| **Exhibit R-2, RDT&E BUDGET ITEM JUSTIFICATION** | | | | | February 2005 | | | |
|---|---|---|---|---|---|---|---|---|
| RDT&E DEFENSE-WIDE (0400)<br>BUDGET ACTIVITY THREE | | | | | TEST AND EVALUATION/SCIENCE AND TECHNOLOGY (T&E/S&T)<br>PROGRAM ELEMENT (PE) 0603941D8Z | | | |
| $ in Millions | FY 2004* | FY 2005* | FY 2006 | FY 2007 | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| PE 0603941D | 0.000 | 0.000 | 28.614 | 44.240 | 68.826 | 100.632 | 102.497 | 104.806 |
| Hypersonic Test | 0.000 | 0.000 | 5.824 | 9.734 | 16.337 | 27.676 | 25.946 | 24.410 |
| Spectrum Efficient Technology | 0.000 | 0.000 | 3.764 | 4.512 | 5.006 | 5.658 | 5.996 | 6.127 |
| Multi-Spectral Test | 0.000 | 0.000 | 4.368 | 5.563 | 8.359 | 12.702 | 12.708 | 12.981 |
| Embedded Instrumentation | 0.000 | 0.000 | 4.195 | 5.281 | 8.100 | 11.622 | 11.624 | 11.856 |
| Directed Energy Test | 0.000 | 0.000 | 5.426 | 9.134 | 14.797 | 24.561 | 25.014 | 24.361 |
| Information Systems Technology Test | 0.000 | 0.000 | 2.370 | 3.759 | 5.783 | 6.357 | 7.201 | 8.435 |
| Software Test | 0.000 | 0.000 | 1.304 | 2.989 | 5.350 | 5.897 | 6.742 | 8.090 |
| Modeling and Simulation | 0.000 | 0.000 | 1.304 | 1.986 | 2.883 | 3.384 | 3.919 | 4.617 |
| Test Range/Facility Technology Improvements | 0.000 | 0.000 | 0.059 | 1.282 | 2.211 | 2.775 | 3.347 | 3.929 |

***Language in the National Defense Authorization Act of 2003 directed the establishment of the Defense Test Resource Management Center (DTRMC). The Act also requires the DTRMC to administer the Central Test and Evaluation Investment Program (CTEIP) and the Test and Evaluation/Science and Technology (T&E/S&T) program effective Fiscal Year 2006.**

**Beginning with FY 2006, program elements 0603941D8Z (T&E/S&T) and 0604940D8Z (CTEIP) are transferred from the Operational Test and Evaluation, Defense (OT&E, D) appropriation (0460) to the Defense-wide RDT&E (0400) appropriation. FY 2004 and 2005 Accomplishments are in the OT&E appropriation.**

## A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION

The T&E/S&T program seeks out and develops test technologies to pace evolving weapons technology. This program is critical to ensuring that the Department of Defense (DoD) has the capability to adequately test the advanced systems that will be fielded in the future. To meet this objective, the T&E/S&T program:

- Exploits new technologies and processes to meet important T&E requirements.
- Expedites the transition of new technologies from the laboratory environment to the T&E community.
- Leverages commercial equipment and networking innovations to support T&E.

Additionally, the program examines emerging test requirements derived from transformation initiatives to identify needed technology areas and develop a long-range roadmap for technology insertion. This program leverages and employs applicable 6.2 applied research from the highly-developed technology base in the DoD laboratories and test centers, industry, and academia to accelerate the development of new test capabilities. This PE also provides funds to perform travel to carry out oversight of the T&E/S&T program.

This Research Category 6.3, Advanced Technology Development PE, develops and demonstrates high payoff technologies for current and future DoD test capabilities.

**B. (U) PROGRAM CHANGE SUMMARY**

| | FY 2004 | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|---|
| Previous President's Budget: | 0.000 | 0.000 | 0.000 | 0.000 |
| Current FY 2006 President's Budget Submission: | 0.000 | 0.000 | 28.614 | 44.240 |
| Total Adjustments: | | | +28.614 | +44.240 |
| Congressional Program Reductions: | | | | |
| Congressional Rescissions: | | | | |
| Congressional Increases: | | | | |
| Reprogramming: | | | +28.614 | +44.240 |
| SBIR/STTR: | | | | |
| Other: | | | | |

**C. (U) OTHER PROGRAM FUNDING** NA

**D. (U) ACQUISITION STRATEGY** NA

**E. (U) PERFORMANCE METRICS**

Percentage of T&E/S&T projects progressing satisfactorily toward technical, financial, schedule, and risk mitigation goals.

| RDT&E PROJECT JUSTIFICATION SHEET (R-2a) | | | | February 2005 | | | | |
|---|---|---|---|---|---|---|---|---|
| DEFENSE WIDE RDT&E (0400)<br>BUDGET ACTIVITY THREE, PE 0603941D | | | | HYPERSONIC TEST | | | | |
| $ in Millions | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| Hypersonic Test | 0.000 | 0.000 | 5.824 | 9.734 | 16.337 | 27.676 | 25.946 | 24.410 |

