



# UNCLASSIFIED

**CLASSIFICATION:**

EXHIBIT R-2, RDT&E Project Justification	DATE: <b>FEBRUARY 2007</b>
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APPROPRIATION/BUDGET ACTIVITY <b>RDT&amp;E, N / BA-4</b>	PROGRAM ELEMENT NUMBER AND NAME 0603925N Directed Energy and Electric Weapon Systems	PROJECT NUMBER AND NAME 9999 - Congressional Plus Ups - Various
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**B. PROGRAM CHANGE SUMMARY:**

Funding:	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Previous President's Budget: (FY07 Pres Controls)	0.000	0.000	0.000	0.000
Current President's Budget (FY08 Pres Controls):	17.893	27.197	0.000	0.000
Total Adjustments	17.893	27.197	0.000	0.000
Summary of Adjustments				
Congressional Increases	17.893	27.197	0.000	0.000
Subtotal	17.893	27.197	0.000	0.000

Schedule:  
Not Applicable.

Technical:  
Not Applicable.

R-1 SHOPPING LIST - Item No. 77  
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Exhibit R-2, RDTEN Budget Item Justification

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EXHIBIT R-2, RDT&E Project Justification							DATE: <b>FEBRUARY 2007</b>			
APPROPRIATION/BUDGET ACTIVITY <b>RDT&amp;E, N / BA-4</b>			PROGRAM ELEMENT NUMBER AND NAME 0603925N Directed Energy and Electric Weapon Systems			PROJECT NUMBER AND NAME 9999 - Congressional Plus Ups - Various				
<b>C. OTHER PROGRAM FUNDING SUMMARY:</b>										
<u>Line Item No. &amp; Name</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>To Complete</u>	<u>Total Cost</u>
0602114N - ONR *										
Maritime Directed Energy Test Center										
0602114N - ONR **										
Spectral Beam Combining Fiber Lasers										
0603235N - ONR										
Maritime Domain Identification System										
0601108F - JTO ***										
0602890F - JTO ***										
0601108F - JTO										
0602114N - ONR ***										
0603114N - ONR										
Notes: * FY05 Congressional Plus Up for Maritime Directed Energy Test Center was under the cognizance of NAVSEA PMS 405 (PE 0603582N PU S0164) BA-4										
** FY05 Congressional plus-up for Spectral Beam Combining Fiber Lasers was under the cognizance of NAVSEA PMS 405 (PE 0205601N PU S9626) BA-4 - Phase III SBIR awarded under a FY05 plus-up										
<b>D. ACQUISITION STRATEGY:</b>										
Not Applicable (R&D effort only)										
<b>E. MAJOR PERFORMERS:</b>										
Government Field Activities: NRL; NSWC CD; NSWC Crane; NSWC DD.										
Academia: Argonne Laboratory; Brooks Institute; Los Alamos National Laboratory; MIT; Penn State University; Thomas Jefferson Laboratory.										
Contractors: Acculight; AES; Ionatron; Raytheon; Analytical Research; Schafer; Envisioneering; SPA; Textron; General Atomics; Northrop Grumman; Boeing; Titan; SYS; EWA; Radiance.										

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Exhibit R-2, RD TEN Budget Item Justification

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Exhibit R-3 Cost Analysis (page 1)										DATE: <b>FEBRUARY 2007</b>				
APPROPRIATION/BUDGET ACTIVITY			PROGRAM ELEMENT				PROJECT NUMBER AND NAME							
<b>RDT&amp;E, N / BA-4</b>			0603925N Directed Energy and Electric Weapon Systems				9999 - Congressional Plus Ups - Various							
Cost Categories	Contract Method & Type	Performing Activity & Location	Total PY s Cost	FY 06 Cost	FY 06 Award Date	FY 07 Cost	FY 07 Award Date	FY 08 Cost	FY 08 Award Date	FY 09 Cost	FY 09 Award Date	Cost to Complete	Total Cost	Target Value of Contract
Transportable Laser Induced Plasma	Various	Various		10.758	03/07								10.758	
Lasers for Navy Applications	Various	Various		3.266	06/06	3.188	06/07						6.454	
Optical Line Replaceable Units	Various	Various		0.961	06/06	0.996	06/07						1.957	
Electromagnetic Launcher Rail Gun	Various	Various		2.908	06/06	0.000		0.000		0.000			2.908	
Deployable Ultra-Short Pulse Laser	Various	Various				2.491	06/07	0.000		0.000			2.491	
Prototype Instr Sys for MUTC	Various	Various				1.096	06/07	0.000		0.000			1.096	
Directed Energy Research	Various	Various				19.426	06/07	0.000		0.000			19.426	
<b>Total</b>			0.000	17.893		27.197		0.000		0.000			45.090	

Remarks:  
 Multiple funding documents and contract vehicles were utilized to obtain the services of the government field activities, academia, and contractors listed on the R-2a Page(s) 7-10.  
 Costs shown reflect all expenses (management, engineering, travel, etc.).

