PE NUMBER: 0602605F
PE TITLE: DIRECTED ENERGY TECHNOLOGY

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2006

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602605F DIRECTED ENERGY 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	42.754	44.169	48.422	53.340	54.252	54.761	55.274	Continuing	TBD
4866	Lasers & Imaging Technology	27.673	29.411	23.433	25.193	25.374	25.585	25.809	Continuing	TBD
4867	Advanced Weapons & Survivability Technology	15.081	14.758	15.482	16.440	16.727	16.867	17.008	Continuing	TBD
55SP	Laser and Imaging Space Tech	0.000	0.000	9.507	11.707	12.151	12.309	12.457	0.000	0.000

(U) A. Mission Description and Budget Item Justification

This program covers research in directed energy technologies, primarily lasers and high power microwaves, that are not space unique. In lasers, this includes moderate to high power lasers (solid state and chemical) and associated optical components and techniques. In advanced weapons, this program examines technologies such as narrowband and wideband high power microwave devices and antennas. Both areas also provide vulnerability/lethality assessments of representative systems. Note: In FY 2006, Congress added $2.5 million for Adaptive Optics Lasercom, $2.8 million for Advanced Laser Materials Development, and $1.8 million for Ceramics for Next-Generation Tactical Laser Systems. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

		FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	43.594	37.709	42.602
(U)	Current PBR/President's Budget	42.754	44.169	48.422
(U)	Total Adjustments	-0.840	6.460	
(U)	Congressional Program Reductions			
	Congressional Rescissions	-0.044	-0.640	
	Congressional Increases		7.100	
	Reprogrammings			
	SBIR/STTR Transfer	-0.796		
(U)	Significant Program Changes:			

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification		DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE: 4866 Lasers & Imaging 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
4866	Lasers & Imaging Technology	27.673	29.411	23.433	25.193	25.374	25.585	25.809	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project examines the technical feasibility of moderate to high power lasers and associated optical components required for Air Force missions including long- and short-range weapons, weapon support such as aimpoint selection, and force protection. The technologies developed in this project are not uniquely space-oriented. Technologies applicable for a wide range of vehicles including unmanned combat air vehicles and fighters are being developed. High power solid state and chemical laser devices, optical components, advanced beam control and atmospheric compensation technologies, laser target vulnerability assessment techniques, and advanced optical processes and techniques are developed. Advanced, short-wavelength laser devices for applications such as illuminators and imaging sources for target identification and assessment are developed.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop high power chemical laser technologies for applications such as directed energy weapons, illuminators, and wavelength specific applications.	5.505	6.037	4.458
(U) In FY 2005: Evaluated enhanced, scaled-up versions of the high pressure ejector nozzles incorporating iodine atom generation as appropriate for potential long-range technology insertion into airborne laser applications. Investigated scalability of high performance zero-gravity singlet delta oxygen generator concepts for airborne laser applications. Demonstrated chemical regeneration techniques or single pass singlet delta oxygen generators to reduce the weight of chemicals required for each mission. Demonstrated beam control technology applicable to future airborne lasers.			
(U) In FY 2006: Continue to investigate scalability of high performance zero-gravity singlet delta oxygen generator concepts for airborne laser applications. Demonstrate advanced chemical and electrical singlet oxygen generator technology to help improve current levels of performance. Investigate laser/fiber pumped molecular gas lasers. Develop advanced diagnostics for chemical oxygen iodine laser performance measurements to identify potential enhancements. Begin work on technologies that would increase the range of future high power airborne lasers. Investigate chemical-electrical hybrid laser technologies that offer potential for power scaling and component size and weight reduction.			
(U) In FY 2007: Continue to investigate scaling of high-performance oxygen generator concepts for airborne laser applications. Evaluate iodine injection schemes for oxygen generator. Evaluate and refine advanced chemical laser technologies demonstrated in FY 2006. Pursue scaling chemical-electric hybrid laser technologies that offer potential for power scaling, component size and weight reduction.			
(U)			
(U) MAJOR THRUST: Develop moderate power solid state laser device, beam control, and associated technologies for	4.904	6.790	9.905

