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

DATE: **February 1995**

BUDGET ACTIVITY: **3 - Advanced Development**

PE NUMBER AND TITLE: **0603605F Advanced Weapons Technology**

| COST (*In Thousands*) | FY 1994 Actual | FY 1995 Estimate | FY 1996 Estimate | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| Total Program Element (PE) Cost | 91,115 | 93,590 | 47,919 | 46,624 | 50,421 | 50,470 | 49,928 | 51,413 | Continuing | Continuing |
| 3150 Advanced Optics Technology | 32,968 | 30,242 | 2,210 | 2,118 | 2,811 | 2,914 | 2,923 | 3,111 | Continuing | Continuing |
| 3151 High Power Semiconductor Laser Technology | 9,057 | 10,292 | 7,994 | 8,175 | 9,567 | 9,567 | 9,566 | 9,862 | Continuing | Continuing |
| 3152 High Power Microwave Technology | 18,916 | 20,852 | 10,728 | 10,781 | 11,046 | 11,146 | 11,144 | 11,440 | Continuing | Continuing |
| 3277 Systems Survivability Technology | 300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 |
| 3647 High Energy Laser Technology | 29,874 | 32,204 | 26,987 | 25,550 | 26,997 | 26,843 | 26,295 | 27,000 | Continuing | Continuing |

**(U) A. Mission Description and Budget Item Justification:** This Advanced Development program demonstrates advanced directed energy and optical imaging concepts. Speed-of-light weapons and long-range, high resolution optical imaging through the turbulent atmosphere offer significant payoffs for many Air Force missions, such as theater missile defense, suppression of enemy air defenses, and space control. This program has demonstrated many major technology breakthroughs such as removing atmospheric distortions from optical transmissions (e.g., laser beams) and in producing small, relatively high power laser diode phased arrays. Major emphasis areas include: high power microwave and high energy laser technologies; long-range optical imaging; and high power laser diodes and diode arrays. All efforts in this program element contain the resources necessary, including civilian salaries, to manage, conduct, and document the technical activities.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |

**(U) B. Program Change Summary ($ in Thousands):**

| | FY 1994 | FY 1995 | FY 1996 | FY 1997 | Total Cost |
|---|---|---|---|---|---|
| (U) Previous President's Budget | 93,690 | 59,500 | 56,120 | 57,368 | Cont |
| (U) Appropriated Value | 94,715 | 96,500 | | | |
| (U) Adjustments to Appropriated Value | | | | | |
| a. Congressional General Reductions | -1,025 | -2,910 | | | |
| b. SBIR | -1,301 | | | | |
| c. Below Threshold Reprogrammings | -1,274 | | | | |
| (U) Current President's Budget | 91,115 | 93,590 | 47,919 | 46,624 | Cont |

(U) Change Summary Explanation:

Funding: For FY 1995, Congress added $20 million for excimer laser technology and $17 million for laser radar. The FY 1996 budget request reflects Air Force technology development needs that are required by the warfighter.

Schedule: Not Applicable.

Technical: Not Applicable.

**(U) C. Other Program Funding Summary:** Not Applicable.

**(U) D. Schedule Profile:** Not Applicable.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | | DATE February 1995 |
|---|---|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology | | PROJECT<br>3150 |

| COST (*In Thousands*) | FY 1994 Actual | FY 1995 Estimate | FY 1996 Estimate | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| 3150 Advanced Optics Technology | 32,968 | 30,242 | 2,210 | 2,118 | 2,811 | 2,914 | 2,923 | 3,111 | Continuing | Continuing |

**(U) A. Mission Description and Budget Item Justification:** This project develops advanced optical technologies for identifying distant or dim objects. This work supports high energy laser technologies since an imaging subsystem is required for target verification, accurate and sustainable laser beam placement on target, and damage assessment. Advanced technologies including nonlinear optics, adaptive optics, and specialized signal processing are being developed. The goal is high quality optical image reconstruction, concentrating on removing turbulent atmosphere-induced distortions. Many of these developed technologies (both techniques and hardware) also have significant application to astronomy research.