**A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION**

The National Aerospace Initiative (NAI) will develop air-breathing weapons, advanced aircraft, and access to space platforms to operate in the hypersonic speed regimes Mach 5 and higher. Hypersonic systems to be developed under the NAI require T&E capabilities in numerous areas ranging from ground testing (wind tunnels, sled tracks, installed-system test facilities, and modeling and simulation (including computational fluid dynamics)) through flight testing. At hypersonic speeds, flight testing will challenge existing ground instrumentation systems (e.g., tracking system slew rate limitations, telemetry dropouts due to ionization) and range safety decision making. Hypersonic weapon systems will depend on several new technological thrusts in areas such as propulsion and engines, structures and materials, guidance and control, seekers and sensors, warheads and payloads, and weapons delivery techniques and end-game dynamics - each requiring supporting T&E capabilities to determine performance, effectiveness, suitability, survivability, and responsiveness to Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems. Service improvement and modernization programs are addressing some basic test facility upgrades using off-the-shelf technologies. However, T&E of hypersonic systems will require technologies not yet developed or available for T&E purposes. The Department must have adequate T&E capabilities in place in time to meet current development, and ultimately, acquisition program schedules. The purpose of this T&E/S&T focus area is to address these T&E technology issues.

**B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM**

| | FY 2004 | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|---|
| Hypersonic Test | 0.000 | 0.000 | 5.824 | 9.734 |

**FY 2004 Accomplishments:** **See OT&E,D (0460) appropriation.**

**FY 2005 Accomplishments:** **See OT&E,D (0460) appropriation.**

**FY 2006 Plans:**

Efforts initiated in prior fiscal years will continue. These efforts include:

- Test Media Effects will complete development of diagnostic tools to measure chemical species, temperature and velocities in hypersonic flows. These tools will enable measurement of vitiates to support hypersonic engine test and evaluation.

Efforts selected as a result of the FY 2006 Broad Agency Announcement (BAA) will be initiated. Planned efforts include:

- Survivable command destruct package to allow safe and reliable termination of hypersonic flight tests.
- Technology to transmit effects and dynamics of Mach 7 + engagements to support weapon system performance evaluation.
- High speed stores separation measurement technology for accurate store/vehicle separation data in hypersonic flight conditions.
- Advanced distributed simulation capabilities for Mach 7 + engagements to allow analysis of hypersonic system performance between test centers and system developers.

A BAA will be initiated in FY 2006 to select efforts for FY 2007 award.

**FY 2007 Plans:**

Efforts initiated in prior years will continue. These efforts include:

- Test Media Effects will complete efforts to model the effects of vitiates on hypersonic combustion engines to allow prediction of engine performance in clean air flight conditions.

Future investigations will be launched to address T&E technology challenges in this focus area for:

- Continuous and survivable instrumentation and communications to provide system performance (including time-space position and attitude information) and allow test system command and control throughout the hypersonic test regime.
- Realistic ground test environments to adequately simulate flight conditions for hypersonic systems and target interaction.
- Aerodynamic models for analysis of hypersonic weapon systems performance.
- Computational Fluid Dynamics models for performance characterization of Mach 7 + hypersonic weapon systems.

A BAA will be initiated in FY 2007 to select efforts for FY 2008 award.

**C. (U) OTHER PROGRAM FUNDING** NA

**D. (U) ACQUISITION STRATEGY** NA

| RDT&E PROJECT JUSTIFICATION SHEET (R-2a) | | | February 2005 | | | | | |
|---|---|---|---|---|---|---|---|---|
| DEFENSE WIDE RDT&E (0400)<br>BUDGET ACTIVITY THREE, PE 0603941D | | | SPECTRUM EFFICIENT TECHNOLOGY | | | | | |
| $ in Millions | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| Spectrum Efficient Technology | 0.000 | 0.000 | 3.764 | 4.512 | 5.006 | 5.658 | 5.996 | 6.127 |

**A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION**

Increased commercial use of the radio frequency (RF) spectrum and DoD's higher demands for bandwidth and test data are impacting the capability to test current weapon systems. Realistic testing of modern military systems, and follow-on training at the completion of a defense system's development phase, rely heavily on the use of the RF spectrum, especially in the "L" and "S" microwave bands. Signal propagation, supportable data rates, and other related characteristics make these bands ideally suited for test telemetry and training applications. However, these are the same characteristics that make these bands highly coveted by the wireless communications industry. The growth in the demand for consumer communication services has resulted in reallocation of RF spectrum from government to non-government use. The reallocation of this spectrum, coupled with the increase in activities that use it, has raised concerns regarding the availability of adequate spectrum to support test and training. Each new generation of military system typically generates ten times more data and information than the system it is replacing, resulting in a 20-year trend of exceptional growth in the demand for test and training related spectrum. The next generation of systems will generate proportionately greater data rates that will exceed the capability of our current test infrastructure. Technological advances in the spectrum efficiency focus area are required to ensure that programs will not have to compromise T&E by reducing the number or quality of tests.