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
airborne tactical applications, primarily aircraft self-defense with integrated sensors. Technologies being addressed include tailored high-brightness, multi-wavelength compact lasers and advanced beam control techniques to minimize platform vibration, atmospheric jitter, and aero-optical effects.			
(U) In FY 2005: Developed laser component technologies for detecting, identifying, tracking, and defeating electro-optic targets from airborne tactical platforms. Designed and fabricated new laser structures for near-infrared, mid-infrared, and long-wavelength operation. Focused development on power scaling, lower weight, reduced volume, robustness, improved beam quality, and higher efficiency. Developed laser system for optical augmentation to detect optical threats such as sniper scopes. Developed integrated aero-optical wavefront sensor beam control technology for tactical applications. Identified inertial reference unit operating requirements for these laser applications and evaluated existing advanced inertial reference unit technology. Began testing tactical beam control propagation codes.			
(U) In FY 2006: Develop laser component technologies for detecting, identifying, tracking, and defeating electro-optic targets from airborne tactical platforms. Enhance new laser structures for near-infrared, mid-infrared, and long-wavelength operation focusing on power scaling, lower weight, reduced volume, robustness, improved beam quality, and higher efficiency. Develop single- and multi-wavelength packaging and delivery methods. Begin development of system-level solutions to aero-optical issues involving tactical laser applications on airborne platforms. Transition most promising concepts to field testing. Assess laser requirements for destroying detectors in the threat sensors. Analyze the failure modes and other effects when various optics are damaged. Complete integrated aero-optical wavefront sensor development. Complete evaluation of advanced inertial reference unit. Continue testing of tactical beam control propagation codes.			
(U) In FY 2007: Design and develop laser sources for jamming/damaging optical threats. Focus on higher efficiency and higher reliability. Perform ground testing of ultra-short pulse laser sources to evaluate tactical applications. Continue development of system-level solutions to aero-optical issues involving tactical laser applications on airborne platforms. Investigate technologies for tactical platform disturbance mitigation and proceed to subsystem implementation of advanced techniques in a controlled environment. Continue applying latest technologies to tactical laser handheld systems. Begin measurements of active and passive flow control techniques and implement laboratory closed loop and feed forward compensation testing. Conduct laboratory tests to characterize performance of platform disturbance mitigation techniques, such as inertial reference units, develop advanced techniques to improve pointing accuracy by more than a factor of two over current state-of-the-art. Develop selected technologies for transition from laboratory to field testing.			
(U)			
(U) MAJOR THRUST: Perform system assessments to include vulnerability assessments on potential high-energy laser	2.612	1.129	2.334

