

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2000
--	------------------------------

BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY
--	--

COST (\$ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	0	0	32,337	32,017	36,279	36,236	36,544	Continuing	TBD
624866 Lasers & Imaging Technology	0	0	16,018	14,953	18,847	19,207	19,098	Continuing	TBD
624867 Advanced Weapons & Survivability Technology	0	0	16,319	17,064	17,432	17,029	17,446	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: Starting in FY 2001, the two projects in this PE were moved in toto from PE 0602601F.

(U) **A. Mission Description**

This is the Applied Research program for directed energy technologies for the Air Force Research Laboratory. In lasers, this PE examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. Technologies researched include high power solid-state and chemical laser devices, optical components, advanced beam control and atmospheric compensation technologies, techniques for laser target vulnerability assessments, and nonlinear optics processes and techniques. In advanced weapons, this PE examines high power microwave and other unconventional weapon concepts using innovative technologies such as compact toroids. This also provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets.

(U) **B. Budget Activity Justification**

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) **C. Program Change Summary (\$ in Thousands)**

	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total Cost</u>
(U) Previous President's Budget (FY 2000 PBR)	0	0	0	
(U) Appropriated Value	0	0		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions				
b. Small Business Innovative Research				

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE February 2000

BUDGET ACTIVITY

02 - Applied Research

PE NUMBER AND TITLE

0602605F DIRECTED ENERGY TECHNOLOGY

(U) C. Program Change Summary (\$ in Thousands) Continued

	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total Cost</u>
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogram				
e. Rescissions				
f. Other				
(U) Adjustments to Budget Years Since FY 2000 PBR			32,337	
(U) Current Budget Submit/FY 2001 PBR	0	0	32,337	TBD
(U) <u>Significant Program Changes:</u> Not Applicable.				

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 2000			
BUDGET ACTIVITY 02 - Applied Research				PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY				PROJECT 624866			
COST (\$ in Thousands)		FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
624866	Lasers & Imaging Technology	0	0	16,018	14,953	18,847	19,207	19,098	Continuing	TBD	
<p>(U) <u>A. Mission Description</u> This project examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. High power solid state and chemical laser devices, optical components, advanced beam control and atmospheric compensation technologies, laser target vulnerability assessment techniques, and nonlinear optical processes and techniques are developed. Advanced, short-wavelength laser devices for application as illuminators and imaging sources as well as advanced optical imagers for target identification and assessment are developed. Laser technologies are studied for their utility in aimpoint selection, target maintenance, and damage assessment.</p> <p>(U) <u>FY 1999 (\$ in Thousands)</u> (U) \$0 This work was performed in PE 0602601F/Project 623326. The funding was \$15.614 million. (U) \$0 Total</p> <p>(U) <u>FY 2000 (\$ in Thousands)</u> (U) \$0 This work is performed in PE 0602601F/Project 623326. The funding is \$19.039 million. (U) \$0 Total</p> <p>(U) <u>FY 2001 (\$ in Thousands)</u> (U) \$1,925 Develop long-range optical technologies for increased resolution, characterization, and data fusion applications. Lightweight membrane mirrors issues for scaling to very large size (~ 10-meter mirrors) will be explored. Issues associated with producing the mirror close to final curvature will be addressed and demonstrated on 0.5 meter class mirror with holographic correction. (U) \$645 Develop and field test nonlinear optics technologies to support beam projection and imaging applications associated with large aperture lightweight optics. The nonlinear optics components that provide optical compensation for beam projection and imaging technology will be scaled up in size and integrated into laboratory/field tests and demonstrations. Additional improvements and techniques to extend the wavelength regime and reduce the number of such components will be pursued. (U) \$2,951 Develop high power chemical and all gas iodine laser technologies for applications such as directed energy weapons, illuminators, and wavelength specific applications. Perform engineering validation of advanced chemical oxygen iodine laser nozzle concepts which include iodine atom production techniques and integrated ejector nozzle concepts. Demonstrate a one-kilowatt all gas phase supersonic iodine laser. Perform validation testing of advanced nozzle concepts for potential application to airborne lasers. (U) \$3,521 Develop laser source, beam control, and target coupling technologies to counter current and next generation air-to-air and surface-to-air missile</p>											
Project 624866				Page 3 of 6 Pages				Exhibit R-2A (PE 0602605F)			