(U) FY 1994:
- (U) Continued advanced optical imaging technology development and demonstrations that support applications such as space object identification. ($2,935K)
  - (U) Demonstrated high resolution optical imaging of low earth orbit satellites in daytime.
  - (U) Fielded daytime imaging capability at Air Force Maui Optical Station to support operational tasking as a contributing sensor to the Space Surveillance Network.
  - (U) Completed development of low light visible sensor and image recovery algorithms to support daytime imaging applications.
- (U) Continued work to develop and implement techniques to exploit optical images of satellites to support space object identification/mission payload assessment applications. ($1,500K)
  - (U) Finalized design for first generation work station to exploit optical images.
- (U) Continued development of nonlinear optics technologies for optical imaging. ($1,286K)
  - (U) Transitioned nonlinear optics technology for sodium wavelength beacon laser from in-house development to a contracted effort for scaling to higher power.
  - (U) Transitioned nonlinear optics compensated imaging technology from in-house development and testing to a contracted effort for advanced development demonstration.
- (U) Continued upgrades/demonstrations at the Air Force Maui Optical Site, HI, and the Malabar, FL, optical sites. ($286K)
  - (U) Complete integration of daytime imagining capability at Maui site to support operational tasking as a contributing sensor to the Space Surveillance Network.
- (U) Continued development of the excimer-based active imaging technology. ($9,230K)
  - (U) Completed final design and began fabrication of receiver hardware for an Active Imaging Testbed.
  - (U) Completed risk reduction experiments for candidate illuminator laser concepts and selected one concept for fabrication.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |
| | PROJECT<br>3150 |

- (U) Began illuminator laser fabrication to support active imaging field tests.

– (U) Continued development of the laser imaging, detection, and ranging field demonstration. ($17,731K)
- (U) Completed initial field tests of tunable laser to evaluate performance.
- (U) Conducted low-power laser ranging and remote sensing proof-of-concept field tests at the Air Force Maui Optical Station.
- (U) Completed preliminary design of scaled laser source to support field demonstrations of laser ranging, imaging, and remote sensing.

(U) FY 1995:

– (U) Continue advanced optical imaging technology development and demonstrations that support applications such as space object imaging. ($850K)
- (U) Produce first high resolution satellite images on 3.5 meter telescope using speckle image sensing and reconstruction.
- (U) Conduct initial field tests of daylight imaging concepts using adaptive optics for atmospheric compensation.
- (U) Evaluate alternatives and select most promising concept for accurate satellite temperature sensing from ground-based sensors.
- (U) Begin formal Imaging and Sensors Mission Study to evaluate mission payoff and technology requirements for advanced optical imaging across the spectrum of military applications.

– (U) Continue work to develop and implement techniques to exploit optical images of satellites to support space object imaging/mission payload assessment applications. ($1,000K)
- (U) Deliver first-generation workstation for optical image exploitation to U.S. Space Command Combined Intelligence Center.

– (U) Continue development of nonlinear optics technologies for non-mechanical corrections in optical imaging. ($980K)
- (U) Demonstrate feasibility of nonlinear optics image compensation for laser guidestar applications using sodium wavelength laser concepts at ten watt power level.

– (U) Continue upgrades/demonstrations at the Air Force Maui Optical Site, HI, and the Malabar, FL, optical sites. ($412K)
- (U) Demonstrate feasibility of optical site networking to rapidly produce multiplier optical images of low earth orbit satellites to support space object identification applications.

– (U) Continue development of the excimer-based active imaging technology. ($10,000K)
- (U) Complete illuminator laser development and delivery.
- (U) Complete active imaging receiver/tracker integration with 3.5 meter telescope at Starfire Optical Range.
- (U) Conduct initial active imaging field tests and demonstrations.

– (U) Continue development of the laser imaging, detection, and ranging field demonstration. ($17,000K)
- (U) Complete design, fabrication, and delivery of full-scale laser source.
- (U) Conduct full-scale tests and demonstrations of laser ranging and imaging for low earth orbit satellites at the Air Force Maui Optical Station.
- (U) Complete modifications to laser system to incorporate wavelength agility in support of remote sensing applications.

(U) FY 1996:

– (U) Continue advanced optical imaging technology development and demonstrations that support applications such as space object identification. ($1,549K)

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology<br>PROJECT 3150 |

- (U) Demonstrate daylight imaging concepts using adaptive optics for atmospheric compensation.
- (U) Downselect to single concepts for active and passive imaging for application to deep space (out to geosynchronous altitudes) space object imaging/mission payload assessment missions.
- (U) Identify and begin development of key concepts and technology for focused development and transition to high-payoff applications for optical sensing, imaging, and stand-off detection.
- (U) Define and demonstrate deep space imaging concepts.
- (U) Demonstrate advanced electro-optical exploitation software tool.

– (U) Continue development of nonlinear optics technologies for non-mechanical corrections in optical imaging. ($561K)
- (U) Integrate nonlinear optics imaging brassboard with 1.5 meter telescope at Starfire Optical Range.

– (U) Continue upgrades/demonstrations at Air Force Maui Optical Site, HI, and the Malabar, FL, optical sites. ($100K)
- (U) Evaluate the potential of laser imaging, detection, and ranging (LIDAR) technology as a permanent addition to the Maui capabilities for space object surveillance and identification.