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
targets. Provide critical design data for laser systems to defeat these targets. Develop directed energy concepts and identify issues relating to system architectures, technology readiness, technology trade offs, mission effectiveness, and military utility.			
(U) In FY 2005: Identified additional laser system constraints and performance degradation. Performed vulnerability assessment on ground targets to assess the effectiveness of relay mirror concept. Investigated the integration of technologies into relay mirror concepts. Performed system assessments of laser systems on tactical and bomber platforms. Provided assessment for various technology program decisions in support of a multiple-use electric laser test and integration lab.			
(U) In FY 2006: Perform lethality assessment studies to assess the effectiveness of the various laser concepts in relevant scenarios. Validate vulnerability assessment models by performing mid-scale and full-scale demonstration experiments. Simulate and investigate advanced adaptive optics for uplink beam control. Develop and evaluate two-beam propagation techniques for tracking and illumination of a cruise missile through an airborne relay mirror. Simulate and investigate tactical and bomber defense laser system technologies.			
(U) In FY 2007: Perform additional lethality assessment studies to assess the effectiveness of the various laser concepts in relevant scenarios. Continue mid-scale and full-scale demonstration experiments to validate vulnerability assessment models. Investigate the scalability, affordability, and application of selected relay mirror, bomber defense, and tactical laser systems. Support analysis-of-alternatives with system engineering and military utility assessments for potential directed energy applications. Provide assessment for a multiple-use electric laser test and integration lab. Provide analysis and support for tactical aircraft laser weapons. Develop modeling tools and techniques for analyzing system integration of directed energy systems with potential aircraft platforms.			
(U)			
(U) MAJOR THRUST: Develop scalable high power solid state and electric laser technologies for applicable next-generation laser device applications such as unmanned aerial vehicle designators/imagers and tactical airborne laser weapons.	3.996	6.294	6.345
(U) In FY 2005: Demonstrated 750 watts using novel rotating disk laser technology. Demonstrated megawatt peak power in pulsed fiber laser operating with nanosecond pulses and 10 kilohertz pulse repetition frequency.			
(U) In FY 2006: Investigate and demonstrate alternative laser architectures and gain media. Demonstrate wavelength versatile laser at greater than five watt power levels in the various wavelengths. Refine laser technologies 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 laser weapon applications.			
(U) In FY 2007: Refine technologies to obtain architectures that are favorable in terms of size, weight, efficiency,			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	affordability, reliability, maintainability, supportability, environmental acceptability (air, land, and maritime), and ruggedness for tactical laser weapon applications. Develop the most promising electric laser technologies for scaling to the weapons class power level. Demonstrate "eyesafe" wavelength electric laser technology for long-range designator and illuminator applications. Perform technical and cost trade off assessments to determine best value for high energy laser testbed.			
(U)				
(U)	MAJOR THRUST: Develop broadly applicable technologies to support future tactical and strategic relay mirrors systems.	0.319	0.546	0.095
(U)	In FY 2005: Investigated potential technologies that could be integrated onto an airborne relay mirror breadboard for further evaluation.			
(U)	In FY 2006: Simulate and investigate advanced adaptive optics for uplink beam control. Develop and evaluate two beam propagation techniques for tracking and illumination of a cruise missile through an airborne relay mirror. Design low-altitude relay mirror field experiments.			
(U)	In FY 2007: Continue investigation of advanced adaptive optics techniques for uplink beam control.			
(U)				
(U)	MAJOR THRUST: Develop optical and beam control technologies to enhance high energy laser beam propagation over long distances in the atmosphere.	2.903	1.617	0.296
(U)	In FY 2005: Developed optical components and complete active tracking experiments. Demonstrated advanced tracking methods and adaptive optics compensation techniques that double the Strehl ratio (peak intensity on target) in stressing atmospheric turbulence. Anchored wave optics propagation code to recent actual beam control performance. Completed concept evaluations using the airborne laser (ABL) wave optics code that includes more detailed models of the ABL beam control system. Completed field testing of advanced tracking algorithms and adaptive optics techniques at the North Oscura Peak propagation range.			
(U)	In FY 2006: Demonstrate high-bandwidth active tracking of uncooperative targets. Begin development of predictive processing techniques to correct atmospheric turbulence-induced track jitter. Experimentally characterize turbulence-induced track jitter over large apertures. Develop and evaluate sensor data, tools, and processes to support an end to end model-based analysis approach for a range of beam control applications.			
(U)	In FY 2007: Investigate active tracking of small/dim targets in conjunction with compensated laser illumination and overall laser system performance characterization. Continue development of predictive processing techniques to correct atmospheric turbulence-induced track jitter. Lay groundwork for field experiments to measure track jitter compensation. Begin developing capability to use sodium beacon adaptive optics to detect small space objects and to image satellites.			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)				
(U)	CONGRESSIONAL ADD: Adaptive Optics Lasercom.	2.478	2.464	0.000
(U)	In FY 2005: Developed and tested advanced technologies for a 2.5 gigabit per second air-to-air-to-ground optical communications system on a government test range. Interfaced with other Air Force and Department of Defense agencies to incorporate joint requirements into system performance.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Adaptive Optics Lasercom.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Ultra-Short Pulse Laser technology Development.	4.956	0.000	0.000
(U)	In FY 2005: Developed ultra-short pulse laser technology to obtain high-average, high-peak power. Investigated system engineering issues to package the ultra-short pulse laser technology into a low-weight, low-volume component. Investigated the relevance of ultra-short pulse laser technology for man portable and vehicle portable applications.			
(U)	In FY 2006: Not Applicable.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Advanced Laser Materials Development.	0.000	2.760	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Advanced Laser Materials Development.			
(U)	In FY 2007: Not Applicable.			
(U)				
(U)	CONGRESSIONAL ADD: Ceramics for Next-Generation Tactical Laser Systems.	0.000	1.774	0.000
(U)	In FY 2005: Not Applicable.			
(U)	In FY 2006: Conduct Congressionally-directed effort for Ceramics for Next-Generation Tactical Laser Systems.			
(U)	In FY 2007: Not Applicable.			
(U)	Total Cost	27.673	29.411	23.433

(U) C. Other Program Funding Summary ($ 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 Cost
(U) Related Activities:									
(U) PE 0601108F, High Energy									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602605F DIRECTED ENERGY TECHNOLOGY**	PROJECT NUMBER AND TITLE **4866 Lasers & Imaging Technology**

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

Laser Research Initiatives.

(U) PE 0602500F, Multi-Disciplinary Space Technology.

(U) PE 0602890F, High Energy Laser Research.

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

(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.

(U) PE 0603605F, Advanced Weapons Technology.

(U) PE 0603924F, High Energy Laser Advanced Technology Program.

