PE NUMBER: 0602890F
PE TITLE: High Energy Laser Research

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2004

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602890F High Energy Laser Research

Cost ($ in Millions)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	0.000	41.498	45.333	48.316	51.699	52.143	53.053	Continuing	TBD
5096 High Energy Laser Research	0.000	41.498	45.333	48.316	51.699	52.143	53.053	Continuing	TBD

Note: In FY 2004, this program was transferred to the Air Force by the Office of the Secretary of Defense. The Air Force continues the tri-Service operation of the program under the High Energy Laser (HEL) Joint Technology Office (JTO).

(U) A. Mission Description and Budget Item Justification

This program funds DOD HEL applied research through the HEL JTO. HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and the ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DOD HEL Science and Technology program. In general, efforts funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid-state lasers, beam control, optics, propagation, and free electron lasers.

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 2003	FY 2004	FY 2005
(U)	Previous President's Budget	0.000	41.854	45.452
(U)	Current PBR/President's Budget	0.000	41.498	45.333
(U)	Total Adjustments	0.000	-0.356	
(U)	Congressional Program Reductions			
	Congressional Rescissions		-0.356	
	Congressional Increases			
	Reprogrammings			
	SBIR/STTR Transfer			

(U) Significant Program Changes:

In FY 2004, this program was transferred to the Air Force by the Office of the Secretary of Defense. The Air Force continues the tri-Service operation of the program under the HEL JTO.

Exhibit R-2a, RDT&E Project Justification			DATE February 2004
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602890F High Energy Laser Research	PROJECT NUMBER AND TITLE 5096 High Energy Laser Research	

Cost ($ in Millions)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
5096 High Energy Laser Research	0.000	41.498	45.333	48.316	51.699	52.143	53.053	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This program funds DOD HEL applied research through the HEL JTO. HEL weapon systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase; defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and the ultra-precision negation of targets in urban environments with no collateral damage. This program is part of an overall DOD HEL Science and Technology program. In general, efforts funded under this program are chosen for their potential to have major impact on multiple HEL systems and on multiple Service missions while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid-state lasers, beam control, optics, propagation, and free electron lasers.

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. Accomplishments/Planned Program ($ in Millions)	FY 2003	FY 2004	FY 2005
(U) For FY 2003, this activity was performed under PE 0602890D8Z, High Energy Laser Research, and the approximate funding for FY 2003 was $45.9 million.			
(U)			
(U) MAJOR THRUST: Explore solid state lasers that have potential for the quickest impact in future HEL weapons because of their inherent small size and the fact that they require only electrical energy in order to run, thereby greatly simplifying systems engineering and supportability.	0.000	11.000	11.000
(U) In FY 2003: Not Applicable.			
(U) In FY 2004: Continue to develop enabling solid state laser technologies through applied research necessary for the demonstration of solid state lasers at initial weapon grade power levels. Under the Joint High Power Solid State Laser program continue development of solid state laser technologies supporting the demonstration of 25 kilowatts in FY 2005 and follow-on 100 kilowatt solid state laser designs.			
(U) In FY 2005: Continue to mature enabling solid state laser technologies through applied research necessary for the demonstration of solid state lasers at initial weapon grade power levels. Support the Joint High Power Solid State Laser program demonstration of 25 kilowatts devices leading to follow-on 100 kilowatt solid state laser designs.			
(U)			
(U) MAJOR THRUST: Explore free electron lasers that have potential in future HEL weapons because they require only electrical energy in order to run and can be designed to operate at a the best wavelength for a specific application	0.000	8.400	8.400

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	within a large range of wavelengths.			
(U)	In FY 2003: Not Applicable.			
(U)	In FY 2004: Continue to accelerate the scaling of free electron lasers toward weapon class power levels. The initial power scaling milestone will be 10 kilowatts for a laboratory demonstrator. Develop a photocathode model as a tool to design advanced robust long-life photocathodes. Design and begin fabrication of a high current radio frequency cavity at 700 megahertz for integration into 10 kilowatt demonstrator. Conduct a study and begin laboratory tests to determine if new optical coating finishing methods produce optical coatings with robustness required for free electron laser applications.			
(U)	In FY 2005: Continue to accelerate the scaling of free electron lasers toward weapon class power levels. Continue 10 kilowatt laboratory demonstration to define development path for scaling toward 100 kilowatt field test demonstrator and eventual megawatt class free electron laser.			
(U)				
(U)	MAJOR THRUST: Develop advanced solid state laser technologies that are applicable to future HEL weapon laser devices.	0.000	3.750	5.000
(U)	In FY 2003: Not Applicable.			
(U)	FY 2004: Develop solid state laser technologies such as laser materials with large fluorescence lifetime and cross-section and the ability to operate at high temperatures, laser gain media thermal management techniques, and modular and scalable architectures for laser power scaling including technologies for beam combining. Develop ceramic laser gain media materials. Optimize ceramic material manufacturing processes for laser applications, fully characterize materials, and set the stage for comparison of single crystal material to ceramic material laser performance. Develop and demonstrate a more efficient high brightness diode array and use it in a demonstration with a fiber laser system. Develop and demonstrate fiber laser beam combining through spectral and phase front sensing approaches. Develop and demonstrate a heat exchanger building block for phase change thermal management/storage system for solid state lasers.			
(U)	FY 2005: Continue to develop solid state laser technologies to provide laser materials with large fluorescence lifetime and cross-section and the ability to operate at high temperatures, laser gain media thermal management techniques, and modular and scalable architectures for laser power scaling including technologies for beam combining.			
(U)				
(U)	MAJOR THRUST: Develop beam-control technologies that are directly applicable to surface, air, and space mission areas. Results of these activities will be transitioned to near-term HEL systems and will also serve to enhance the HEL-related technology base and industrial capability. Develop atmospheric characterization technologies and techniques aimed at making precise absorption measurements in interesting atmospheric windows, measuring and assimilating information on turbulence at locations relevant to tactical HEL systems, and developing and testing real-time characterization tools to assist the HEL operator.	0.000	10.218	10.683

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(U) In FY 2003: Not Applicable.