**B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM**

| | FY 2004 | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|---|
| Spectrum Efficient Technology | 0.000 | 0.000 | 3.764 | 4.512 |

**FY 2004 Accomplishments: See OT&E,D (0460) appropriation.**

**FY 2005 Accomplishments: See OT&E,D (0460) appropriation.**

**FY 2006 Plans:**

Efforts initiated in prior fiscal years will continue. These efforts include:

- Phased Array Antenna will complete demonstration of an autonomous neural network and antenna algorithms that will provide improved tracking accuracy for ground-based receive antennas. This will allow improved tracking accuracy during dynamic testing and reduce signal fading during high dynamic maneuvers.
- Combined Coding Modulation will complete the development and demonstration of a modulator and demodulator to improve the efficiency of T&E telemetry systems. This will increase the quantity of test vehicles that can be evaluated during weapon system and systems-of-systems testing.

Projects identified by the FY 2006 Program Research & Development Announcement (PRDA) process will be initiated. Efforts are planned in the following areas:

- Optical communications brassboard to demonstrate optical telemetry to augment the existing and planned RF telemetry spectrum for systems-of-systems testing.
- Advanced modulation and encoding technologies, including methods to deconflict RF spectrum use, to allow T&E of systems-of-systems in a Joint Urban Operations (JUO) environment.
- Development of adaptive antenna arrays for unobtrusive and non-interfering operations for system under test, and variable beamwidth directional antennas for frequency sharing during system-of-systems tests.
- Algorithms that support ultra-high data rate pre-processing, compression, storage, and bandwidth- efficient modulation schemes for transmission of T&E data in dynamic test environments.
- Advanced designs for remotely tunable datalink transceivers to provide increased data security, improve range safety, and allow for inter-range operation coordination.

A PRDA will be initiated in FY 2006 to select efforts for FY 2007 award.

**FY 2007 Plans:**

Efforts initiated in prior fiscal years will continue. These efforts include:

- RF Microelectromechanical System (MEMS) Antenna will complete fabrication and flight testing of a MEMS software-defined antenna system that will allow dynamic reconfiguration of the antenna transmit frequency and polarity to support adaptive use of the telemetry spectrum during test events.

Additional investigations will be initiated as a result of the PRDA process to address critical T&E technology issues such as:

- Techniques for overcoming transmission losses during ionization periods of hypersonic systems testing.
- Methods to increase efficiency and reliability of future telemetry, command and control, and datalink communications for T&E.
- Methods to improve transmission efficiency by compensating for Doppler shift in coherent telemetry receivers.

A PRDA will be initiated in FY 2007 to select efforts for FY 2008 award.

**C. (U) OTHER PROGRAM FUNDING** NA

**D. (U) ACQUISITION STRATEGY** NA

| RDT&E PROJECT JUSTIFICATION SHEET (R-2a) | | | | February 2005 | | | | |
|---|---|---|---|---|---|---|---|---|
| DEFENSE WIDE RDT&E (0400)<br>BUDGET ACTIVITY THREE, PE 0603941D | | | | MULTI-SPECTRAL TEST | | | | |
| $ in Millions | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| Multi-Spectral Test | 0.000 | 0.000 | 4.368 | 5.563 | 8.359 | 12.702 | 12.708 | 12.981 |

**A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION**

DoD S&T programs are developing new technologies for use in multi-spectral and hyperspectral sensors, seekers, and detectors for weapon systems and intelligence, surveillance, and reconnaissance systems. T&E of new multi-spectral and hyperspectral sensors to be used in these future weapon systems will require new T&E technologies. Current methods for testing multi-spectral and hyperspectral sensors rely heavily on expensive field test programs. While these field tests provide realistic data for sensor testing, they leave several critical gaps. For example, test conditions are not repeatable because environments observed one day will be different the next day. Imagery can be collected and stored to partially mitigate this deficiency, but this process is expensive and cannot cover the full spectrum of environments required for complete test article evaluation and performance analysis. The T&E community needs the ability to test these advanced seekers and sensors in a repeatable, objective fashion before and after integrating them into warfighting systems. This T&E/S&T focus area is addressing these needs through research efforts in scene generation, injection and projection to create test technologies that can be combined into integrated multi-spectral and hyperspectral test capabilities. Without these new T&E technologies, DoD will not be able to adequately test and evaluate the multi-spectral and hyperspectral weapon systems of the future.

