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

DATE: June 2001

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

	COST ($ in Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	52,336	42,973	43,758	37,744	41,961	45,744	46,705	47,692	Continuing	TBD
3150	Advanced Optics Technology	18,248	15,244	764	782	4,285	5,159	5,267	5,378	Continuing	TBD
3151	High Power Solid State Laser Technology	6,835	3,817	5,993	8,545	9,800	10,182	10,396	10,616	Continuing	TBD
3152	High Power Microwave Technology	6,385	8,578	12,343	9,998	8,752	8,935	9,122	9,315	Continuing	TBD
3647	High Energy Laser Technology	20,868	15,334	24,658	18,419	19,124	21,468	21,920	22,383	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: FY 2003 - FY 2007 budget numbers do not reflect the DoD strategy review results.

(U) A. Mission Description

This PE provides for the development and demonstration of advanced directed energy and optical concepts. In advanced optics, very long range imaging and space optics technologies are demonstrated. In solid state lasers, compact, reliable, relatively high power, cost-effective single devices and arrays of devices are demonstrated. In high power microwave, technologies such as narrow and wideband devices and antennas are demonstrated. In high energy lasers, technologies such as high power chemical lasers and beam control technologies are demonstrated. Note: Congress added $7 million for Field Laser Radar upgrades, $8 million for High Resolution Space Object Imaging (also known as GLINT), and $3 million for LaserSpark Missile Countermeasures in FY 2001.

(U) B. Budget Activity Justification

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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

		FY 2000	FY 2001	FY 2002	Total Cost
(U)	Previous President's Budget (FY 2001 PBR)	56,805	33,371	33,904	
(U)	Appropriated Value	57,495	43,371		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions				
	b. Small Business Innovative Research	-1,355			
	c. Omnibus or Other Above Threshold Reprogram	-1,390			
	d. Below Threshold Reprogram	-1,811			
	e. Rescissions	-603	-398		
(U)	Adjustments to Budget Years Since FY 2001 PBR			9,854	
(U)	Current Budget Submit/FY 2002 PBR	52,336	42,973	43,758	TBD

(U) Significant Program Changes:

Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

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

DATE: June 2001

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3150

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3150	Advanced Optics Technology	18,248	15,244	764	782	4,285	5,159	5,267	5,378	Continuing	TBD

(U) A. Mission Description

This project develops advanced optical technologies for locating, identifying, and analyzing distant and/or dim objects. This work supports high energy laser applications in target verification, accurate and sustainable laser beam placement on target, and near-real-time damage assessment. Several advanced technologies including nonlinear optics (NLO), adaptive optics, and specialized optical processing are being developed. The goal is high quality optical image reconstruction, concentrating on removing turbulent atmosphere-induced distortions. Many of the technologies developed/being developed have significant application to astronomy research.

(U) FY 2000 ($ in Thousands)

(U) $360 Continued to develop NLO technologies for non-mechanical beam correction in laser beam projection and optical imaging. Investigated the use of a single NLO device to optically correct the aberrations of a one-meter diameter class bifocal relay mirror breadboard system. Tested the laboratory relay mirror breadboard system at operationally significant laser wavelengths for non-mechanical beam steering.

(U) $205 Continued to investigate advanced optical concepts necessary to deploy and use very large (10-meter diameter and larger) space-based optical mirrors for imaging, laser beam projection, and laser beam relay missions. Investigated and developed the materials and techniques for instilling mirror shape and curvature memory into thin membrane mirrors for space orbit deployment. Space mirrors must have and keep a predetermined shape and curvature. Pressure canopies causing optical distortions of space optical systems can, therefore, be eliminated.

(U) $296 Continued to investigate novel signature techniques for assessing the operational status of satellites out to geosynchronous earth orbit (GEO) to support space situational awareness. Continued the evaluation of techniques for identifying classes of satellites at GEO range. Transitioned successful identification techniques to the Air Force Space Command for operational use. Investigated new techniques for individual satellite identification and for health status assessments.

(U) $11,591 Continued to develop technologies for active imaging of geosynchronous space objects. Completed design, verified through simulation design parameters, and bought initial hardware for receiver for the Geo Light Imaging National Testbed at White Sands Missile Range, NM.