(U) FY 1997:

– (U) Continue advanced optical imaging technology development and demonstrations that support applications such as space object imaging. ($1,638K)
- (U) Demonstrate accurate temperature sensing of low earth orbit satellites using ground-based sensors.
- (U) Continue demonstration programs to address requirements for space object identification/mission payload assessment out to geosynchronous altitudes.
- (U) Conduct initial demonstrations to address feasibility of specific high-payoff applications for optical sensing, imaging, and stand-off detection.

– (U) Continue development of nonlinear optics for non-mechanical corrections in optical imaging. ($380K)
- (U) Evaluate and demonstrate nonlinear optics brassboard for full-aperture compensation on 1.5 meter telescope at Starfire Optical Range.

– (U) Continue upgrades/demonstrations at the Air Force Maui Optical Site, HI, and the Malabar, FL, optical sites. ($100K)
- (U) Begin integration of newly-completed 3.67 meter telescope at Maui into site control systems to allow routine use as a new contributing sensor for the Space Surveillance Network.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |
| | PROJECT<br>3150 |

**(U) B. Program Change Summary ($ in Thousands):**

| | FY 1994 | FY 1995 | FY 1996 | FY 1997 | Total Cost |
|---|---|---|---|---|---|
| (U) Previous President's Budget | 34,640 | 5,000 | 5,000 | 5,200 | Cont |
| (U) Current President's Budget | 32,968 | 30,242 | 2,210 | 2,118 | Cont |

(U) Change Summary Explanation:

Funding: The FY 1996 budget request reflects Air Force technology development needs that are required by the warfighter. FY 1995 includes $10 million Congressional add for excimer laser technology and $17 million Congressional add for the laser imaging, detection, and ranging field demonstration.

Schedule: Not Applicable.

Technical: Not Applicable.

**(U) C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

**(U) D. Schedule Profile:** Not Applicable.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY: 3 - Advanced Development | PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology — PROJECT: 3151 |

| COST (*In Thousands*) | FY 1994 Actual | FY 1995 Estimate | FY 1996 Estimate | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| 3151 High Power Semiconductor Laser Technology | 9,057 | 10,292 | 7,994 | 8,175 | 9,567 | 9,567 | 9,566 | 9,862 | Continuing | Continuing |

**(U) A. Mission Description and Budget Item Justification:** This project continues to yield revolutionary breakthroughs in compact, robust, affordable laser system technology, which is being developed and transitioned for a wide range of military applications requiring small compact laser sources with low to moderate optical power. Near-term applications include compact, reliable infrared sources for use with night vision systems, battlefield surgery instruments, and covert communication systems. Longer term applications, up to and including weapon applications, focus on compact higher power sources. This project leads development and builds upon a wide range of commercial advancements. Commercially available semiconductor lasers (1/10 watt) are widely used due to their low-cost, small size and weight, high reliability, and high efficiency in converting electricity to laser energy. The project preserves these attractive features while scaling to the higher powers (one to ten watts and above) and/or military application-specific wavelengths required for a wide range of applications. The project is divided into three technology areas. First, it investigates methods to increase output power from individual semiconductor laser diodes. Second, it develops semiconductor laser array integration methods, which produce a single, high quality laser beam at significantly higher power levels. Third, it develops wavelength-specific laser diodes for military applications. This project also works directly with field users to develop proof-of-capability demonstrations and field tests for these revolutionary laser sources. This technology has many commercial applications, especially for eye-safe lasers.

(U) FY 1994:
- (U) Continued development of laser diodes for improved performance/higher power in single diode and array applications. ($1,890K)
  - (U) Achieved five watts (pulsed) near diffraction-limited power and 7.5 watts continuous wave power from a master oscillator power amplified single device.
- (U) Continued development of coherent laser diode arrays for improved performance/higher power in array applications. ($2,844K)
  - (U) Successfully phased a laser array of approximately 1000 diodes for improved performance/higher power in array applications.
  - (U) Successfully phased a 9x100 array of diode lasers in a master oscillator power amplifier configuration.
- (U) Continued development of high power laser diodes and diode arrays at alternate wavelengths that will be transitioned to military applications. ($4,323K)
  - (U) Successfully developed the first mid-infrared diode laser array.
  - (U) Demonstrated quantum-well diode laser operating at 40 degrees kelvin and four micron wavelength.
  - (U) Demonstrated room temperature operation of a single diode laser at over one watt output power and two microns wavelength.

(U) FY 1995:
- (U) Continue development of laser diodes for improved performance/higher power in single diode and array applications. ($2,213K)
  - (U) Demonstrate ten watts continuous wave power with good beam quality from a single broad-area diode laser.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology<br>PROJECT 3151 |

- (U) Complete development and demonstrate one kilowatt diode-pumped solid-state laser brassboard for active tracking illumination at the Starfire Optical Range.