**B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM**

| | FY 2004 | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|---|
| Multi-Spectral Test | 0.000 | 0.000 | 4.368 | 5.563 |

**FY 2004 Accomplishments:** **See OT&E,D (0460) appropriation.**

**FY 2005 Accomplishments: See OT&E,D (0460) appropriation.**

**FY 2006 Plans:**

Efforts initiated in prior fiscal years will continue. These efforts include:

- Dynamic Hyperspectral Thermal Signature Model will complete development of the signature model. This final release open-source software package will be capable of generating multi-spectral and hyperspectral imagery for use in testing of advanced weapon systems, such as Future Combat Systems.
- Hyperspectral Testbed Design will complete the testbed design and initiate subsystem fabrication of the prototype Long Wave Infrared (LWIR) hyperspectral testbed.
- Multi-Spectral Stimulator Injection Test Method will demonstrate closed-loop real-time operation of the prototype hardware system. The prototype demonstration will incorporate real-time Radio Frequency (RF) output with clutter, correlated with the Infrared (IR) output. This will allow for realistic, direct injection hardware-in-the-loop testing of multi-spectral weapon systems in the Mid-Wave IR (MWIR), LWIR and millimeter wave (MMW) frequencies.

Projects identified by the FY 2006 Broad Agency Announcement (BAA) process will be initiated. Efforts are planned in the following areas:

- Technologies to support the development and integration of visible and near-IR (NIR) multi-spectral and hyperspectral sensor testbeds including scene generation, image projection, and evaluation of sensor performance.
- Methodologies to evaluate performance of hyperspectral imaging systems including the development of data mining techniques to extract critical test data from massive hyperspectral data sets (hyperspectral/multi-spectral signature, scene and script storage, retrieval and reuse).

A BAA will be initiated in FY 2006 to select efforts for FY 2007 award.

**FY 2007 Plans:**

Efforts initiated in prior fiscal years will continue. These efforts include:

- Hyperspectral Testbed Design will complete fabrication, integration, and demonstration of the prototype hyperspectral image projection system. This testbed will allow repeatable closed loop testing of advanced hyperspectral imagers under controlled, user defined test conditions that can not be efficiently achieved in field testing.

Projects identified by the FY 2007 BAA process will be initiated. Efforts are planned in the following areas:

- Technologies to support the generation and projection of polarized visible and near-IR imagery for T&E of advanced weapon systems.

- Advanced algorithms for personal computer (PC) based high fidelity scene generation capabilities in the visible and IR spectrum.
- Calibration techniques to support evaluation of multi-spectral and hyperspectral imagers.

A BAA will be initiated in FY 2007 to select efforts for FY 2008 award.

**C. (U) OTHER PROGRAM FUNDING** NA

**D. (U) ACQUISITION STRATEGY** NA

| RDT&E PROJECT JUSTIFICATION SHEET (R-2a) | | | February 2005 | | | | | |
|---|---|---|---|---|---|---|---|---|
| DEFENSE WIDE RDT&E (0400)<br>BUDGET ACTIVITY THREE, PE 0603941D | | | EMBEDDED INSTRUMENTATION | | | | | |
| $ in Millions | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| Embedded Instrumentation | 0.000 | 0.000 | 4.195 | 5.281 | 8.100 | 11.622 | 11.624 | 11.856 |

**A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION**

Instrumentation requirements for systems-under-test, hardware-in-the-loop testing, and training are increasing exponentially for new weapon systems. Onboard or personnel-borne instrumentation and equipment are required for sensing and collecting critical performance data; determining accurate time, space, position, and attitude information; interfacing with command and control data links; monitoring and reporting system-wide communications; reporting human operator performance; and storing and transmitting data. These requirements drive the need for enabling technologies for miniaturized, non-intrusive instrumentation suites with increased survivability in harsh environments.

There is minimal space available for adding instrumentation to new weapon systems subsequent to their development. Additional weight and power draw can adversely affect the weapon system's signature and performance. Instrumentation for humans-in-the-loop, such as a dismounted soldier, should not detrimentally affect the soldier's performance or operational burden. New technologies can be exploited to integrate small non-intrusive embedded instrumentation (EI) into new platforms during design and development, and, in some cases, into existing platforms. This EI can provide the required data for T&E, training, and logistics throughout the system's lifecycle, and provide the ability to collect critical system performance data during combat missions.

The use of embedded instrumentation for T&E, training, and logistics has the potential for significantly reducing the total ownership costs of new weapon systems while enhancing force readiness. Accordingly, the Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170.01D states that acquisition programs should include embedded instrumentation as part of system trade-off studies and design analyses. The EI focus area will advance technologies needed to facilitate compliance with CJCSI 3170.01D.

**B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM**

| | FY 2004 | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|---|
| Embedded Instrumentation | 0.000 | 0.000 | 4.195 | 5.281 |

**FY 2004 Accomplishments:** **See OT&E,D (0460) appropriation.**

**FY 2005 Accomplishments:** **See OT&E,D (0460) appropriation.**

**FY 2006 Plans:**

Efforts initiated in prior fiscal years will continue. These efforts include:

- Advanced Munitions Flight Test Instrumentation will complete flight tests of the instrumentation module on a munition. This embedded instrumentation package will provide time, space, and position information (TSPI) to improve munition evaluation without adversely impacting the munition design or function.

