OSD RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

Date: February 2007

APPROPRIATION/ BUDGET ACTIVITY	PE NUMBER AND TITLE
RDT&E/ Defense Wide BA# 2	**0602227D8Z - Medical Free Electron Laser**

Cost ($ in Millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Total Program Element (PE) Cost	19.558	15.813	0.000	0.000	0.000	0.000	0.000	0.000
P483 Medical Free Electron Laser	19.558	15.813	0.000	0.000	0.000	0.000	0.000	0.000

A. Mission Description and Budget Item Justification: (U) The Medical Free Electron Laser (MFEL) was terminated starting in FY 2008.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	19.725	10.255	10.567	10.334
Current BES/President's Budget (FY 2008/2009)	19.558	15.813	0.000	0.000
Total Adjustments	-0.167	5.558	-10.567	-10.334
Congressional Program Reductions		-0.092		
Congressional Rescissions				
Congressional Increases		5.650		
Reprogrammings	0.383			
SBIR/STTR Transfer	-0.550			
Other			-10.567	-10.334

C. Other Program Funding Summary: Not Applicable.

D. Acquisition Strategy: Not Applicable.

E. Performance Metrics: Not Applicable.

OSD RDT&E PROJECT JUSTIFICATION (R2a Exhibit)

Date: February 2007

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RDT&E/ Defense Wide BA# 2	**0602227D8Z - Medical Free Electron Laser**	**P483**

Cost ($ in Millions)		FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
P483	Medical Free Electron Laser	19.558	15.813	0.000	0.000	0.000	0.000	0.000	0.000

A. Mission Description and Project Justification: (U) The Medical Free Electron Laser program was terminated starting in FY 2008.

B. Accomplishments/Planned Program:

Accomplishment/Planned Program Title	FY 2006	FY 2007	FY 2008	FY 2009
Medical Free Electron Laser	19.558	15.813	0.000	0.000

FY 2006 Accomplishments: Thus far, more than 30 clinical procedures have been developed in several medical specialties, including ophthalmology, orthopedics, thermal and chemical burn treatment, and neurosurgery. Work in these areas will continue under the current three-year center grants, with the primary focus of the work remaining on the development of militarily relevant laser medicine applications.

Optical Coherence Tomography (OCT) applications have been developed for examining the structure of joint cartilage and are now being used for early diagnosis of degenerative disease and monitoring of surgical repair of orthopedic injuries. Endoscopic imaging using hand-held OCT probes has been shown to be capable of detecting minor changes in the epithelial cells of gastrointestinal, and respiratory tracts, and such devices have been used to obtain optical biopsies for early assessment of injuries to the trachea and respiratory tract due to smoke and other agents. Work on improving the resolution and speed of OCT imaging continues to be a significant thrust with axial resolutions of 3 um obtained. An ophthalmic OCT imaging system is in regular clinical use to monitor retinal morphology and pathologic changes. A greater than 100-fold increase in OCT imaging speed provides new opportunities to detect subtle changes in various tissues to improve the management of a range of injuries and to use OCT for a broad area of diagnostic purposes. Other technologies include Diffuse Optical Spectroscopy techniques that potentially can be used to non-invasively determine changes in hemodynamic parameters such as oxy/deoxy-hemoglobin ratios and tissue perfusion. Recent work has demonstrated the application of these techniques to the study of cortical depression and tissue perfusion in brain following blast and penetrating head injury. Optical diagnostic methods based on Raman scattering and terahertz spectroscopy continue to be studied to detect and rapidly characterize important biomolecules of interest. Analysis of tissue associated with Parkinson's disease has indicated a possible marker for quantitative measurement of disease progression. Optical methods using passive infrared imagers are also being used to recognize and evaluate clinical conditions, such as collapsed lung and hemorrhagic shock, in a forward casualty care setting.

A wide range of our studies have examined the interactions of laser energy with tissues, cells and biological macromolecules. Models for laser ablation have been developed and used to examine the course of the post-ablation healing process. Studies using the unique single micropulse capability of the Stanford continue, and are providing valuable information on the role of wavelength, pulse structure and pulse sequence in the ablation process on the molecular level. These studies have also demonstrated the nature and extent of collateral damage due to short term temperature effects, and improved healing of laser surgical methods compared to conventional bone cutting in cranial surgery. Work has recently begun on the use of osteogenic liposomes, which have been shown to induce new bone formation at sites of injury. The use of laser energy to draw the liposomes to the injury site and precisely trigger the osteogenic activity is being examined. Effective closure of various wounds and blood vessels has been accomplished using photochemical tissue bonding techniques.