– (U) Continue development of coherent laser diode arrays for improved performance/higher power in array applications. ($3,659K)
  - (U) Demonstrate a suitable array architecture that can be scaled to the 50-100 watt power level by FY 1996.
– (U) Continue development of high power laser diodes and diode arrays at alternate wavelengths that will be transitioned to military applications. ($4,120K)
  - (U) Demonstrate one watt continuous wave, diffraction-limited output at 2.1 microns wavelength.
  - (U) Demonstrate 0.1 watt continuous wave output power at 4.2 microns wavelength.
– (U) Continue to investigate applications for these advanced semiconductor laser diodes and diode arrays. ($300K)
  - (U) Transition the Field Medical Laser System and Medical (Med) Pen to a commercial partner for commercialization.

(U) FY 1996:
– (U) Continue development of laser diodes for improved performance/higher power in single diode and array applications. ($2,962K)
  - (U) Demonstrate three watts of continuous power from a single aperture.
  - (U) Demonstrate devices that will have the potential to be modulated and scaled to higher powers.
  - (U) Demonstrate coupling to single mode fibers at moderate power levels.
– (U) Continue development of coherent laser diodes and diode arrays for improved performance/higher power in array applications. ($2,577K)
  - (U) Demonstrate 50 watts continuous power from a phased array of diode lasers.
  - (U) Demonstrate the ruggedness and reliability of a high power system with a one cubic foot laser head.
– (U) Continue development of high power laser diode arrays at alternate wavelengths that will be transitioned to military applications such as sources for illuminators and infrared countermeasures. ($2,077K)
  - (U) Demonstrate lasing of one watt laser diode at a four micron wavelength.
  - (U) Demonstrate single longitudinal mode operation at a wavelength of 3.3 microns.
– (U) Continue to investigate applications for these advanced semiconductor laser diodes and diode arrays. ($378K)
  - (U) Transition semiconductor laser technology to the Ballistic Wind Program.
  - (U) Investigate visible laser technology to update access denial and medical devices.
  - (U) Demonstrate material systems and laser architectures that are scaleable to 50 watts at mid-infrared wavelengths.

(U) FY 1997:
– (U) Continue development of laser diodes for improved performance/higher power in single diode and array applications. ($2,805K)
  - (U) Demonstrate five watts of continuous power from a single aperture.
  - (U) Demonstrate coupling to single mode fibers at high power levels.
  - (U) Demonstrate devices that will have the potential to be modulated and scaled to high powers.
– (U) Continued development of coherent laser diode arrays for improved performance/higher power in array applications. ($2,300K)

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |
| | PROJECT<br>3151 |

- (U) Demonstrate 100 watts of continuous power from a phased array of diode lasers.
- (U) Demonstrate the salability of a one cubic foot laser head to 200 watts.

– (U) Develop high power laser diodes and diode arrays at alternate wavelengths that will be transitioned to military applications such as sources for illuminators and infrared countermeasures. ($2,570K)

- (U) Demonstrate lasing of 100 milliwatts at a wavelength of five microns.

– (U) Continue to investigate applications for these advanced semiconductor laser diodes and diode arrays. ($500K)

- (U) Investigate blue/green diode laser technology for underwater communications, optical memory, and flat panel displays.
- (U) Investigate a space illuminator application.

**(U) B. Program Change Summary ($ in Thousands):**

| | FY 1994 | FY 1995 | FY 1996 | FY 1997 | Total Cost |
|---|---|---|---|---|---|
| (U) Previous President's Budget | 10,250 | 6,348 | 6,900 | 6,900 | Cont |
| (U) Current President's Budget | 9,057 | 10,292 | 7,994 | 8,175 | Cont |

(U) Change Summary Explanation:

Funding: The FY 1996 budget request reflects Air Force technology development needs that are required by the warfighter.

Schedule: Not Applicable.

Technical: Not Applicable.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |
| | PROJECT<br>3151 |

**(U) C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602234N, Systems Support Technology.
- (U) Representatives from Army, Navy, Ballistic Missile Defense Organization, National Laboratories, and Air Force using commands are members of the government review team for this technology.
- (U) Joint field demonstrations of this technology are ongoing with: the Air Force Pararescue School; the Air Force Special Operations Command; the U.S. Coast Guard; and the U.S. Customs Service.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

**(U) D. Schedule Profile:** Not Applicable.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | | | | | | | | DATE February 1995 | |
|---|---|---|---|---|---|---|---|---|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | | | | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology | | | | | | PROJECT<br>3152 |
| COST (*In Thousands*) | FY 1994 Actual | FY 1995 Estimate | FY 1996 Estimate | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | Cost to Complete | Total Cost |
| 3152 High Power Microwave Technology | 18,916 | 20,852 | 10,728 | 10,781 | 11,046 | 11,146 | 11,144 | 11,440 | Continuing | Continuing |

**(U) A. Mission Description and Budget Item Justification:** This project develops high power microwave generation technologies. It also develops a susceptibility/ vulnerability/lethality data base to identify potential vulnerabilities of U.S. systems to high power microwave threat parameters and to provide a basis for future weaponization decisions. Representative U.S. and foreign assets will be tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) technologies are being developed. The technologies developed in this project will demonstrate the applicability of high power microwaves to support various missions such as suppression of enemy air defense, counter-air, command and control warfare, and aircraft self-protection.