Projects identified by the FY 2006 Broad Agency Announcement (BAA) will be initiated. Areas of potential research are:

- Synthetic instrumentation that combines sensor technology with integrated processing techniques to create multi-functional instruments.
- Techniques to achieve miniaturized, reduced-weight instrumentation packaging.
- Methods to improve instrument survivability in harsh environments, such as at hypersonic speeds.
- Advanced wireless data and communications techniques, including the use of vehicle power lines as a data bus for data transfer and distribution.
- Low power instrumentation to reduce on-board power demands.
- Smaller, higher capacity recorders to support passive operation of embedded instrumentation.
- Compact and stable timing reference units to support TSPI data and for applying metadata tags to data messages.
- Passive devices for improving ground truth measurements, such as for attitude and miss-distance measurements.

A BAA will be initiated in FY 2006 to select efforts for FY 2007 award.

**FY 2007 Plans:**

Efforts initiated in prior fiscal years will be continued. Future investigations will be launched to address T&E technology challenges in this focus area for:

- Human performance instrumentation to support T&E in Joint Urban Operations environments.

- Non-intrusive network interfaces with critical operational components including the MIL-STD-1553 data bus to support gathering operational data without affecting operational performance.
- Instrumentation command and control techniques to provide remote operation of instrumentation during T&E events.
- High anti-jam signal processing techniques for T&E operations in an electronic warfare and jamming environment.

A BAA will be initiated in FY 2007 to select efforts for FY 2008 award.

**C. (U) OTHER PROGRAM FUNDING** NA

**D. (U) ACQUISITION STRATEGY** NA

| RDT&E PROJECT JUSTIFICATION SHEET (R-2a) | | | | February 2005 | | | | |
|---|---|---|---|---|---|---|---|---|
| DEFENSE WIDE RDT&E (0400)<br>BUDGET ACTIVITY THREE, PE 0603941D | | | | DIRECTED ENERGY TEST | | | | |
| $ in Millions | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| Directed Energy Test | 0.000 | 0.000 | 5.426 | 9.134 | 14.797 | 24.561 | 25.014 | 24.361 |

## A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION

Directed Energy (DE) technologies are rapidly transitioning into acquisition programs and Advanced Concept Technology Demonstrations (ACTDs). These weapons technologies, which primarily consist of High Energy Laser (HEL) and High Power Microwaves (HPM), are outpacing their supporting test technologies. Advancements in HEL and HPM have created a new class of weapon systems in which energy is placed on a target instantaneously, making traditional test techniques for evaluating conventional munitions (with flight times ranging from seconds to minutes) not applicable to DE systems' T&E. As a result, new technology solutions are needed to ensure adequate developmental, live fire, and operational test capabilities are available when the DE acquisition programs are ready to test.

DE system and component testing requires two principal assessments: how well the weapon is performing and the specific interaction of energy and target. The current ability to assess DE systems performance and interactions is based on effects testing, i.e. determining if and when the target was destroyed. This does not provide the detailed test data required to understand DE system performance. Military utility of these weapons will be dependent on the knowledge acquired through T&E to know how much to trust the technologies under development and how best to use them. This T&E/S&T focus area is developing the needed technologies to quantitatively assess both HEL and HPM performance and target interaction to support thorough testing of DE systems.

## B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM

| | FY 2004 | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|---|
| Directed Energy Test | 0.000 | 0.000 | 5.426 | 9.134 |

**FY 2004 Accomplishments:** **See OT&E,D (0460) appropriation.**

**FY 2005 Accomplishments: See OT&E,D (0460) appropriation.**

**FY 2006 Plans:**

Efforts initiated in prior fiscal years will continue. These efforts include:

- The Quantum Well Infrared Photodetector (QWIP) project will complete in FY 2006 with lab and field testing of the integrated QWIP and Computed Tomographic Imaging Spectrometer (CTIS) camera.
- Range Profiles of Turbulence will complete in FY 2006 with the integration and demonstration of a brassboard Differential Image Motion (DIM) Light Detection and Ranging (LIDAR) system. The DIM LIDAR data will be compared to truth data to verify system performance.
- The Modulated Retro Target Sensors (MRTS) project will complete in FY 2006 by conducting field demonstrations of the prototype retroreflector sensor system integrated on the target and the remote data acquisition system. The FY 2006 tests will determine the optimum spacing of the MRTS retroreflectors for various target configurations.

