

UNCLASSIFIED

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

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| Exhibit R-2, RDT&E Budget Item Justification | DATE February 2007 |
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| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602890F High Energy Laser Research |
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| Cost (\$ in Millions) | FY 2006 Actual | FY 2007 Estimate | 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 | 50.271 | 52.136 | 50.303 | 51.159 | 58.588 | 58.572 | 55.985 | 57.008 | Continuing | TBD |
| 5096 High Energy Laser Research | 50.271 | 52.136 | 50.303 | 51.159 | 58.588 | 58.572 | 55.985 | 57.008 | Continuing | TBD |

(U) A. Mission Description and Budget Item Justification

This program funds Department of Defense (DoD) high energy laser (HEL) applied research through the HEL Joint Technology Office (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. 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 little or 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. Note: In FY 2007, Congress added \$2.2 million for Air Laser Technology Development. 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)

| | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
|--------------------------------------|----------------|----------------|----------------|----------------|
| (U) Previous President's Budget | 46.669 | 50.166 | 50.737 | 55.026 |
| (U) Current PBR/President's Budget | 50.271 | 52.136 | 50.303 | 51.159 |
| (U) Total Adjustments | 3.602 | | | |
| (U) Congressional Program Reductions | | -0.032 | | |
| Congressional Rescissions | | -0.198 | | |
| Congressional Increases | | 3.200 | | |
| Reprogrammings | 4.824 | -1.000 | | |
| SBIR/STTR Transfer | -1.220 | | | |

(U) Significant Program Changes:
 Not Applicable.

C. Performance Metrics
 Under Development.

Exhibit R-2a, RDT&E Project Justification

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|-----------------------------------------------|-------------------|---------------------|---------------------|---------------------|-------------------------------------------------------------------|---------------------|---------------------|--------------------------------------------------------------------|---------------------|-------|
| 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 2006 Actual | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total |
| 5096 High Energy Laser Research | 50.271 | 52.136 | 50.303 | 51.159 | 58.588 | 58.572 | 55.985 | 57.008 | Continuing | TBD |
| Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

(U) A. Mission Description and Budget Item Justification

This program funds Department of Defense (DoD) high energy laser (HEL) applied research through the HEL Joint Technology Office (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. 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 little or 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. Note: In FY 2007, Congress added \$2.2 million for Air Laser Technology Development. 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)

| | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|----------------|----------------|
| (U) MAJOR THRUST: Advance solid-state laser development, to include advanced technology demonstrations up to a Technology Readiness Level of 6. | 10.910 | 10.524 | 10.271 | 9.424 |
| (U) In FY 2006: Awarded contracts for phase III of the Joint High Power Solid State Laser (JHPSSL) project, to demonstrate 100 kilowatt laser devices. Conducted necessary studies to understand and improve field ability of solid state lasers. | | | | |
| (U) In FY 2007: Participate in the 100 kilowatt JHPSSL demonstration. Analyze successful pieces from applied research projects (e. g. long-life diode laser drivers, thin-disc amplifiers, and fiber laser amplifiers) for future advanced demonstration of solid state laser systems. | | | | |
| (U) In FY 2008: Continue to participate in the 100 kilowatt JHPSSL project. Provide for independent government-sponsored measurements of the 100 kilowatt laser(s). Initiate a joint high-power beam director development effort, suitable for mating with the JHPSSL phase III laser device. | | | | |
| (U) In FY 2009: The 100 kilowatt laboratory demonstration will occur during this period. Continue with the joint high-power beam director development effort, suitable for mating with the JHPSSL phase III laser device. | | | | |
| (U) MAJOR THRUST: Mature technologies that will provide system level performance commensurate with fieldable solid-state laser devices | 8.720 | 7.733 | 8.232 | 8.686 |