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Exhibit R-3, Project Cost Analysis

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EXHIBIT R-2a, RDT&E Project Justification		DATE: <b>FEBRUARY 2007</b>
APPROPRIATION/BUDGET ACTIVITY <b>RDT&amp;E, N / BA-4</b>	PROGRAM ELEMENT NUMBER AND NAME 0603925N Directed Energy and Electric Weapon System	PROJECT NUMBER AND NAME 9999 - Congressional Plus Ups - Various

**B. Accomplishments/Planned Program**

<b>Transportable LIPC 9357</b>	FY 06	FY 07	FY 08	FY 09
Accomplishments/Effort/Subtotal Cost	10.758	0.000	0.000	0.000
RDT&E Articles Quantity	N/A	N/A	N/A	N/A

These funds were provided by Congressional Plus Up for the continued development of directed energy weapon system technology to counter terrorist attacks that employ asymmetric methods such as vehicle bombs, small boat attacks, suicide bombers, etc. Efforts include engineering and demonstration of miniature lasers to determine the maximum extended range and resultant effects associated with this laser guided energy, and includes the development and delivery of a mobile, demonstration prototype. The Transportable Laser Induced Plasma Channel (LIPC) will be used for development of guided Radio Frequency (RF) energy. LIPC is a Force Protection issue. The direct discharge of electrical energy guided by LIPC has the potential to provide a revolutionary weapon capability that can be employed to, among other applications, disable electronics and vehicles, and disrupt or destroy critical communication infrastructures. The LIPC enhanced directionality of energy may allow an improved efficiency of the transmission of the directed energy to a target, thereby offering reduced source size and power and/or an extended effectiveness range.

Initial system engineering and demonstration/testing of miniature lasers at limited ranges was accomplished with FY 04 funding. FY 05 funding was utilized for system design and engineering efforts to demonstrate LIPC at longer ranges that allows the Navy to show the military usefulness of this technology in various environments for Anti Terrorism / Force Protection (AT/FP). Funding will be used for continued development and demonstration of LIPC at tactically significant ranges, and for development of a mobile, demonstration prototype.

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Exhibit R-2a, RDTEEN Project Justification

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**B. Accomplishments/Planned Program**

Lasers for Navy Applications 9531/9823	FY 06	FY 07	FY 08	FY 09
Accomplishments/Effort/Subtotal Cost	3.266	3.188	0.000	0.000
RDT&E Articles Quantity	N/A	N/A	N/A	N/A

This funding supports the accomplishment of the requisite engineering, assessment, test, and demonstration of a near term High Energy Laser (HEL) Weapon Systems (HELWS) capability against littoral and asymmetric threats. Joint Vision 2020 requires the assessment and demonstration of the complementary nature of HELWS, coupled with defensive missiles/guns for ship self-defense. Mission survivability is required of our surface ships. High Energy Lasers offer the potential for complementing ship self-defensive weapon systems at tactically significant ranges. Critical to demonstrating this capability are accomplishment of the system engineering and analyses associated with laser development and analysis of engagement effects. This effort is vital to the Navy's plan to develop and field a naval laser to meet future Navy requirements.

FY06 funds were provided by Congressional Plus Up for Laser Lethality and Vulnerability research, testing, and analysis. A ship's mission survivability is greatly improved by increasing, and extending in range, the Probability of Kill (Pk) of the Rolling Airframe Missile (RAM). This can be accomplished by using a High Energy Laser Weapon System (HELWS) to irreversibly damage and disable a threat missile's sensor systems (by charring or damaging the radome) causing the threat missile to simplify its maneuvering attack flight profile. Critical to demonstrating this concept are experiments and analyses associated with laser charring of composite radomes and the resultant decrease of the signal-to-noise ratio that would cause missile break lock to occur and the resultant change in effective Pk of RAM. Success of this effort is a vital portion of the overall plan to develop and field a Naval HELWS to meet future Naval operational requirements. In order to achieve required milestones this ship defense enhancement capability must be shown as viable. Taking the concept to a flight demonstration phase requires preparation of detailed system and test requirements, concept definition work, and "over the water" field testing at fairly long ranges. The engineering analysis will assure technical feasibility of the proposed testing and the expected results. Engineering efforts will continue in FY 06 on the system and test requirements, and system architecture studies to support a flying target demo utilizing a prototype 1-micron laser weapon system.