Projects identified by the FY 2006 Broad Agency Announcement (BAA) process will be initiated. Efforts are planned in the following areas:

- Methods to measure and evaluate the total instantaneous output power of continuous wave HEL systems within 1% of the true output power to support static beam/target interaction testing.
- Methods to measure optical transmissivity with a 100 times increase in sampling rates over current measurement techniques at different wavelengths along laser beam paths to support HEL T&E.
- Survivable sensor concepts for airborne and ground targets to measure DE (HEL or HPM) effects without interfering with system operation or perturbing test environment.
- DE (HEL or HPM) hardened flight termination system/range destruct package to safely and reliably provide for termination of the target, even when high concentrations of DE are present on the target.

A BAA will be initiated in FY 2006 to select efforts for FY 2007 award.

**FY 2007 Plans:**

Future investigations will be launched to address T&E technology challenges in this focus area for:

- Techniques to accurately predict and understand the total beam distribution for HEL and HPM systems to address critical safety issues such as ensuring that T&E events do not affect civilian or military infrastructure.

- Wide-spectrum, single substrate imagers to enhance imaging and detection of HEL beams from a variety of systems/sources.
- Use of physics-based models incorporated into virtual geographical representations of T&E ranges to provide 3-dimensional, geodetically accurate models of beam propagation, beam spread, lethal range, fluence on target, and atmospheric effects.

A BAA will be initiated in FY 2007 to select efforts for FY 2008 award.

**C. (U) OTHER PROGRAM FUNDING** NA

**D. (U) ACQUISITION STRATEGY** NA

| RDT&E PROJECT JUSTIFICATION SHEET (R-2a) | | | | February 2005 | | | | |
|---|---|---|---|---|---|---|---|---|
| DEFENSE WIDE RDT&E (0400)<br>BUDGET ACTIVITY THREE, PE 0603941D | | | | INFORMATION SYSTEMS TECHNOLOGY TEST | | | | |
| $ in Millions | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| Information Systems Technology Test | 0.000 | 0.000 | 2.370 | 3.759 | 5.783 | 6.357 | 7.201 | 8.435 |

**A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION**

The S&T community is developing advanced Information Systems Technology (IST) to support DoD's Critical Transformational Capabilities—Conduct Information Operations, Deny Enemy Sanctuary, and Leverage Information Technologies. Advancements in IST will provide commanders and staff with an adaptive, network-centric, configurable information visualization environment, which will improve the speed and quality of command decisions. Information assurance and survivability are central to achieving these advancements. These IST advances will enable a spectrum of capabilities ranging from enhanced management and exploitation of intelligence, surveillance, and reconnaissance assets to next-generation tactical radio systems. Successful implementation of these transformational capabilities will necessitate a corresponding transformation in DoD's ability to test and evaluate IST. The IST Test (ISTT) focus area will address the T&E scenarios, technologies, and analysis tools required to ensure that information systems delivered to the warfighter provide an assured capability to acquire, verify, protect, and assimilate information necessary for battlefield dominance within a complex network-centric environment.

**B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM**

| | FY 2004 | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|---|
| Information Systems Technology Test | 0.000 | 0.000 | 2.370 | 3.759 |

**FY 2004 Accomplishments:** **See OT&E,D (0460) appropriation.**

**FY 2005 Accomplishments: See OT&E,D (0460) appropriation.**

**FY 2006 Plans:**

Projects identified by the FY 2006 Broad Agency Announcement (BAA) process will be initiated. Potential areas of investigation include:

- Development of T&E metrics to determine the effectiveness of IST and Information Operations.
- Tools that employ artificial intelligence to support the instrumentation and visualization of IST T&E environments.
- Development of non-intrusive instrumentation and T&E communication networks (including networks-of-networks) that do not affect the performance of information systems under evaluation, especially for humans-in-the-loop network-centric environments.
- Methods to support T&E of decision aids used in network-centric operations.
- Ability to assess information assurance within complex systems-of-systems.
- Methods to evaluate the performance of network-centric operations in a multi-node dynamic environment.

A BAA will be issued to select efforts for FY 2007 award.

**FY 2007 Plans:**

Efforts initiated in FY 2006 will continue. Future investigations will be launched to address IST T&E technology challenges. Areas of potential investigation include:

- Techniques for capturing spatial and temporal registration across large numbers of sensors, multimedia communications, and human-system interface devices.
- Techniques for capturing and evaluating multiple simultaneous collaborative user data links.
- Techniques for capturing and evaluating human physical and cognitive performance.
- Developing T&E capability to evaluate IST advances from a "human-out" perspective; i.e., determine what information actually enhances a warfighter's performance.
- Technologies to non-intrusively assess low probability of detection/low probability of intercept communications and data links.
- Methods to assess the contribution of IST to decision superiority in operational scenarios.

Additional IST T&E technology issues will be identified, incorporated into the ISTT roadmap, and addressed in future research plans.

A BAA will be initiated in FY 2007 to select efforts for FY 2008 award.