(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.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2006
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE: 4867 Advanced Weapons & Survivability 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
4867	Advanced Weapons & Survivability Technology	15.081	14.758	15.482	16.440	16.727	16.867	17.008	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project explores high power microwave (HPM) and other unconventional weapon concepts using innovative technologies. Technologies are developed that support a wide range of Air Force missions such as the potential disruption and degradation of an adversary's electronic infrastructure and military capability. This effect can often be applied covertly with no collateral structural or human damage. Targeted capabilities include local computer and communication systems, as well as large and small air defense and command and control systems. This project also provides for vulnerability assessments of representative U.S. strategic and tactical systems to HPM weapons, HPM weapon technology assessment for specific Air Force missions, and HPM weapon lethality assessments against foreign targets.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Investigate and develop technologies for narrowband and wideband high power microwave (HPM) components to support multiple Air Force applications such as the disruption of electronic systems and subsystems.	7.212	7.058	4.033

(U) In FY 2005: Investigated higher-power compact repetitively operated sources. Improved the electrical efficiency of wideband HPM sources in order to achieve greater range, longer lifetime, and smaller packaging. Conducted pulsed atmospheric breakdown experiments. Conducted explosive generator development experiments to support compact single-shot HPM sources. Conducted a sub-scale (laboratory) repetitively pulsed gigawatt class experiment. Developed conformal phased array antenna for HPM systems. Selected a repetitively pulsed multi-gigawatt technology for HPM breadboard munitions and airborne electronic attack proof-of-concept. Utilized nanotechnology components (nanotubes) to continue development of cathodes and anodes for repetitively pulsed HPM experiments. Developed target identification concept using wideband technology. Developed wideband technology target identification source to demonstrate increased standoff range.

(U) In FY 2006: Develop a compact repetitively pulsed gigawatt-class HPM source. Develop a conformal high power phased array antenna for the compact pulsed HPM source. Develop compact permanent magnets for the compact pulsed gigawatt HPM source. Develop a compact pulse power system to drive the HPM source. Conduct laboratory measurements of the compact pulsed gigawatt HPM demonstration unit. Develop vacuum systems that are compact and can be installed in an airborne platform. Develop compact solid-state wideband source and antenna for target identification. Develop target identification algorithms. Conduct target identification field experiments to determine optimal design.

(U) In FY 2007: Conduct measurements using the compact repetitively pulsed gigawatt-class HPM demonstration unit.

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4867 Advanced Weapons & Survivability Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U)	Improve the compact HPM source and conformal antenna that they can be integrated into an airborne platform. Develop a command and control system for the airborne platform HPM unit. Implement nanotechnology to reduce the HPM source weight and size. Conduct field tests of the mesoband system that will characterize the system and demonstrate the effectiveness of the system. Develop an engineering model of a compact wideband target identification system that can be used to conduct laboratory experiments for applications such as targets under trees.			
(U)				
(U)	MAJOR THRUST: Develop and use the ability to assess the effects/lethality of HPM directed energy weapon technologies against representative air and ground systems.	2.268	2.133	4.804
(U)	In FY 2005: Conducted further susceptibility tests to determine relative importance of source parameters to cause desired effects on targets. Proceeded with the refinement of codes to predict probability of effect on target equipment and to guide experiment direction. Refined modeling techniques to incorporate HPM technologies into warfighting/war gaming activities. Proceeded with validation of computer codes' ability to adequately predict the electromagnetic coupling to, and probability of effect on, target equipment within complex structures.			
(U)	In FY 2006: Continue to advance elemental modeling methodology to predict target susceptibility through modeling. Develop advanced descriptions of target functional behavior for insertion into modeling and simulation codes. Continue susceptibility testing of electronic targets.			
(U)	In FY 2007: Predict susceptibilities of relevant current electronic systems based on model and manufacturer and verify accuracy with experiment. Conduct further experiments on the systems and compare predictions with experiments. Adjust models as required. Identify and mitigate platform susceptibility to onboard HPM and associated electromagnetic interference/electromagnetic compatibility considerations for fratricide issues. Refine preliminary battle damage assessment system for "ruggedized" use with HPM sources. Continue susceptibility testing of electronic targets. Apply hardening techniques and technology to identified platforms. Identify and mitigate HPM susceptibility for military systems against both domestic and foreign sources.			
(U)				
(U)	MAJOR THRUST: Develop and apply sophisticated models to enhance the development of HPM and related technology.	0.767	0.747	0.742
(U)	In FY 2005: Investigated/enhanced plasma models and developed the physics algorithms for use with HPM technologies. Developed improved algorithms for higher frequency wideband HPM modeling. Investigated methods for integration of electromagnetic and acoustic software with thermal and electron transport codes for high-fidelity surface simulations. Applied virtual modeling for HPM component technologies.			
(U)	In FY 2006: Validate plasma model on dielectric pulse power interfaces and antenna breakdown. Improve the fidelity of the solution to electromagnetic models by statically refining the numerical grid and by having a boundary			