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
02 - Applied Research	0602605F DIRECTED ENERGY TECHNOLOGY	624866
(U) <u>A. Mission Description Continued</u>		
(U) <u>FY 2001 (\$ in Thousands) Continued</u>		
	threats to aircraft platforms. Develop an electrically pumped mid-infrared solid state laser operating at room temperature, eliminating the optical pump source and cryogenic cooler for mid-infrared lasers. Investigate novel materials effects associated with plasma/spark and ultra-fast lasers for countering focal plane array seekers. Obtain a high fidelity surrogate seeker for laboratory testing of effects. Develop a moderate power ultra-fast laser source for investigations of novel atmospheric propagation characteristics.	
(U) \$6,976	Develop low-cost, scalable, high power solid state laser architectures by integrating doped fiber lasers with diode-laser pump sources for directed energy applications such as unmanned aerial vehicle designators/imagers and next generation weapons applications such as space-based lasers and airborne lasers. Develop promising fiber laser technologies exhibiting attributes that will enable applications that require laser mobility such as low-cost, high efficiency (approaching 30%), compactness (30 milliwatts per cubic centimeter), and scalability. Develop integration technologies necessary for demonstration of power at one kilowatt.	
(U) \$16,018	Total	
(U) <u>B. Project Change Summary</u>		
	Not Applicable.	
(U) <u>C. Other Program Funding Summary (\$ in Thousands)</u>		
(U) Related Activities:		
(U) PE 0603319F, Airborne Laser Demonstrator.		
(U) PE 0603444F, Maui Space Surveillance System.		
(U) PE 0603605F, Advanced Weapons Technology.		
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.		
(U) <u>D. Acquisition Strategy</u>		
	Not Applicable.	
(U) <u>E. Schedule Profile</u>		
(U) Not Applicable.		
Project 624866	Page 4 of 6 Pages	Exhibit R-2A (PE 0602605F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 2000			
BUDGET ACTIVITY 02 - Applied Research				PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY				PROJECT 624867			
COST (\$ in Thousands)		FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
624867	Advanced Weapons & Survivability Technology	0	0	16,319	17,064	17,432	17,029	17,446	Continuing	TBD	
<p>(U) <u>A. Mission Description</u> High power microwave (HPM) and other unconventional weapon concepts using innovative technologies are explored in this project. Technologies that support a wide range of Air Force missions such as suppression of enemy air defenses, command and control warfare, and vehicle self-protection are developed. This project provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets. In addition to directed energy weapon threats, this project conducts assessments of specific space environmental (natural and man-made) effects on space systems and develops hardening technologies and methodologies.</p> <p>(U) <u>FY 1999 (\$ in Thousands)</u> (U) \$0 This work was performed in PE 0602601F/Project 625797. The funding was \$14.730 million. (U) \$0 Total</p> <p>(U) <u>FY 2000 (\$ in Thousands)</u> (U) \$0 This work is performed in PE 0602601F/Project 625797. The funding is \$18.632 million. (U) \$0 Total</p> <p>(U) <u>FY 2001 (\$ in Thousands)</u> (U) \$3,074 Investigate technologies for developing multi-pulsed HPM components to support multiple Air Force applications as recommended by Phase II Directed Energy Applications in Tactical Airborne Combat (DE ATAC) Study. Investigate better modeling techniques in order to incorporate HPM technologies into warfighting/war gaming activities. (U) \$1,868 Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems. Formulate susceptibility criteria for DE ATAC Phase II concepts. Conduct susceptibility tests on representative command and control warfare targets. (U) \$2,000 Develop wideband HPM technologies that will support command and control warfare applications. Research advanced antenna designs driven by command and control warfare concept studies. Continue to improve the electrical efficiency of HPM sources in order to achieve greater range or smaller packaging. Validate computer codes' ability to predict the electromagnetic coupling to command and control target equipment within complex structures. Begin development of codes to predict probability of effect on target equipment based on coupling to the target. (U) \$2,899 Develop narrowband HPM technologies that will support suppression of enemy air defenses. Expand range of predictability of HPM effects models for military electronic targets of interest. Validate predictability of models. Complete development of component technologies - prime power, pulsed power, sources, and antennas - for repetitively pulsed systems.</p>											
Project 624867				Page 5 of 6 Pages				Exhibit R-2A (PE 0602605F)			

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
02 - Applied Research	0602605F DIRECTED ENERGY TECHNOLOGY	624867
(U) <u>A. Mission Description Continued</u>		
(U) <u>FY 2001 (\$ in Thousands) Continued</u>		
(U) \$3,716	Investigate high power microwave (HPM) technologies that will support offensive and defensive advanced airborne tactical applications made possible based on increased power available on future aircraft. Design optimal sources for the most promising concepts identified by the trade off study. Perform HPM effects experiments upon targets of interest to determine effectual lethality of each concept.	
(U) \$1,956	Continue to assess the vulnerability of U.S., NATO, and foreign satellites to the effects of directed energy weapons, primarily high energy lasers and high power microwaves. Previous assessments will be updated, as required, based on new intelligence information. Other directed energy effects will be included as appropriate.	
(U) \$806	Continue investigation of best means for Active Denial Technologies to support Agile Combat Support applications. Continue development of millimeter-wave sources for Active Denial Technology - conduct experiments including beam transport and power extraction. Investigate HPM source enhancement technologies using computer simulations.	
(U) \$16,319	Total	
(U) <u>B. Project Change Summary</u>		
	Not Applicable.	
(U) <u>C. Other Program Funding Summary (\$ in Thousands)</u>		
(U) Related Activities:		
(U) PE 0602202F, Human Systems Technology.		
(U) PE 0603605F, Advanced Weapons Technology.		
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.		
(U) <u>D. Acquisition Strategy</u>		
	Not Applicable.	
(U) <u>E. Schedule Profile</u>		
(U) Not Applicable.		