(U) $5,796 Continued upgrades to the Field Laser Demonstrator for increased sensitivity to obtain very accurate data on space objects and to evaluate techniques for remote sensing of the atmosphere. Continued to install a laser radar system on the Advanced Electro Optical System telescope on Maui, HI. Performed experiments for space applications such as high accuracy orbital measurements, imaging for target identification, and satellite status assessment.

(U) $18,248 Total

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BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
PROJECT 3150	

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands)

(U)	$197	Develop nonlinear optics technologies for non-mechanical beam correction in laser beam projection and optical imaging. Demonstrate with a breadboard, applications such as target designation and remote sensing in a controlled environment. Pursue the development of these technologies in a scalable manner for beam projection using an orbiting platform with nonlinear optics correction techniques.
(U)	$184	Investigate advanced concepts to deploy and use very large (greater than 10-meter diameter) space-based mirrors for applications such as imaging, laser beam projection, and laser beam relay. Continue to pursue component development of nonlinear optics materials and devices that can be scaled to much larger sizes with the required speed, resolution, and power handling capability for space relay mirror applications.
(U)	$7,927	Continue to develop technologies for active imaging of geosynchronous space objects. Continue development and integration of initial hardware for the Geo Light Imaging National Testbed at White Sands Missile Range, NM.
(U)	$6,936	Continue upgrades to the Field Laser Demonstrator for increased sensitivity to obtain very accurate data on space objects and to evaluate techniques for remote sensing of the atmosphere. Continue to install a laser radar system on the Advanced Electro Optical System telescope on Maui, HI. Perform experiments for space applications such as high accuracy orbital measurements, imaging for target identification, and satellite status assessment. Investigate laser imaging of ground targets from unmanned air vehicles or satellites for standoff intelligence detection.
(U)	$15,244	Total

(U) FY 2002 ($ in Thousands)

(U)	$552	Develop nonlinear optics technologies for non-mechanical beam correction in laser beam projection and optical imaging. Design and develop brassboard laser beam control system utilizing nonlinear optics technology for space relay mirror applications. This will use advanced optical concepts appropriate for a bifocal relay mirror concept.
(U)	$212	Investigate advanced concepts to deploy and use very large space-based optical mirrors that support missions such as imaging and laser beam projection and laser beam relay. Integrate advanced optical technology for laser beam steering and aberration correction into a one meter (or larger) diameter class lightweight, deployable mirror and field test the resulting optical system.
(U)	$764	Total

(U) B. Project Change Summary

Not Applicable.

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PROJECT: 3150	

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

(U) Related Activities:

(U) PE 0603444F, Maui Space Surveillance Systems.

(U) PE 0602102F, Materials.

(U) PE 0602605F, Directed Energy Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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

DATE: June 2001

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3151

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3151	High Power Solid State Laser Technology	6,835	3,817	5,993	8,545	9,800	10,182	10,396	10,616	Continuing	TBD

(U) A. Mission Description

This project continues to yield revolutionary breakthroughs in compact, robust, and affordable laser system technology for a wide range of military applications requiring small compact laser sources. This is a long-term technology development project with both near-term and long-term goals. Near-term goals include developing compact, reliable infrared sources that can be used for a range of applications including night vision systems, landing zone markers, remote sensing, and covert communication systems. Longer-term goals focus on producing compact, significantly higher power sources that could be applied to military applications including aircraft self-protection. This project leads the development of, and builds upon, a wide range of commercial advancements. Commercially available solid state lasers are widely used due to their low-cost, small size and weight, high reliability, and high efficiency in converting electricity to laser energy. This project preserves these attractive features while continually scaling output to higher powers and efficiencies and to military application-specific wavelengths. This project is divided into two technology areas. The first area investigates methods to develop low-cost, scalable, high power solid state lasers. This effort builds upon a strong industrial technology base. Secondly, wavelength specific solid state lasers for military applications such as infrared countermeasures are developed.

(U) FY 2000 ($ in Thousands)

(U) $3,695 Continued to 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. Demonstrated high electrical efficiency (approximately 20%), compact packaging, and high power density (10 milliwatts per cubic centimeter) to enable applications requiring laser mobility. Demonstrated a 100 watt, packaged fiber laser.