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| BUDGET ACTIVITY 02 Applied Research | PE NUMBER AND TITLE 0602890F High Energy Laser Research | PROJECT NUMBER AND TITLE 5096 High Energy Laser Research | | | |
| (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> | |
| (U) In FY 2006: Conducted research to enable power scaling with reduced optical distortion, improved efficiency, and improved mass/weight characteristics. Developed scaleable architectures for beam combining. Examined architecture improvements, such as elimination of free-space optics in fiber systems. Conducted an industry proposal call for FY 2006; awarded eight contracts. | | | | | |
| (U) in FY 2007: Develop technology that will lead to improved laser gain material and single mode fiber suitable for beam combination. Improve the efficiency and reliability of diode pump sources. Conduct Service and Agency proposal call for FY 2007. | | | | | |
| (U) In FY 2008: Develop technology that will lead to improved fieldability, serviceability, and ruggedness. Develop power scaling architectures with good beam quality and suitable mass and weight. Conduct an industry proposal call for FY 2008. | | | | | |
| (U) In FY 2009: Develop technology that will lead to improved fieldability, serviceability, and ruggedness. Develop power scaling architectures with good beam quality and suitable mass and weight. Conduct Service and Agency proposal call for FY 2009. | | | | | |
| (U) MAJOR THRUST: Investigate new technologies that have revolutionary potential for HEL applications. | 2.199 | 2.189 | 2.411 | 2.529 | |
| (U) In FY 2006: Explored novel laser technologies to have increase efficiency and decrease mass/volume. Integrated short-pulse laser technology into this initiative. Conducted an industry proposal call for FY 2006, awarded three contracts. | | | | | |
| (U) In FY 2007: Explore novel laser technologies to increase efficiency and decrease mass/volume. Integrate short-pulse laser technology into this initiative. Conduct a Service and Agency proposal call for FY 2007. | | | | | |
| (U) In FY 2008: Explore novel laser technologies to increase efficiency and decrease mass/volume. Conduct a Service and Agency proposal call for FY 2008. | | | | | |
| (U) In FY 2009: Explore novel laser technologies to increase efficiency and decrease mass/volume. Conduct a Service and Agency proposal call for FY 2009. | | | | | |
| (U) MAJOR THRUST: Explore free electron lasers (FEL) that have potential in future HEL weapons. Conduct system level technology development and trade studies to facilitate scaling FELs to weapons-class power levels and shipboard integration. | 9.330 | 9.463 | 10.028 | 10.153 | |
| (U) In FY 2006: Conducted research in power scaling for a 100 kilowatt class FEL. Designed | | | | | |

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| (U) B. Accomplishments/Planned Program (\$ in Millions) | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|----------------|----------------|
| high-average-current photocathode and injector capability, suitable beam-breakup thresholds, and power scaling capability of the optical resonator. Continued component testing with the 10 kilowatt laboratory device to define a development path for scaling to a 100 kilowatts. Conducted an industry proposal call for FY 2006, awarded seven contracts. | | | | |
| (U) In FY 2007: Demonstrate high average current photocathode and injector capability, suitable beam-breakup thresholds, and power scaling of the optical resonator. Complete the 10 kilowatt laboratory demonstration. Conduct a Service and Agency proposal call for FY 2007. | | | | |
| (U) In FY 2008: Continue to investigate the development path for scaling to a 100 kilowatt lab demonstration. Conduct an industry proposal call for FY 2008 | | | | |
| (U) In FY 2009: Continue to investigate the development path for scaling to a 100 kilowatt lab demonstration. Conduct a Service and Agency proposal call for FY 2009. | | | | |
| (U) MAJOR THRUST: Conduct technology experiments to select promising chemical generator and chemical regeneration technologies that can be scaled for weapons application. | 5.420 | 7.303 | 5.690 | 6.057 |
| (U) In FY 2006: Developed and demonstrated closed-cycle chemical laser, focused on chemical oxygen iodine (COIL) devices. Explored novel concepts on electric-gas phase laser generation. Conducted an industry proposal for FY 2006, awarded five contracts. | | | | |
| (U) In FY 2007: Demonstrate closed-cycle COIL devices. Demonstrate electric-oxygen pumping schemes to minimize the chemistry. Develop electric-gas phase laser generation technologies. Fund Air Laser Project to produce oxygen deltlets through electric pumping. Conduct a Service and Agency proposal call for FY 2007. | | | | |
| (U) In FY 2008: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct an industry proposal call for FY 2008. | | | | |
| (U) In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009. | | | | |
| (U) MAJOR THRUST: Develop technology to support high performance beam control systems and integrated demonstrations. | 8.560 | 8.918 | 9.615 | 10.234 |
| (U) In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control techniques, to include conformal and tiled apertures, and fiber-based technologies. Continued the study | | | | |