(U) FY 1994:
- (U) Continued technology development of generic high power microwave hardware. ($2,865K)
  - (U) Obtained 20 gigawatts power from ultra-wideband hydrogen switched source.
  - (U) Obtained one gigawatt peak power from ultra-wideband gallium arsenide solid-state source.
- (U) Continued efforts evaluating the susceptibility of military hardware and software to high power microwave. ($500K)
  - (U) Completed preliminary suicide/fratricide assessment of F-16.
  - (U) Completed initial susceptibility investigations for integrated air defense systems.
- (U) Began efforts addressing suppression of enemy air defense systems for burnout of enemy internal electronics. ($1,820K)
  - (U) Demonstrated radio frequency energy extraction from plasma filled magnetically insulated line oscillator.
  - (U) Began tests of specific air defense systems electronic hardware.
- (U) Continued efforts addressing aircraft self-protection technologies. ($3,931K)
  - (U) Completed in-depth analysis of F-16 testbed aircraft.
  - (U) Took delivery of electronically steerable ultra-wideband high power microwave source.
  - (U) Expanded high power microwave effects database with respect to infrared guided missiles.
  - (U) Adapted several engagement models to include high power microwave effects.
- (U) Completed experiment on active denial technology. ($1,300K)
  - (U) Completed L-band hardware for active denial technology demonstration.
- (U) Continued development of the laser-induced microwave emissions program using excimer laser technology. ($8,500K)
  - (U) Developed tailored laser sources for testing.
  - (U) Began testing materials and components.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology<br>PROJECT 3152 |

(U) FY 1995:
- (U) Continue technology development of generic high power microwave hardware. ($1,912K)
  - (U) Continue to develop narrowband and wideband high power microwave sources and antennas for various applications.
- (U) Continue efforts evaluating the susceptibility of representative military hardware and software to high power microwave effects. ($500K)
  - (U) Complete aircraft shelter radio frequency penetration effects.
  - (U) Complete ultra-wideband F-16 radio frequency effects.
  - (U) Characterize current-generation jet engine control systems.
  - (U) Transition frequency mode-stir techniques to aircraft and automobile industry that reduces time in conducting susceptibility tests by 90%.
- (U) Continue efforts addressing suppression of enemy air defenses systems. ($1,915K)
  - (U) Begin weapons application experiment design.
  - (U) Downselect high power microwave narrowband source.
  - (U) Conduct experiments on selected integrated air defense assets.
- (U) Continue efforts addressing aircraft self-protection technologies. ($3,025K)
  - (U) Develop detailed weapons application design.
  - (U) Downselect high power microwave wideband source.
  - (U) Continue testing and dynamic simulations of infrared and radio frequency guided missiles.
  - (U) Design an experiment proof-of-concept.
- (U) Complete active denial technology demonstration. ($1,800K)
  - (U) Complete X-band hardware for active denial technology demonstration.
- (U) Focus efforts addressing command and control warfare, space control, and counter-air technologies. ($1,200K)
  - (U) Begin development of wideband submunition concept for command and control warfare disruption mission.
  - (U) Explore ultra-high power wideband high power microwave weapons concept for electronics damage.
  - (U) Continue development of communications equipment effects database and begin database on aircraft maintenance and avionics equipment.
- (U) Continue development of the laser-induced microwave emissions program using excimer laser technology. ($10,500K)
  - (U) Perform laser-induced microwave emissions experiments on simulated systems.
  - (U) Develop short pulse source for laser-induced microwave emissions.

(U) FY 1996:
- (U) Continue technology development of generic high power microwave hardware. ($1,951K)
  - (U) Continue development of narrowband and wideband high power microwave sources and antennas.
- (U) Continue efforts evaluating the susceptibility of representative military hardware and software to high power microwave effects. ($500K)

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |
| | PROJECT<br>3152 |

- (U) Conduct studies of electromagnetic propagation through facilities.
- (U) Complete data base on various ground and flightline maintenance equipment.
- (U) Complete susceptibility report for large U.S. aircraft and begin hardening criteria development.
- (U) Complete experiments to determine coupling of high power microwave energy into hangers.

– (U) Continue efforts addressing suppression of enemy air defense systems. ($1,615K)
- (U) Conduct low power coupling and high power damage experiments on selected integrated air defense assets.
- (U) Refine system parameter requirements and perform go/no go decision.