(U) $2,780 Continued to develop and demonstrate laser source and beam control technologies needed to counter current and next generation air-to-air and surface-to-air missile threats. Demonstrated and delivered to an Army-Air Force program, a one cubic foot system with reliable and scalable, two watt average power solid state lasers in bands II and IV, for current generation threats to aircraft platforms.

(U) $360 Continued to develop and demonstrate novel target coupling technologies needed to counter current and next generation air-to-air and surface-to-air missile threats. Demonstrated ultra-fast laser beam control and target coupling effects for countering focal plane array seekers.

(U) $6,835 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: June 2001
BUDGET ACTIVITY: 03 - Advanced Technology Development	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology	PROJECT: 3151

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands)

(U)	$1,982	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 and airborne lasers. Demonstrate a fiber laser module at several hundreds of watts of power.
(U)	$1,142	Develop and demonstrate laser source and beam control technologies needed to counter current and next generation air-to-air and surface-to-air missile threats. Continue development of a reliable four micron wavelength solid state laser, with a goal of achieving five watts average power, for countering current generation threats to aircraft platforms.
(U)	$693	Develop and demonstrate novel target coupling technologies needed to counter current and next generation air-to-air and surface-to-air missile threats. Demonstrate novel device structures and incoherent beam combining techniques for improving beam quality, required for fast jet aircraft and large aircraft self-protection.
(U)	$3,817	Total

(U) FY 2002 ($ in Thousands)

(U)	$2,112	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 and airborne lasers. Demonstrate high electrical efficiency (approaching 30%) and compact packaging, exhibiting high power density (approaching one kilowatt per cubic foot) to enable applications requiring laser mobility. Demonstrate one kilowatt, packaged brassboard fiber laser module showcasing the building block technology of future directed energy, megawatt-class electric lasers. Demonstrate wavelength-versatile integrated laser/nonlinear optics at five watt power levels.
(U)	$2,835	Develop and demonstrate laser source and beam control technologies needed to counter current and next generation air-to-air and surface-to-air missile threats. Demonstrate a multi-wavelength source (two and four microns) with sufficient brightness for countering current generation threats to aircraft platforms. Demonstrate sources in the 8-12 micron range for missile threat detection and remote sensing applications.
(U)	$1,046	Develop and demonstrate novel target coupling technologies needed to counter current and next generation air-to-air and surface-to-air missile threats. Demonstrate a multi-wavelength laser source with high beam quality based on novel device structures and incoherent beam combining techniques developed in FY 2001.
(U)	$5,993	Total

(U) B. Project Change Summary

Not Applicable.

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PROJECT 3151	

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

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0603270F, Electronic Combat Technology.

(U) PE 0602605F, Directed Energy Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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DATE: June 2001

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

PROJECT: 3152

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3152	High Power Microwave Technology	6,385	8,578	12,343	9,998	8,752	8,935	9,122	9,315	Continuing	TBD

(U) A. Mission Description

This project develops high power microwave (HPM) generation technologies. It also develops a susceptibility/vulnerability/lethality data base to identify potential vulnerabilities of U.S. systems to HPM threats and to provide a basis for future offensive and defensive weapons system decisions. Representative U.S. and foreign assets are tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) technologies are being developed. This project will demonstrate the applicability of HPM technologies that can deny/degrade/damage/destroy electronic systems and subsystems for missions such as suppression of enemy air defense, command and control warfare, and aircraft self-protection.

(U) FY 2000 ($ in Thousands)

(U) $3,327 Continued to develop and demonstrate HPM technologies to degrade and/or destroy the electronic elements of an adversary's Integrated Air Defense System. Investigated and began development of models to quantify the effectiveness of a narrowband repetitively pulsed system against electronic targets of interest applicable to munitions or airborne platforms, and continued integration of pulse power and radio frequency source components for an integrated critical experiment with single shot technologies. Initiated a full power laboratory breadboard experiment to validate repetitively pulsed high power microwave weapon concepts.

(U) $2,358 Continued to develop and demonstrate wideband HPM technologies to disrupt and degrade an adversary's command and control and infrastructure. Conducted initial wideband field experiments with brassboard devices to demonstrate command and control warfare effectiveness. Conducted effects experiments to better define optimal source parameters for command control warfare applications. Evaluated technical capabilities of current HPM source concepts through field experiments. Conducted laboratory experiments to demonstrate brassboard compact devices critical to development of air-delivered submunitions. Developed an initial air-delivered HPM submunition payload design. Demonstrated technologies for potential transition. Applied computer codes to predict coupling to targets and validate their accuracy. Conducted validation of computer models developed under applied research funds.