(U) In FY 2004: Continue to develop beam control technology to improve HEL system performance. Seek to provide critical technology options for use in tactical scenarios on tactical platforms such as aircraft, ground vehicles, and maritime platforms, thus enabling the advantages of HELs to be applied in a wide variety of military operations. Develop high mechanical strength, high hardness HEL windows with low optical path distortions for tactical HEL applications. Develop technology to fabricate conformal HEL windows for tactical air vehicles. Develop wavefront sensors that are insensitive to high scintillation environments and prepare to benchmark performance in a simulated high scintillation environment. Establish a government optical metrology capability to precisely measure adsorption and reflectivity of optical coatings. Develop methods for discrimination, pointing, and tracking in high clutter using three-dimensional imaging. Continue to develop characterizations that concentrate on understanding atmospheric limitations in low-altitude tactical scenarios in order to increase the lethal range.

(U) In FY 2005: Continue to develop beam control technology to improve HEL system performance. Seek to provide critical technology options for use in tactical scenarios on tactical platforms such as aircraft, ground vehicles, and maritime platforms, thus enabling the advantages of HELs to be applied in a wide variety of military operations. Provide developed beam component technologies for integration into laboratory test beds for performance comparison and enhancement. Continue to develop characterizations that concentrate on understanding atmospheric limitations in low-altitude tactical scenarios (such as turbulence, thermal blooming, and platform disturbances) in order to increase the lethal range. Begin to plan a thermal blooming experiment.

(U)

(U) MAJOR THRUST: Develop chemical laser technologies that provide higher performance and better supportability. Results of these activities will result in chemical lasers that are lighter and more affordable.	0.000	2.750	3.650

(U) In FY 2003: Not Applicable.

(U) In FY 2004: Continue to develop and demonstrate closed-cycle chemical lasers, especially chemical oxygen iodine laser-derived devices, appropriate for space-based and tactical applications. Develop chemical laser generators that are capable of operating in a gravity free environment and conduct proof-of-concept testing of these devices.

(U) In FY 2005: Continue to develop and demonstrate closed-cycle chemical lasers, especially chemical oxygen iodine laser-derived devices. Conduct technology development/experiments to allow selection of the most promising chemical laser generators and chemical regeneration techniques that can be scaled for tactical weapon system applications.

(U)

(U) MAJOR THRUST: Develop lethality technologies that concentrate on providing a strong scientifically-based understanding of laser kill mechanisms to allow the design of future HEL systems with the maximum kill probability for the minimum system size and cost.	0.000	4.280	4.400

(U) In FY 2003: Not Applicable.

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(U) In FY 2004: Continue to develop a firm, physics-based understanding of the mechanisms involved in the interaction between HEL beams and the targets they strike. Continue to develop databases that will be accepted by the HEL community and validated models that will be available to systems designers. Develop a subset of target folders for tactical laser weapons like the Advanced Tactical Laser and Mobile Tactical High Energy Laser.

(U) In FY 2005: Continue to develop a firm, physics-based understanding of the mechanisms involved in the interaction between HEL beams and the targets they strike. Continue to develop databases that will be accepted by the HEL community and validated models that will be available to systems designers.

(U)

(U) MAJOR THRUST: Develop a fully realistic model of end-to-end HEL system performance, from birth of photons in the laser to their death at the target, thereby improving the design of HEL systems and reducing the need for expensive field testing.	0.000	1.100	2.200

(U) In FY 2003: Not Applicable.

(U) In FY 2004: Continue to develop the infrastructure for integrating existing and emerging high-fidelity component models into an end-to-end engagement model, thereby improving the design of HEL systems and reducing the need for expensive field testing. Continue to develop widely accepted engagement model for non-expert users capable of supporting many HEL systems, targets, and scenarios. The model will include platform constraints, provide parametrically represented probability of kill for various target surfaces, and allow for constrained sensitivity analyses.

(U) In FY 2005: Begin validation of infrastructure for integrating existing and emerging high-fidelity component models into an end-to-end engagement model, thereby improving the design of HEL systems and reducing the need for expensive field testing. Begin to validate engagement model using Service specific scenarios.

(U) Total Cost	0.000	41.498	45.333

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

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
PE 0602500F, (U) Multi-Disciplinary Space Technology.									
(U) PE 0601108F, High Energy Laser Research Initiatives.									
(U) PE 0603444F, Maui Space Surveillance System.									
(U) PE 0603500F,									

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

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) PE 0602605F, Directed Energy Technology.

(U) PE 0602307A, Advanced Weapons Technology.

(U) PE 0602114N, Power Projection Applied Research.

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

(U) D. Acquisition Strategy

Not Applicable.