FY 06 funding was provided for acquisition of a second laser (20kW) to provide the capability to test/demonstrate combined laser operations, and engineered conversion of these lasers to demonstrate longer range with higher output power. FY 07 funding will provide the system engineering and application of the beam conversion technology, procured and developed with FY 05/06 funding, to accomplish beam combining of the two lasers to provide and demonstrate a 30kW laser weapon capability at significantly longer ranges.

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**B. Accomplishments/Planned Program (Cont.)**

Optical Line Replaceable Units/9824	FY 06	FY 07	FY 08	FY 09
Accomplishments/Effort/Subtotal Cost	0.961	0.996	0.000	0.000
RDT&E Articles Quantity	N/A	N/A	N/A	N/A

The FY 07 Plus up will support the detailed design and development of a prototype, and test a multifunction, low power laser Optical Line Replacement Units (OLRUs). This prototype is referred to as the Integrated Reconnaissance/targeting and Intervention Sensor (IRIS) OLRU. This funding allows for the continuing implementation of ultra short pulse laser micromachining processes for ceramic circuit board development and continues development of advanced processing techniques in support of semiconductor and dielectric processing.

Current operational environments dictate that precision micromachining technology, which does not introduce residual thermal or mechanical stress in materials, e.g., circuit boards, semiconductor materials, fuel injectors, be developed and utilized to increase reliability in deployed tactical equipment/systems. Optical Line Replaceable Units (OLRUs) will minimize equipment/system volume, weight, cooling, and electrical requirements, in addition to increasing reliability. The potential for advanced electronics and semiconductor manufacturing improvements in accuracy and efficiency drives the urgency to deploy ultra short pulse laser micromachining into the entire Department of Defense (DoD) industrial base in support of ongoing operations.

This FY06 effort addressed a laser system designed that parts subject to failure were easily accessible and could be replaced in a simple and repeatable fashion by end users. These parts would be contained in sealed, Line Replaceable Units (LRUs). A military technician would then be able to replace failed LRUs on site with minimal time and support equipment. It would also be possible to develop internal monitors within the weapon system to verify successful LRU replacement without firing the High Energy Laser (HEL). The ability of the end user to service the laser has promise for vast savings in repair costs as well as time utilization for a single laser unit.

The introduction of LRUs radically changes the way future combat-ready HEL systems are designed. In particular, the Optical Line Replaceable Unit (O-LRU) effort may spawn new technologies and design strategies needed for the Advanced Tactical Laser (ATL) transition from an Advanced Concept Technology Demonstration (ACTD) to a robust, reliable, and field sustainable operational system.

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APPROPRIATION/BUDGET ACTIVITY

PROGRAM ELEMENT NUMBER AND NAME

PROJECT NUMBER AND NAME

**RDT&E, N / BA-4**

0603925N Directed Energy and Electric Weapon System

9999 - Congressional Plus Ups - Various

**B. Accomplishments/Planned Program (Cont.)**

<b>Electromagnetic Launcher (Rail Gun) 9183</b>	FY 06	FY 07	FY 08	FY 09
Accomplishments/Effort/Subtotal Cost	2.908	0.000	0.000	0.000
RDT&E Articles Quantity	N/A	N/A	N/A	N/A

Funding is provided to assess the shipboard impact and to demonstrate the feasibility of a kinetic energy electromagnetic rail gun. A rail gun accelerates projectiles to hypervelocity without the aid of propellant charges. It has the potential to provide the Navy with higher velocity warheads, reduced flight times, and increased range while eliminating the hazards of propellant charges and unexploded munitions.

An assessment of implementing an electromagnetic launcher as a future flight upgrade to the DD(X) destroyer will be conducted. This assessment would determine the ship electric power system and thermal management impacts, leveraging the existing Integrated Power System (IPS) architecture.

This effort develops prototype hardware that supports risk reduction of a potential shipboard implementation.

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**RDT&E, N / BA-4**

PROGRAM ELEMENT NUMBER AND NAME

0603925N Directed Energy and Electric Weapon System

PROJECT NUMBER AND NAME

9999 - Congressional Plus Ups - Various

**B. Accomplishments/Planned Program (Cont.)**

<b>Deploy Ultra-Short Pulse Laser Dev 9998</b>	FY 06	FY 07	FY 08	FY 09
Accomplishments/Effort/Subtotal Cost	0.000	2.491	0.000	0.000
RDT&E Articles Quantity	N/A	N/A	N/A	N/A

Joint Vision 2020 requires the assessment and demonstration of the complementary nature of High Energy Laser (HEL) Weapon Systems, coupled with missiles/guns for ship self-defense. This funding supports the accomplishment of the requisite engineering, design, assessment, test, and demonstration of a deployable Ultra-Short Pulse Laser.

Low to moderate power HEL systems offer the potential for complementing ship self-defensive weapon systems at tactically significant ranges. The ability to damage or disable electronic and optical components has been demonstrated. Critical to employment of this capability is the accomplishment of the system engineering and design, and the analysis of the resultant engagement effects. This effort is vital to the Navy's effort to develop and field a deployable laser that will meet near and mid term Navy requirements.