(U) $700 Continued to develop and evaluate active denial technologies for non-lethal weapons applications. Began the development of beam transportation in a high specific power, non-lethal directed energy source technology for man-portable applications. Demonstrated subsystem-level vehicle-mounted non-lethal directed energy weapons technology.

(U) $6,385 Total

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands)

(U)	$3,653	Develop and demonstrate high power microwave (HPM) technologies to render inoperative electronic components of an adversary's Integrated Air Defense System. Demonstrate and quantify the effectiveness of a repetitively pulsed system against electronic targets of interest. Conduct a full power breadboard demonstration to validate repetitively pulsed capability application development.
(U)	$3,205	Develop and demonstrate HPM technologies to render inoperative command and control components of an adversary. Conduct field experiments with brassboard devices to demonstrate command and control warfare effectiveness. Conduct ground-based, field experiments demonstrating effectiveness of air-delivered HPM sub-munition. Transition selected technologies. Apply computer codes to predict coupling to targets and validate their accuracy.
(U)	$1,220	Develop, demonstrate, and evaluate active denial technology for multiple mission applications including future peacekeeping assignments. Complete demonstrations of vehicle-mounted non-lethal directed energy weapons technology. Start hardware development for ancillary subsystems for man-portable applications.
(U)	$500	Develop active denial technologies for airborne platform applications as recommended by Phase I of the Directed Energy Applications in Tactical Airborne Combat study. Analyze critical technologies for airborne active denial, including beam control, source efficiency, antenna gain, and aircraft integration.
(U)	$8,578	Total

(U) FY 2002 ($ in Thousands)

(U)	$3,720	Develop and demonstrate narrowband HPM technologies to damage or destroy an adversary’s electronic systems. Demonstrate pulsed power and narrowband HPM source capability applicable to munitions and airborne concepts. Continue to investigate and develop models to quantify the effectiveness of a narrowband repetitively pulsed system against electronic targets of interest applicable to munitions or airborne platforms. Select repetitively pulsed HPM technology for multi-gigawatt application development. Evaluate narrowband technologies to address aircraft protection against surface to air missiles.
(U)	$3,500	Develop and demonstrate wideband HPM technologies to disrupt, degrade, damage, or destroy an adversary’s command and control and infrastructure. Develop integrated compact source design(s) based on effects data and technology advances for improved effectiveness in HPM munitions and airborne electronic attack missions. Continue effects experimentation on an expanded set of targets to refine optimal source parameters, expand target set, and support susceptibility predictions. Begin building probability of effect database using experimental data from several programs. Transition selected technologies. Continue to refine modeling and simulation codes to more accurately predict wideband HPM coupling in realistic scenarios. Complete probability of effect models for engagement models.
(U)	$2,123	Develop and evaluate active denial technologies for non-lethal weapons applications including man-portable applications. Continue analysis of

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PROJECT 3152	

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

critical technologies for airborne active denial. Begin fabrication of critical subsystems (antenna, prime power, power conditioning, and other) for integrated man-portable system for Active Denial Applications.

(U) $3,000 Develop the means to integrate high power microwave (HPM) devices onto unmanned aerial platforms, such as an unmanned combat air vehicle (UCAV). Perform integration, thermal control, and target studies for such concepts. Investigate the feasibility of using ultra-wideband HPM to geolocate and identify targets of interest, and perform battle damage assessment. Perform lethality assessments of HPM on targets of interest to gauge the military utility and effectiveness of the integrated HPM and UCAV concept.

(U) $12,343 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602202F, Human Systems Technology.