– (U) Continue efforts addressing aircraft self-protection technologies. ($2,000K)
- (U) Develop host aircraft hardening criteria.
- (U) Complete wideband source/antenna design integration.
- (U) Design source experiment.
- (U) Continue testing and dynamic simulations of guided missiles.

– (U) Continue efforts addressing command and control warfare and counter-air technologies. ($2,310K)
- (U) Continue development of compact wideband sources and antennas for both damage and disruption missions.
- (U) Perform limited in situ experiments on command/control/communications equipment in building/facilities.
- (U) Extend materials studies to in situ effects applications.

– (U) Continue development of the laser-induced microwave emissions program. ($1,400K)
- (U) Develop an integrated response model of the laser-induced microwave emissions phenomenon.
- (U) Conduct experiments on actual systems.
- (U) Conduct feasibility experiments of laser-induced microwave emissions applications.

– (U) Continue development of high power microwave space control technologies. ($952K)
- (U) Initiate application concept studies.

(U) FY 1997:

– (U) Continue technology development of generic high power microwave hardware. ($1,771K)
- (U) Continue development of narrowband and wideband high power microwaves sources and antennas.

– (U) Continue efforts evaluating the susceptibility of representative military hardware and software to high power microwave effects. ($500K)
- (U) Complete database on foreign aircraft.
- (U) Complete hardening criteria on large U.S. aircraft.
- (U) Conduct experiments of electromagnetic propagation through facilities.

– (U) Continue efforts addressing suppression of enemy air defenses. ($2,100K)
- (U) Conduct experiments on selected integrated air defense assets.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |
| | PROJECT<br>3152 |

- (U) Complete concept design of technology demonstration.
- (U) Begin source technology integration.

– (U) Continue efforts addressing aircraft self-protection technologies. ($1,755K)
- (U) Initiate hardening requirements on the experimental platform.
- (U) Conduct experiment to demonstrate protection technologies.
- (U) Prepare plan to transition technology to system program offices.

– (U) Continue efforts addressing command and control warfare and counter-air technologies. ($2,125K)
- (U) Finalize wideband source and pulse power designs.
- (U) Continue equipment characterization.
- (U) Develop effects database on foreign aircraft maintenance and avionics equipment.

– (U) Continue development of the laser-induced microwave emissions program. ($1,500K)
- (U) Develop an integrated response model of the laser-induced microwave emissions phenomenon.
- (U) Conduct experiments on actual systems and develop draft hardening specifications.
- (U) Conduct feasibility experiments.

– (U) Continue development of high power microwave space control technologies. ($1,030K)
- (U) Continue application concept studies.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |
| | PROJECT<br>3152 |

**(U) B. Program Change Summary ($ in Thousands):**

| | FY 1994 | FY 1995 | FY 1996 | FY 1997 | Total Cost |
|---|---|---|---|---|---|
| (U) Previous President's Budget | 20,000 | 11,500 | 11,000 | 11,300 | Cont |
| (U) Current President's Budget | 18,916 | 20,852 | 10,728 | 10,781 | Cont |

(U) Change Summary Explanation:

Funding: The FY 1996 budget request reflects Air Force technology development needs that are required by the warfighter. FY 1995 was increased by Congressional adds of $10 million for excimer laser technology and $1.5 million for enhanced high power microwave technology.

Schedule: Not Applicable.

Technical: Not Applicable.

**(U) C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602120A, Electronic Survivability and Fuzing Technology.
- (U) PE 0602111N, Anti-Air Warfare, Anti-Surface Warfare Technology.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

**(U) D. Schedule Profile:** Not Applicable.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | | DATE February 1995 |
|---|---|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology | | PROJECT<br>3277 |

| COST (*In Thousands*) | FY 1994 Actual | FY 1995 Estimate | FY 1996 Estimate | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| 3277 Systems Survivability Technology | 300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 |

**(U) A. Mission Description and Budget Item Justification:** This project developed technologies to evaluate and enhance Air Force systems electromagnetic pulse survivability. The project has been terminated.

(U) FY 1994:
– (U) Demonstrated technologies for simulating electromagnetic pulses. ($300K)

(U) FY 1995: Not Applicable.

(U) FY 1996: Not Applicable.

(U) FY 1997: Not Applicable.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |
| | PROJECT<br>3277 |

**(U) B. Program Change Summary ($ in Thousands):**

| | FY 1994 | FY 1995 | FY 1996 | FY 1997 | Total Cost |
|---|---|---|---|---|---|
| (U) Previous President's Budget | 300 | 0 | 0 | 0 | 1,800 |
| (U) Current President's Budget | 300 | 0 | 0 | 0 | 1,800 |

(U) Change Summary Explanation:

Funding: Project terminated in FY 1995.

Schedule: Not Applicable.

Technical: Not Applicable.