A major upgrade in the components of the Duke University Free Electron Laser (FEL) system has been completed. It operates the first distributed optical klystron FEL, obtaining the highest FEL gain for a storage-ring based FEL and realized controlled switching of polarization by a nonoptical technique. The Duke FEL is unique in its capabilities at ultraviolet wavelengths. More than 5,000 hours of beam time was provided for the use of various scientists at the three FEL facilities combined.

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FY 2007 Plan: Plans for 2007 include continuing work on improving the contrast and depth of Optical Coherence Tomography (OCT) imaging with emphasis on its use in burn and respiratory tract injury, further development of new ultrasmall fiber optic endoscopy systems, new applications of Near Field Optical Microscopy, and other microscopy techniques. Continuing studies in neurological, reconstructive, and ophthalmic surgery applications of lasers, as well as continuing work on optimal laser parameters for dermal and hard tissue cutting and subsequent healing. Development of small, commercially feasible lasers with such optimal parameters will also be sought. Studies will continue on photochemical bonding of tissue, developing new photosensitizers and methods for their delivery, mechanisms for controlling various cellular activities, development of small, battery powered laser nerve stimulation package for forward clinical use, and the use of photodynamic therapy in treating infections of selected microorganisms. Studies on laser ablation and the subsequent healing processes will continue with a continuing focus on determining tissue viability at the wound site, as this is critical for effective wound management. Work on the application of laser-controlled osteogenic liposomes to accelerate musculoskeletal repair will also be a significant focus, and effective wound closure using photochemical tissue bonding will begin clinical trials. In addition, basic efforts are carried out using laser-based spectroscopy methods on the structure and nature of biologically important macromolecules such as proteins; on the dynamics of various surface-based processes; and on the nature, formation and deposition processes of complex thin films. Continued work on spectroscopic methods, surface-based processes, and the nature and formation of thin films are also planned for 2007. Continued efforts to improve performance and reliability at each of the sites, and to supply increased beam time for use by investigators in all of the disciplines noted above. Continuing effort, includes the development of new materials for waveguides through which the laser energy may be routed as well as refinements in the existing laser systems.

C. Other Program Funding Summary: Not Applicable.

D. Acquisition Strategy: Not Applicable.

E. Major Performers

Category	Name	Location	Type of Work and Description	Award Date
Labs				
	US Army Institute for Surgical Research	San Antonio, TX	Collaboration with university based centers on understanding military needs, on use of specialized animal models and human study facilities, and on arranging clinical studies and technology transfer. Collaboration areas include testing of program developed optical techniques for diagnosing and monitoring blood loss and oxygen carrying capability, brain injury, windpipe damage, burn diagnostics, and wound treatment.	01 MAR 2006
	Naval Medical Research Center	Bethesda, MD	Collaboration with university based centers on understanding military needs, on animal models and human studies, and on arranging clinical studies and technology transfer. Collaboration areas include infrared imaging for field deployable devices for multiple combat casualty care	01 AUG 2005

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			injury assessments by first responders.	
Universities				
	Massachusetts General Hospital	Boston, MA	Photodynamic therapy applied to wound disinfection and infectious disease (e.g., Leishmaniasis), photochemical bonding for nerve, blood vessel and other tissue repair, and advances and diagnostic applications of optical coherence tomography (OCT), endoscopic confocal microscopy, and various nonlinear optical techniques.	01 FEB 2004
	University of California	Irvine, CA	Diffuse optical spectroscopy applied to hemodynamics and brain trauma diagnostics and monitoring, OCT applied to windpipe damage assessment from smoke or chemical insult, burn diagnostics, and surgery for orthopedic and facial injuries. Many studies performed in collaboration with Army Institute for Surgical Research.	15 FEB 2004
	Vanderbilt University	Nashville, TN	Laboratory and clinical studies of wavelength and pulse duration effects of efficiency and collateral damage in laser surgery, diagnostic and therapeutic studies of MFELP breakthroughs in optical nerve stimulation, in technique for analyzing macromolecules as markers for health and disease, and in narrow spectral width x-rays.	01 FEB 2004
	Stanford University	Stanford, CA	Development of luminous human, animal and bacterial cells, development and clinical application of laser and other surgical instrumentation, including breakthrough pulsed electron avalanche knife, studies of wound healing using novel luminescent cells and delivery of wound healing factors techniques, and collaboration with Vanderbilt and Duke on pulsed laser surgery studies.	01 FEB 2004
	Duke University	Durham, NC	Studies of portable infrared imaging devices for medics and forward deployed surgical teams to quickly diagnose injury (e.g. pneumothorax, hemothorax, and compartment syndrome), studies of mechanisms and laser therapy for trauma induced brain seizures, development of small infrared lasers replicating the wavelength and pulse properties for surgical procedures, and operation of facilities based on the unique ultraviolet output of a storage ring free electron laser.	01 FEB 2004