(U) PE 0602605F, Directed Energy Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: June 2001
BUDGET ACTIVITY: 03 - Advanced Technology Development	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology	PROJECT: 3647

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
3647	High Energy Laser Technology	20,868	15,334	24,658	18,419	19,124	21,468	21,920	22,383	Continuing	TBD

(U) A. Mission Description

This project provides for the development, demonstration, and detailed assessment of technology needed for high energy laser weapons. Near-term focus is on ground-based and airborne high energy laser missions, although the technology developed for this project is directly applicable to most high energy laser applications. Critical technologies developed and demonstrated include advanced high energy laser devices and laser beam control to efficiently compensate and propagate laser radiation through the atmosphere to a target. Correcting the laser beam for distortions induced by propagation through the turbulent atmosphere is the key technology in most high energy laser applications. The beam control technology developed in this project has a significant benefit to the astronomy community. Detailed computational models to establish high energy laser weapon effectiveness and satellite and missile vulnerability are developed.

(U) FY 2000 ($ in Thousands)

(U) $473 Continued to develop and demonstrate the technology for scalable, high efficiency, high energy laser devices for potential weapon applications. Completed assessment of an efficient, wavelength-shifted chemical oxygen-iodine laser (COIL) device, for application as a moderate- to high-power illuminator laser. Using computer models, evaluated candidate advanced COIL concepts to identify promising approaches for significant improvements.

(U) $894 Continued to perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats. Re-defined the counterspace system-level lethality criterion for high energy lasers, based on the evaluation of data from individual satellite vulnerability assessments. Transitioned to the Space Warfare Center an improved tool for the analysis of high resolution optical images for space surveillance. Completed studies to evaluate capabilities for data fusion between optical imagery and radar data from space surveillance.

(U) $190 Continued to investigate and develop advanced, high energy laser optical components for future weapon systems. Continued the investigation of high performance optical coatings (ultra-low absorption, low scatter) to enable uncooled high energy laser optical components, with emphasis on low-stress designs applicable to lightweight mirror and window substrates.

(U) $8,363 Continued to perform atmospheric compensation/beam control experiments from large aperture ground-based platforms to support applications ranging from weaponization to space object identification. Characterized and optimized the performance of the advanced adaptive optics system on the 3.5 meter telescope at the Starfire Optical Range (SOR) in compensating for the optical distortions induced by atmospheric turbulence. Conducted satellite illumination experiments on a range of unaugmented space objects to evaluate and anchor detailed computer models. Demonstrated active (daylight) tracking of selected space objects at low bandwidth. Began investigation of advanced adaptive optics concepts

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

with the potential to improve compensation performance at lower elevation angles. Continued the development of a 50-watt sodium-wavelength laser, for use as the high-altitude beacon for high-performance, full-aperture compensation of the Starfire Optical Range (SOR) 3.5 meter telescope.

(U) $8,523 Continued to develop and evaluate beam control/compensation techniques for atmospheric attenuation and distortion on laser beam propagation from airborne platforms for applications such as theater missile defense. Continued evaluation of advanced concepts for active tracking and atmospheric compensation under propagation conditions representative of typical airborne laser engagement scenarios. Then conducted laboratory experiments under precisely controlled conditions to evaluate and optimize performance under realistic turbulence conditions. Conducted realistic extended-beacon tracking and atmospheric compensation experiments against an instrumented target board on the side of an aircraft, under propagation conditions scaled to represent those expected in airborne laser engagement scenarios.

(U) $2,425 Continued to investigate the LaserSpark missile countermeasure technology. Examined the infrared countermeasures effectiveness of the multiple internal laser effects (MILE) associated with plasma/sparks. Performed laboratory testing of MILE on advanced focal plane array seeker mockups using properly formatted laboratory lasers. Completed effectiveness studies on seekers in operational scenarios. Performed initial design planning and coordination for a limited field demonstration of aimpoint control and countermeasure effectiveness on in-flight seekers.

(U) $20,868 Total

(U) FY 2001 ($ in Thousands)

(U) $664 Perform vulnerability assessments on potential high energy laser targets to provide critical design data for laser systems to defeat these targets. Review/develop the system-level deny/disrupt/damage/destroy criteria for counterspace high energy laser systems, based on new data from satellite vulnerability assessments. Transition an improved tool for the analysis of high-resolution optical images to the National Air Intelligence Center.

(U) $6,049 Perform atmospheric compensation/beam control experiments from ground-based platforms to support applications including antisatellite weapons, satellite tests and diagnostics, and high-resolution satellite imaging. Complete characterization of return signals from laser illuminated satellites to design system for active (laser-illuminated) tracking of unaugmented low earth orbit satellites. Analyze data from previous satellite imaging and tracking experiments for design of 24-hour laser beam control system. Begin design of target-loop atmospheric compensation for laser projection to satellites on weapons-class beam director (3.5-meter telescope). Model and analyze long-path atmospheric effects for design of multiconjugate adaptive optics for low-elevation compensation of lasers and imaging.