**(U) C. Other Program Funding Summary:** Not Applicable.

**(U) D. Schedule Profile:** Not Applicable.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | | | | | | | | DATE: February 1995 | |
|---|---|---|---|---|---|---|---|---|---|
| BUDGET ACTIVITY: 3 - Advanced Development | | | PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology | | | | | PROJECT: 3647 | |
| COST (*In Thousands*) | FY 1994 Actual | FY 1995 Estimate | FY 1996 Estimate | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | Cost to Complete | Total Cost |
| 3647 High Energy Laser Technology | 29,874 | 32,204 | 26,987 | 25,550 | 26,997 | 26,843 | 26,295 | 27,000 | Continuing | Continuing |

**(U) A. Mission Description and Budget Item Justification:** This project develops and demonstrates technology and conducts detailed assessments needed for high energy laser weapons. The technology developed by this project is directly applicable to most high power applications. The project demonstrates the critical technologies for: scaleable laser devices; optical components; and laser beam control to efficiently compensate and propagate laser radiation through the atmosphere to a target. It also develops and uses detailed computational models to establish high energy laser weapon effectiveness and satellite and missile vulnerability. Correcting the laser beam for atmospheric disturbances is the key technology in most high energy laser applications. The beam control technology developed in this project had, and will continue to have, a significant benefit to the astronomy community.

(U) FY 1994:

- (U) Continued development and demonstration of high energy laser device components for potential weapon applications. ($3,339K)
  - (U) Demonstrated high pressure operation of small-scale chemical oxygen-iodine laser device, providing a concept to simplify and reduce weight of pressure recovery systems.
  - (U) Demonstrated long run times on small-scale chemical oxygen-iodine laser device with stable power output and thermal control.
  - (U) Optimized hardware configuration and operating conditions on small-scale chemical oxygen-iodine laser device, resulting in two times increase in laser power per unit flow area and three times increase in output laser power.
  - (U) Demonstrated high performance optical coatings for chemical oxygen-iodine laser wavelength with extremely low absorption while maintaining low scatter and excellent environmental stability.
- (U) Continued atmospheric compensation/beam control experiments, including activation of the new 3.5 meter telescope. ($12,142K)
  - (U) Demonstrated improved satellite and star tracking performance through the use of adaptive optics for atmospheric compensation.
  - (U) Completed integration and activation of new 3.5 meter telescope, including collecting first light images of astronomical objects and demonstrating the ability to accurately point to low earth orbit satellites.
  - (U) Began development of second-generation adaptive optics hardware for 3.5 meter telescope.
  - (U) Completed initial extended beacon atmospheric compensation test in ground-based field testing which simulates the high altitude propagation path for theater missile defense scenarios.
- (U) Continued atmospheric measurements and characterization of the high energy laser beam propagation environment from ground and airborne platforms. ($10,000K)
  - (U) Obtained coincident strength-of-turbulence measurements between airborne measurements and ground-based measurements to confirm the validity of radar turbulence measurements database.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology<br>PROJECT 3647 |

- (U) Built and integrated all hardware to support detailed airborne horizontal path atmospheric characterization experiments planned for FY 1995.

– (U) Continued vulnerability assessments for potential high energy laser targets. ($2,893K)
  - (U) Completed testing of sub-scale, mid-scale, and full-scale targets for laser vulnerability of theater missiles at three different government laser facilities.
  - (U) Completed assessments of three satellite targets.
  - (U) Developed methodology for quantifying systematic uncertainties in satellite component designs and system-level response to component-level degradation.
  - (U) Completed test program on four satellite components; identified temporary effects and energy thresholds for permanent instead of temporary effects.
  - (U) Acquired optical analysis codes and evaluated vulnerability of a satellite optical system.
– (U) Continued development of excimer laser technology supporting the laser-induced microwave emissions program. ($1,500K)
  - (U) Delivered moderate-power, frequency agile laser source which meets power requirements for laser-induced microwave emissions phenomenology tests.

(U) FY 1995:
– (U) Continue development and demonstration of high energy laser components for potential weapon applications. ($3,592K)
  - (U) Test advanced chemical oxygen-iodine laser spray generator concept at moderate-scale to measure key performance parameters.
  - (U) Evaluate beam quality of moderate-scale chemical oxygen-iodine laser devices operating at high pressure.
– (U) Continue atmospheric compensation/beam control experiments from ground-based platforms. ($19,028K)
  - (U) Complete development and installation of first-generation adaptive optics system on 3.5 meter telescope and conduct first atmospheric compensation experiments.
  - (U) Demonstrate real-time compensation for tilt anisoplanatism on 1.5 meter telescope.
  - (U) Conduct first field experiments on 1.5 meter telescope to evaluate hybrid beacon sensing for atmospheric compensation, validating the baseline concept for full-scale, ground-based laser beam control systems.
  - (U) Complete development of one kilowatt track illuminator laser and begin installation at Starfire Optical Range.
  - (U) Develop long-wave infrared sensor and demonstrate long-wave infrared sensor acquisition of satellites.
  - (U) Integrate improved tracker into existing ground-based hardware to evaluate performance of integrated tracking/atmospheric compensation in field testing which simulates the high altitude, horizontal propagation path for theater missile defense scenarios.
– (U) Continue atmospheric measurements and characterization of the high energy laser beam propagation environment from ground and airborne platforms. ($6,352K)
  - (U) Complete high altitude airborne flights to obtain optical measurements of atmospheric turbulence along long horizontal propagation paths.
– (U) Continue development of excimer laser technology supporting the laser-induced microwave emissions program. ($1,500K)
  - (U) Complete evaluation of laser-induced microwave emissions phenomenology to establish feasibility for operational applications.

