarios. Continue high power microwave effects tests to improve HPM system design and lethality. Identify and mitigate additional vulnerabilities of US infrastructure to HPM attack.				
(U)					
(U)	MAJOR THRUST: Develop and evaluate active denial technologies for non-lethal, anti-personnel weapon applications such as ground force protection from a standoff aircraft.	2.559	4.603	4.354	6.331
(U)	In FY 2004: Acquired knowledge and capabilities critical for future active denial systems via field support of operation/testing/demonstration of the first ground-based system. Began the development of millimeter wave source for airborne applications including continuation of interactions with system specific computational physics simulations to validate design before source construction. Improved active denial system specific computational physics simulations capability for millimeter wave sources. Completed conceptual design study for mobile ground-based test stand for future airborne level radiating system demonstration. Updated subsystem approaches based on original airborne technical feasibility study. Provided technical expertise and background to external organizations tailoring active denial concepts and capabilities to their needs.				
(U)	In FY 2005: Provide user support 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. Baseline computational physics				

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simulations of millimeter-wave sources against the draft detailed design drawings. Investigate updated subsystem approaches based on the original airborne technical feasibility study. 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 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)

(U)	MAJOR THRUST: Develop the technology to integrate high power microwave (HPM) devices on aerial platforms and investigate specific target sets of interest.	0.838	4.703	4.337	4.321

(U) In FY 2004: Continued airborne electronic attack specific target identification efforts for individual targets and cluster of targets. Conducted additional HPM experiments in the transverse electromagnetic cell anechoic chamber and the upgraded smaller anechoic chamber. Began investigation of source to aircraft integration issues (e.g., electrical and physical interface and thermal control). Defined aircraft alterations and source shielding required to mount an HPM source on an aircraft. Began investigating the feasibility of using a wideband HPM source to geolocate and identify targets of interest and perform battle damage assessment.

(U) In FY 2005: Proceed with target identification efforts to include foreign and domestic and individual and cluster targets. Perform target lethality assessments. Maintain and upgrade the test facilities. Investigate source to aircraft integration issues such as electrical and physical interface, thermal control, center of mass, antennas, and electromagnetic interference/electromagnetic compatibility. Test determined source

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shielding requirements for mounting a source on an aircraft. Investigate the feasibility of using ultra-wideband high power microwave (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. Perform 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	8.058	11.402	10.684	12.795

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

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(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 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

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 2004 Actual	FY 2005 Estimate	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	8.052	4.454	1.848	1.868	1.958	2.081	2.091	2.097	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, 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)	FY 2004	FY 2005	FY 2006	FY 2007
(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.	2.060	2.525	1.848	1.868
(U) In FY 2004: Demonstrated optimized high pressure ejector nozzles performance for airborne laser systems. Demonstrated advanced iodine generation, iodine injection, and chemical oxygen iodine test sequence utilizing a laboratory test stand. Investigated chemical recirculation on tactical airborne platforms to greatly reduce the amount of chemicals carried onboard the aircraft.				
(U) In FY 2005: Conduct follow-on demonstrations of advanced iodine generation, iodine injection, and chemical oxygen iodine test sequence utilizing the laboratory test stand. Integrate the best iodine generation concept into a laser device to predict overall device-level performance and identify device-level issues. Perform 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.				
(U)				
(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	1.801	1.929	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 3647 High Energy Laser Technology

	airborne platforms.				
(U)	In FY 2004: Demonstrated advanced tracking methods and adaptive optics compensation techniques that double the Strehl ratio (peak laser intensity on target) in stressing atmospheric turbulence environments. Completed evaluation of the compensated beacon illumination technique. Completed initial evaluations using physics level wave optics simulations of several advanced concepts designed to improve performance of the Airborne Laser. These included a compensated beacon approach, several advanced tracking algorithms, and an adaptive reconstructor concept. Designed low absorption coatings for Airborne Laser deformable mirrors to be fabricated using magnetron sputtering technology.				
(U)	In FY 2005: Complete beam control technology demonstration and transition of these technologies to the Airborne Laser System program. Complete concept evaluations using the Airborne Laser wave optics code that includes more detailed models of the Airborne Laser beam control system. Complete field testing of advanced tracking algorithms and adaptive optics techniques at the North Oscura Peak propagation range. Mature advanced beam control technologies. Fabricate and test low absorption deformable mirror coating and compare to existing deformable mirror coating. Transition to the Airborne Laser program.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Laser Spark Countermeasure Program.	4.191	0.000	0.000	0.000
(U)	In FY 2004: Performed laboratory effects tests and modeling to resolve measured differences in the damage threshold of different focal plane arrays and expanded the database to include additional pulse length data and at least one additional focal plane array type. Performed laboratory effects testing to extend previous results into the ultra short pulse length regime. Performed and documented a countermeasure effectiveness study for selected operational scenarios. Designed, fabricated, and used a brassboard countermeasure laser system in a field demonstration test to show the effectiveness of the laser spark countermeasure (at relatively low power) against both conscan and imaging test assets with a single threat independent pulse format.				
(U)	In FY 2005: Not Applicable.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	Total Cost	8.052	4.454	1.848	1.868

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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)

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(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 that are supporting future enhancements to airborne lasers have been coordinated with the Airborne Laser program office.										

(U) D. Acquisition Strategy

Not Applicable.