(U) $5,649 Develop and evaluate beam control/compensation techniques for atmospheric attenuation and distortion on laser beam propagation from airborne platforms for applications such as theater missile defense. Continue computer simulation of additional advanced concepts for active tracking and

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

atmospheric compensation using adaptive optics under propagation conditions representative of typical airborne laser engagement scenarios. Conduct advanced active tracking and adaptive optics experiments using representative turbulence phase screens. Perform passive tracking demonstrations, anisoplanatism studies, and common-path/common-mode studies. Develop and integrate hardware for future static and dynamic active tracking and atmospheric compensation demonstrations using advanced concepts under propagation conditions scaled to represent those expected in airborne laser engagement scenarios.

(U) $2,972 Continue to investigate the LaserSpark missile countermeasure technology. Develop and demonstrate the infrared countermeasures effectiveness of the multiple internal laser effects (MILE) associated with plasma/sparks. Continue laboratory testing of MILE on advanced focal plane array seeker mockups using properly formatted laboratory lasers. Develop flyout simulations of MILE on conical scan and focal plane array seekers. Continue design planning and coordination for a limited field demonstration of aimpoint control and countermeasure effectiveness on in-flight seekers.

(U) $15,334 Total

(U) FY 2002 ($ in Thousands)

(U) $509 Perform vulnerability assessments on potential high energy laser targets to provide critical design data for laser systems to defeat these targets. Provide data from sure-safe analysis to Air Force Space Command, for setting standards for laser illumination of space objects. Improve the data fusion of optical and radar measurements of space objects.

(U) $9,664 Perform atmospheric compensation/beam control experiments from the Starfire Optical Range 3.5-meter telescope for applications including antisatellite weapons, satellite tests and diagnostics, and high-resolution satellite imaging. Complete sodium-wavelength laser to be used as mesospheric beacon for full compensation of large aperture telescopes. Demonstrate low-bandwidth active tracking of uncooperative satellites in the earth's shadow. Perform compensated laser propagation to satellite targets; use detailed measurements of energy and beam profile on target to characterize anisoplanatic effects and validate propagation models. Design and begin integration of integrated laser beam control system using active tracking and target return loop adaptive optics. Begin fabrication of scoring laser and sensors for integrated beam control demonstration. Begin design of Rayleigh beacon point-ahead atmospheric compensation system for laser projection to satellites on weapons-class beam director (3.5-meter telescope). Design multiconjugate adaptive optics system for low-elevation compensation of lasers and imaging.

(U) $12,372 Develop and evaluate beam control/compensation techniques for atmospheric attenuation and distortion on laser beam propagation from airborne platforms for applications such as theater missile defense. Simulate advanced optical and beam control concepts for active tracking and atmospheric beam and image correction under conditions representative of those of airborne lasers. Perform advanced compensated beacon experiments. Conduct field demonstrations in support of advanced beam control concepts to increase energy on target by a factor of two in

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

moderate turbulent atmospheres and up to factors of four in strong turbulent atmospheres. Demonstrate advanced static and dynamic active tracking and atmospheric compensation methods under propagation conditions scaled to represent those expected in airborne laser engagements. Execute field tests of the shearing interferometer versus the Hartmann wavefront sensor. Update wave-optics computer simulations based on field test results to more effectively evaluate and improve subsequent advanced concepts.

(U) $2,113 Develop and demonstrate the technology for scalable, high energy laser devices with improved efficiency, for insertion in airborne lasers and other potential weapon applications. Evaluate and optimize multiple high pressure ejector nozzles performance using modeling and simulation and laboratory nozzle test stand. Investigate low flow rate basic hydrogen peroxide and zero-gravity generator concepts and complete the design of the most promising concept for fabrication and bench testing. Explore iodine injection and iodine generation methods and select the most promising for insertion into advanced chemical oxygen iodine test sequence utilizing a laboratory test stand.

(U) $24,658 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0602605F, Directed Energy Technology.

(U) PE 0603319F, Airborne Laser Demonstration.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.