**C. (U) OTHER PROGRAM FUNDING** NA

**D. (U) ACQUISITION STRATEGY** NA

| RDT&E PROJECT JUSTIFICATION SHEET (R-2a) | | | | February 2005 | | | | |
|---|---|---|---|---|---|---|---|---|
| DEFENSE WIDE RDT&E (0400)<br>BUDGET ACTIVITY THREE, PE 0603941D | | | | SOFTWARE TEST | | | | |
| $ in Millions | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| Software Test | 0.000 | 0.000 | 1.304 | 2.989 | 5.350 | 5.897 | 6.742 | 8.090 |

## A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION

Use of complex, high-speed, software-intensive systems is increasing within weapons; Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems; and other automated information processing systems. Most software-intensive systems are developed, tested, and fielded in significantly shorter periods than hardware systems. Software components are generally upgraded more frequently than hardware in systems. Testing systems with software components requires rigorous software configuration control to ensure that reported test results apply to the actual fielded software.

Most current software tests are manpower intensive and require expert knowledge of the system under test. An automated, objective test capability is required to assess the effectiveness and performance of future software systems as well as to determine the appropriate amount of regression testing required when that software is modified. As the use of "learning" software proliferates, testing will be required to identify unacceptable behavior, detect defects in behaviors that have yet to be learned, and to predict the future performance of the learning software. Significant integration and interoperability issues among software systems and large databases must be overcome to enable testing of software-intensive systems. Artificial stimulation will be needed for both load and security testing. Methods to verify software integrity must also be identified. The Software Test focus area will develop the T&E technologies necessary to adequately test software intensive systems as the complexity of these systems increases in the future.

## B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM

| | FY 2004 | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|---|
| Software Test | 0.000 | 0.000 | 1.304 | 2.989 |

**FY 2004 Accomplishments:** **See OT&E,D (0460) appropriation.**

**FY 2005 Accomplishments:** **See OT&E,D (0460) appropriation.**

**FY 2006 Plans:**

The efforts selected by the FY 2006 Broad Agency Announcement (BAA) process will be awarded. The initial emphasis of this focus area will be developing and demonstrating technologies to objectively test software-intensive systems. Areas of potential investigation are:

- Development of metrics to objectively quantify the performance of software-intensive systems and adaptive software systems.
- Automated techniques to assess software system effectiveness and suitability.
- Development of metrics to quantify standards for regression testing of modified software.
- Methods to perform automated regression testing after accepted software has been modified.

A BAA will be issued to identify additional efforts for FY 2007 award.

**FY 2007 Plans:**

Efforts initiated in FY 2006 will continue. Additional efforts identified by the FY 2007 BAA will be initiated. Efforts will continue to expand the ability to evaluate software-intensive systems. Potential areas of investigation include:

- Techniques to support automated assessment of cognitive/adaptive software systems.
- Ability to test software-intensive systems embedded in systems-of-systems configurations.
- Methods to assess code integrity within software-intensive systems.
- Techniques to assess multi-level security within software intensive system architectures.

Additional T&E technology issues will be identified and incorporated into the Software Test roadmap to support continued development in this focus area. A BAA will be initiated in FY 2007 to select efforts for FY 2008 award.

**C. (U) OTHER PROGRAM FUNDING** NA

**D. (U) ACQUISITION STRATEGY** NA

| RDT&E PROJECT JUSTIFICATION SHEET (R-2a) | | | | February 2005 | | | | |
|---|---|---|---|---|---|---|---|---|
| DEFENSE WIDE RDT&E (0400)<br>BUDGET ACTIVITY THREE, PE 0603941D | | | | MODELING AND SIMULATION | | | | |
| $ in Millions | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| Modeling and Simulation | 0.000 | 0.000 | 1.304 | 1.986 | 2.883 | 3.384 | 3.919 | 4.617 |

**A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION**

Weapon and Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) systems are becoming more complex and software intensive as well as increasingly interdependent and interoperable with other systems. These characteristics coupled with enhanced performance, such as operating at hypersonic velocities, make it increasingly more difficult and unaffordable to perform comprehensive test and evaluation without the use of constructive, virtual, and live modeling and simulation (M&S). Much work has been done to develop M&S for use in engineering design (detailed engineering models), platform analysis (one-on-one), mission analysis (many-on-many), and theater level (force-on-force) simulations. However, advancements are needed to enable reusing a model from one of these levels with other models from the same or different levels to support T&E. In order to evaluate advanced weapon systems and systems-of-systems, advanced M&S technology tools are required to provide flexibility to integrate models and simulations of varying resolution and fidelity and to maximize the reuse of validated engineering models and simulations. The M&S focus area will leverage emerging technologies to facilitate model integration and improve simulation performance to support T&E of future weapon systems.