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |
| | PROJECT<br>3647 |

– (U) Continue vulnerability assessments for potential high energy laser targets. ($1,732K)
  – (U) Complete ground tests against full-scale theater missile targets.
  – (U) Complete technical report documentation on assessment results on past six satellite targets.
  – (U) Incorporate uncertainty methodology into satellite vulnerability assessment process.
  – (U) Complete three new satellite models and vulnerability assessments.
  – (U) Perform vulnerability analysis on two satellite optical systems.

(U) FY 1996:
– (U) Continue development and demonstration of high energy laser components for potential weapon applications. ($4,245K)
  – (U) Integrate advanced chemical oxygen-iodine laser generator to demonstrate scaled performance.
– (U) Continue atmospheric compensation/beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification. ($21,230K)
  – (U) Using newly-installed one kilowatt track illuminator laser, demonstrate active tracking of low earth orbit satellites with 3.5 meter telescope.
  – (U) Evaluate synergistic effects between atmospheric compensation and active tracking of satellite targets.
  – (U) Demonstrate and evaluate the performance of hybrid beacon sensing on 3.5 meter telescope.
  – (U) Demonstrate 24-hour passive acquisition of low earth orbit satellites using long wavelength infrared acquisition sensor.
  – (U) Continue development of next generation adaptive optics for the 3.5 meter telescope.
  – (U) Complete integrated tracking/atmospheric compensation experiments in static ground testing.
  – (U) Conduct active tracking experiments against dynamic targets simulating the theater missile defense scenario.
– (U) Continue vulnerability assessments for potential high energy laser targets. ($1,512K)

(U) FY 1997:
– (U) Continue development and demonstration of high energy laser components for potential weapon applications. ($3,030K)
  – (U) Complete scaled experiments of chemical oxygen-iodine laser device to demonstrate performance of advanced generators and high pressure operation.
– (U) Continue atmospheric compensation/beam control experiments from ground-based platforms to support applications ranging from weaponization to space object imaging. ($21,020K)
  – (U) Complete development and installation of scaled sodium wavelength laser to support full-scale hybrid beacon sensing for 3.5 m telescope.
  – (U) Conduct initial ground-based laser integrated beam control demonstrations against selected low earth orbit satellites (up to 400 kilometers).
  – (U) Continue satellite active tracking experiments, to evaluate synergistic effects with atmospheric compensation, investigate phenomenology of satellite target illumination for various targets and engagements, and demonstrate 24-hour satellite tracking capability.
  – (U) Complete development and begin installation of next generation adaptive optics for the 3.5 meter telescope.

- (U) Complete active tracking experiments with advanced hardware and track algorithms against dynamic targets simulating the theater missile defense scenario.

– (U) Continue vulnerability assessments for potential high energy laser targets. ($1,500K)

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) | DATE February 1995 |
|---|---|
| BUDGET ACTIVITY<br>3 - Advanced Development | PE NUMBER AND TITLE<br>0603605F Advanced Weapons Technology |
| | PROJECT<br>3647 |

**(U) B. Program Change Summary ($ in Thousands):**

| | FY 1994 | FY 1995 | FY 1996 | FY 1997 | Total Cost |
|---|---|---|---|---|---|
| (U) Previous President's Budget | 28,500 | 36,652 | 33,220 | 33,968 | Cont |
| (U) Current President's Budget | 29,874 | 32,204 | 26,987 | 25,550 | Cont |

(U) Change Summary Explanation:

Funding: The FY 1996 budget request reflects Air Force technology development needs that are required by the warfighter.

Schedule: Not Applicable.

Technical: Not Applicable.

**(U) C. Other Program Funding Summary:**

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603319F, Airborne Laser Demonstration.
- (U) PE 0305910F, SPACETRACK.
- (U) PE 0603217C, Ballistic Missile Defense, Advanced Development (High Altitude Balloon Experiment).
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

**(U) D. Schedule Profile:** Not Applicable.