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4867 Advanced Weapons & Survivability Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
	conformal solution. Continue integration of electromagnetic codes with thermal and electron transport codes.			
(U)	In FY 2007: Validate integration of electromagnetic codes with thermal and electron transport codes for HPM sources and components. Continue improving the fidelity of the solution to electromagnetic models by automatically refining the numerical grid.			
(U)				
(U)	MAJOR THRUST: Investigate HPM technologies that support offensive and force protection airborne tactical applications made possible by the increased power available on future aircraft.	4.834	4.820	5.903
(U)	In FY 2005: Improved the HPM effects modeling and simulation database so it is warfighter friendly. Upgraded source models to include aircraft concept of operations. Proceeded with source self-mitigation efforts, so as not to interfere with host platform. Investigated source to aircraft command and control efforts. Completed current source component study of plastic-laminate pulse forming lines with integrated Marx pulser. Tested source upgrades and their effect of the aircraft, as well as the command and control interface.			
(U)	In FY 2006: Refine HPM system source code to reflect payload to platform integration issues such as thermal, x-ray, and electrical issues. Examine the status of power conditioning subsystems to determine their applicability to an airborne experiment. Ensure understanding of air breakdown potentials given specific antenna interfaces. Continue refinement of solid state subsystem designs.			
(U)	In FY 2007: Further develop HPM source materials and assess applicability of solid state subsystem designs supporting ruggedized high power airborne. Integrate and test HPM subcomponents to determine applicability to a counter-improvised explosive device mission. Extend HPM system source code to reflect multiple options for high power subsystem components. Refine antenna concepts to meet airborne requirements for counter electronics including addressing issue related to propagation, air breakdown, and radomes. Mature relativistic magnetron technologies. Begin development of full power source test capability which will enable final validation of world record source development. Refine existing beam control/antenna concepts to meet airborne requirements including addressing issue related to propagation, breakdown, and radomes. Research, study and identify technology or data (effects, safety, stabilization, engagement) requirements impacting overall airborne conceptual approach.			
(U)	Total Cost	15.081	14.758	15.482

(U) C. Other Program Funding Summary ($ 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 Cost
(U) Related Activities:									
(U) PE 0602202F, Human Systems									

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602605F DIRECTED ENERGY TECHNOLOGY**	PROJECT NUMBER AND TITLE **4867 Advanced Weapons & Survivability Technology**

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

Technology.

(U) PE 0603605F, Advanced Weapons 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 2006**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602605F DIRECTED ENERGY TECHNOLOGY**

PROJECT NUMBER AND TITLE: **55SP Laser and Imaging 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
55SP Laser and Imaging Space Tech	0.000	0.000	9.507	11.707	12.151	12.309	12.457	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 0602500F, Multidisciplinary Advanced Development Space Technology, Project 5023, Laser and Imaging 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

Develop advanced, long-range optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large, lightweight optics; and optical coatings that support relay mirror systems. Relay mirror systems can greatly extend the range of high-power laser weapons, as well as low-power imaging systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced, long-range, optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large, lightweight optics; and optical coatings that support relay mirror systems. Relay mirror systems can greatly extend the range of high-power laser weapons, as well as low-power imaging systems.	0.000	0.000	7.680
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Begin investigations in support of a high-power demonstration to kill a missile through a relay mirror. Complete development of first generation advanced wavefront control device for imaging and beam projection.			
(U)			
(U) MAJOR THRUST: Assess the survivability and vulnerability of satellites to the effects of high-energy laser, as well as other directed energy systems, and update catalogues satellites.	0.000	0.000	1.827
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Develop and apply improved algorithms and hardware for satellite characterization and vulnerability assessment. Continue to update assessment methodology by anchoring modeling tools to empirical data, including results of laser illumination, tracking, and compensated imaging data. Assess the survivability and vulnerability of aerospace systems to the effects of directed energy weapons. Update response databases for continued improvement of predictive avoidance analyses and provide data to U.S. Strategic Command for the performance of Laser Clearinghouse functions.			
(U) Total Cost	0.000	0.000	9.507

Exhibit R-2a, RDT&E Project Justification		DATE February 2006
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 55SP Laser and Imaging Space Tech

(U) C. Other Program Funding Summary ($ 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 Cost

(U) Related Activities:

(U) PE 0602500F, Multi-Disciplinary Space Tech.

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

(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.

(U) PE 0603605F, Advanced Weapons Technology.

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

(U) D. Acquisition Strategy

Not Applicable.