**B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM**

| | FY 2004 | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|---|
| Modeling and Simulation | 0.000 | 0.000 | 1.304 | 1.986 |

**FY 2004 Accomplishments:** **See OT&E,D (0460) appropriation.**

**FY 2005 Accomplishments: See OT&E,D (0460) appropriation.**

**FY 2006 Plans:**

The efforts selected by the FY 2006 Broad Agency Announcement (BAA) process will be awarded. The initial emphasis of this focus area will be to develop technologies that support the reuse of various levels of system models to augment T&E capabilities. Areas of potential investigation are:

- Aggregation and disaggregation among various levels of models and simulations, and the capability to interlink different levels of models to operate in real time.
- Technology supporting large data exchange among distributed simulations over large geographical distances with little to no latency.
- Techniques to provide intuitive visualization of large amounts of simulation data.

A BAA will be issued to identify efforts for FY 2007 award.

**FY 2007 Plans:**

Efforts initiated in FY 2006 will continue. Additional efforts identified by the FY 2007 BAA will be initiated. Potential areas of investigation include:

- Techniques to create realistic synthetic environments and targets for stressing systems-under-test.
- Ability to create realistic synthetic forces with improved representation of human physiological and psychological performance.
- Techniques to augment T&E events with systems-of-systems simulations of network-centric and C4ISR systems.
- Automated capability to select and assemble M&S components of various combinations into complete simulation environments to satisfy specific T&E requirements across a variety of application domains, levels of resolution, and time scales.

Additional T&E technology issues will be identified and incorporated into the M&S roadmap to support continued development in this focus area. A BAA will be initiated in FY 2007 to select efforts for FY 2008 award.

**C. (U) OTHER PROGRAM FUNDING** NA

**D. (U) ACQUISITION STRATEGY** NA

| RDT&E PROJECT JUSTIFICATION SHEET (R-2a) | | | | February 2005 | | | | |
|---|---|---|---|---|---|---|---|---|
| DEFENSE WIDE RDT&E (0400)<br>BUDGET ACTIVITY THREE, PE 0603941D | | | | TEST RANGE/FACILITY TECHNOLOGY IMPROVEMENTS | | | | |
| $ in Millions | FY 2004 | FY 2005 | FY 2006 | FY 2007 | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| Test Range/Facility Technology Improvements | 0.000 | 0.000 | 0.059 | 1.282 | 2.211 | 2.775 | 3.347 | 3.929 |

**A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION**

The Department's Quadrennial Defense Review (QDR) transformation initiatives, as well as its drive to reengineer business and acquisition processes, are resulting in an increased rate of technology insertion into new and existing weapons systems. As the pace of spiral development increases, the operational tempo at ranges and facilities that support the test and evaluation of these systems will increase. The capability of T&E infrastructure to collect and archive accurate T&E data, analyze that data, and provide timely reporting of test results must be improved to support DoD transformation goals. This will require technology improvements to expedite processes, minimize the expenditure of human capital, and reduce test costs. The Test Range/Facility Technology Improvements focus area will develop technologies to enhance data collection and analysis, test management, and reporting to facilitate T&E missions and deliver near real-time analysis of results.

**B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM**

| | FY 2004 | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|---|
| Test Range/Facility Technology Improvements | 0.000 | 0.000 | 0.059 | 1.282 |

**FY 2004 Accomplishments:** NA

**FY 2005 Accomplishments:** NA

**FY 2006 Plans:**

Although substantive efforts are planned to begin in FY 2007, the program will establish the foundation for the Test Range/Facility Technology Improvements focus area in FY 2006. This effort includes:

- Identifying subject matter experts.
- Identifying an Executing Agent.
- Establishing a working group and refining the Test Range/Facility Technology Improvements roadmap.

A Broad Agency Announcement (BAA) will be issued to identify efforts for FY 2007 award.

**FY 2007 Plans:**

The efforts selected by the FY 2007 BAA process will be awarded. The initial emphasis of this focus area will be the development of technologies to handle the vast amounts of data that each test event generates and methods to increase the operational tempo of T&E events without adversely affecting the quality of testing. Areas of potential investigation are:

- Technologies to expedite collection, handling, processing, analysis, and report generation of large quantities of data.
- Techniques to acquire and apply metadata (data about the data such as time stamps and data source) to enhance analysis capabilities.
- Methods that improve the availability, turnaround, and calibration of instrumentation and support systems for T&E events.
- Capabilities that support the ready retrieval of data and data dictionaries for reuse to minimize retesting.
- Improving the availability of T&E data to the S&T community, program offices, and warfighters.
- Replacing manpower-intensive and –dependent functions with automation.
- Techniques for conducting distributed testing with centralized test oversight. This includes technology that allows using systems in multiple locations to achieve a systems-of-systems test environment and the ability to provide remote operation of test facilities to minimize personnel and test management costs.

Additional T&E technology issues will be identified and incorporated into the Test Range/Facility Technology Improvements roadmap to support continued development in this focus area. A BAA will be initiated in FY 2007 to select efforts for FY 2008 award.

**C. (U) OTHER PROGRAM FUNDING** NA

**D. (U) ACQUISITION STRATEGY** NA