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| (U) B. Accomplishments/Planned Program (\$ in Millions) | | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
| of atmospheric limitations at low altitude, such as turbulence, thermal blooming, and platform disturbances. Conducted an industry proposal for FY 2006, awarded eight contracts. | | | | | |
| (U) In FY 2007: Develop beam control technologies, such as all-fiber systems with conformal apertures and active controls for boundary layer mitigation. Complete atmospheric compensation technologies. Conduct a Service and Agency proposal call for FY 2007. | | | | | |
| (U) In FY 2008: Develop/provide beam control technology options for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems). Conduct an industry proposal call for FY 2008. | | | | | |
| (U) In FY 2009: Develop/provide beam control technology options for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems). Conduct a Service and Agency proposal call for FY 2009. | | | | | |
| (U) MAJOR THRUST: Develop a lethality database, and integrate into a systems-level architecture plan. | | 3.500 | 3.814 | 4.056 | 4.076 |
| (U) In FY 2006: Developed a predictive, physics-based methodology for prediction of target lethality based on an understanding of the mechanism of laser/target material interaction. Developed databases that will be accepted by the HEL community, and integrated in validated models for laser systems designers. | | | | | |
| (U) In FY 2007: Catalog existing lethality databases for common use. Develop an architecture plan to consolidate and compare historical data. Initiate laser systems inputs for the Joint Munitions Effect Manual. | | | | | |
| (U) In FY 2008: In close coordination with existing HEL models, integrate lethality data into campaign-level HEL system models. Develop laser systems inputs for the Joint Munitions Effect Manual. | | | | | |
| (U) In FY 2009: In close coordination with existing HEL models, integrate lethality data into campaign-level HEL system models. Develop laser systems inputs for the Joint Munitions Effect Manual. | | | | | |
| (U) CONGRESSIONAL ADD: High Power Fiber Laser Program. | | 1.152 | 0.000 | 0.000 | 0.000 |
| (U) In FY 2006: Conducted Congressionally-directed effort for the High Power Fiber Laser Program. | | | | | |
| (U) In FY 2007: Not Applicable. | | | | | |
| (U) In FY 2008: Not Applicable. | | | | | |
| (U) In FY 2009: Not Applicable. | | | | | |

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| (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
|------------------------------------------------------------------------------------------------|----------------|----------------|----------------|----------------|
| (U) CONGRESSIONAL ADD: Oxygen Laser Optical Source. | 0.480 | 0.000 | 0.000 | 0.000 |
| (U) In FY 2006: Conducted Congressionally-directed effort for the Oxygen Laser Optical Source. | | | | |
| (U) In FY 2007: Not Applicable. | | | | |
| (U) In FY 2008: Not Applicable. | | | | |
| (U) In FY 2009: Not Applicable. | | | | |
| (U) CONGRESSIONAL ADD: Air Laser Technology Development. | 0.000 | 2.192 | 0.000 | 0.000 |
| (U) In FY 2006: Not Applicable. | | | | |
| (U) In FY 2007: Conduct Congressionally-directed effort in Air Laser technology Development. | | | | |
| (U) In FY 2008: Not Applicable. | | | | |
| (U) In FY 2009: Not Applicable. | | | | |
| (U) Total Cost | 50.271 | 52.136 | 50.303 | 51.159 |

| (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> | <u>FY 2010</u> | <u>FY 2011</u> | <u>FY 2012</u> | <u>FY 2013</u> | <u>Cost to</u> | <u>Total Cost</u> |
|----------------------------------------------------------------------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------|
| | <u>Actual</u> | <u>Estimate</u> | <u>Complete</u> | |
| (U) PE 0602500F, Multi-Disciplinary Space Technology. | | | | | | | | | | |
| (U) PE 0601108F, High Energy Laser Research Initiatives. | | | | | | | | | | |
| (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 | | | | | | | | | | |

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BUDGET ACTIVITY

02 Applied Research

PE NUMBER AND TITLE

**0602890F High Energy Laser
Research**

PROJECT NUMBER AND TITLE

5096 High Energy Laser Research**(U) C. Other Program Funding Summary (\$ in Millions)**

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.