The current world threat environment mandates an urgency in providing the most up-to-date technology based solutions to counter littoral and asymmetric threats. Funds are required to engineer, design, test, and demonstrate weapon-grade laser capabilities that can be deployed in the near and mid term that will counter the requisite threats.

FY 07 funding will provide the system engineering, system design, and prototype development/demonstration of a deployable ultra-short pulse laser.

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**B. Accomplishments/Planned Program (Cont.)**

<b>Prototype Instr Sys for MUTC 9A01</b>	FY 06	FY 07	FY 08	FY 09
Accomplishments/Effort/Subtotal Cost	0.000	1.096	0.000	0.000
RDT&E Articles Quantity	N/A	N/A	N/A	N/A

FY 07 funding is provided to design and build a prototype capability for Multi-Service and Special Operations Forces to train in an urban environment. This project would meet the need for a computer enhanced urban training site that allows for live/virtual/constructive training to be integrated with advanced technology. The project will identify deficiencies in the existing infrastructure at Muscatatuck and identify the respective solutions that can be solved through a phased installation approach of equipment, instrumentation, wireless-connectivity, and enhanced computer capabilities. The site will then be able to provide the urban training environment necessary to all services.

The Joint Forces Command has established the need for sites that have the capability to conduct mission rehearsals, planning, and exercises within an urban environment. These sites need to provide a venue for joint intergovernmental, interagency, and special operations training. More specifically, training infrastructures need to be put in place that will allow today's armed forces to meet the need for Military Operations on Urban Terrain (MOUT) and the Military Utility Assessment Range (MUAR). This project will allow such capabilities to be put in place at the Muscatatuck Urban Training Center. Urban training comprises one of the most actively studied issues in the armed forces today, with a substantial amount of investment for range infrastructure being planned in the near to midterm to improve MOUT. This push towards urban training is based on the changing demographics in world population towards major urban centers vice rural areas. Current military operations show that it is increasingly likely that forces will engage in the midst of urban populations as opposed to the open field.

The current world threat situation mandates an urgency in providing the most up-to-date technology-based solutions. It is imperative that our forces train in similar environments to what they will actually face. The training strategy being developed by U.S. Forces focuses on progressively more complex training, beginning with individual and team training on an Urban Assault Course, more advanced training in a live-fire shoot house, and finally company, battalion, and brigade training in a Combined Arms Collective Training Facility. Crowd control and separation of antagonists from civilians is another area that requires specialized training and equipment. The Indiana National Guard is developing the Muscatatuck Urban Training Center to become a full-immersion contemporary urban operating environment for doctrinal training events that can be used as a MUAR for advanced technology.

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**RDT&E, N / BA-4**

0603925N Directed Energy and Electric Weapon System

9999 - Congressional Plus Ups - Various

**B. Accomplishments/Planned Program (Cont.)**

<b>Directed Energy Research 9A28</b>	FY 06	FY 07	FY 08	FY 09
Accomplishments/Effort/Subtotal Cost	0.000	19.426	0.000	0.000
RDT&E Articles Quantity	N/A	N/A	N/A	N/A

This funding will be utilized to accelerate development of Directed Energy and Electric Weapon Systems for the U.S. Navy. Funding will be used for advanced component and prototype development of the following technology areas associated with Directed Energy and Electric Weapon Systems research:

- Lethality/Vulnerability research, analysis, and engineering
- Electromagnetic Rail Gun Weapon System (EMRG WS) research and engineering
- Free Electron Laser (FEL) research and analysis
- High Energy Laser (HEL) research, engineering, analysis, and design.

Joint Vision 2020 highlights the emerging asymmetric threat facing the United States today and in the future. This includes conflict involving conventional weapons against traditional threats, it also includes those "ambiguous situations residing between peace and war, such as peacekeeping and peace enforcement operations, as well as noncombatant humanitarian relief operations and support to domestic authorities."

The current world threat situation mandates an urgency in providing the most up-to-date technology-based solutions to our war fighters. It is imperative that our forces maintain technical superiority. With the Navy's programmed introduction of ship integrated power systems, the foundation has been established for fielding shipboard directed energy and electric weapon systems. Laser systems provide for the speed of light engagements, with cost savings realized through the reduction or elimination of defensive missiles and guns/magazines required by current self protection missile and gun systems. Lasers also provide a force protection capability that has low collateral damage with graded lethality. The rail gun will provide the Navy with persistent fire power that will accelerate projectiles to hypervelocity without the aid of propellant charges to provide higher velocity warheads, reduced flight times, and increased range while eliminating the hazards of propellant charges and unexploded munitions.

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