

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

**February 2007**

| BUDGET ACTIVITY                                       |                   | PE NUMBER AND TITLE                               |                     |                     |                     |                     |                     |                     |
|---|-------------------|---|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| <b>2 - Applied Research</b>                           |                   | <b>0602784A - MILITARY ENGINEERING TECHNOLOGY</b> |                     |                     |                     |                     |                     |                     |
| COST (In Thousands)                                   | FY 2006<br>Actual | FY 2007<br>Estimate                               | FY 2008<br>Estimate | FY 2009<br>Estimate | FY 2010<br>Estimate | FY 2011<br>Estimate | FY 2012<br>Estimate | FY 2013<br>Estimate |
| Total Program Element (PE) Cost                       | 48789             | 51278   | 51120               | 52118               | 52903               | 53563               | 55026               | 56441               |
| 855 TOPOGRAPHICAL, IMAGE INTEL & SPACE                | 11634             | 11318   | 14719               | 15438               | 16066               | 16748               | 17668               | 18559               |
| H71 ATMOSPHERIC INVESTIG                              | 6472              | 6741  | 6676                | 6853                | 6927                | 6980                | 7134                | 7290                |
| T40 MOB/WPNS EFF TECH                                 | 16136             | 15560   | 17565               | 17747               | 17942               | 18087               | 18485               | 18892               |
| T41 MIL FACILITIES ENG TEC                            | 4834              | 5034  | 4206                | 4085                | 3976                | 3778                | 3722                | 3617                |
| T42 COLD REGIONS ENGR TECH                            | 4334              | 4550  | 4680                | 4761                | 4812                | 4850                | 4957                | 5046                |
| T45 ENERGY TEC APL MIL FAC                            | 2790              | 3377  | 3274                | 3234                | 3180                | 3120                | 3060                | 3037                |
| T48 Center for Geosciences & Atmospheric Research     | 1630              |   |                     |                     |                     |                     |                     |                     |
| T52 Stationary Power and Energy Applied Research (CA) |                   | 3857  |                     |                     |                     |                     |                     |                     |
| T53 Military Engineering Applied Research (CA)        | 959               | 841   |                     |                     |                     |                     |                     |                     |

**A. Mission Description and Budget Item Justification:** The objective of this applied research program element (PE) is to provide military engineering technologies in support of the Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. Research is conducted that supports special requirements for battlefield visualization, tactical decision aids, weather intelligence products, and capabilities to exploit space assets. Results are tailored to support the materiel development, test, and operations communities in evaluating the impacts of weather, terrain, and atmospheric obscuration on military materiel and operations. Major research efforts focus on: advanced distributed simulation including networking of models, complex data interchange, and collaborative training; military engineering including improving airfields and pavements, sustainment and cold regions engineering, vehicle mobility modeling, and reduced logistics footprint at base camps; facilities engineering including simulation of infrastructure capabilities for force projection, protection, and readiness; and battlespace environments including terrain awareness. This research improves the efficiency and cost effectiveness of supporting the training/readiness/force projection missions in garrison and force sustainment missions in theaters of operation. Research is transitioned to PE 0603734A (Military Engineering Advanced Technology), PE 0603125A (Combating Terrorism, Technology Development), and to Project Managers (PM) such as PM Force Projection and Project Director, Combat Terrain Information Systems. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, and the Army Research Laboratory located at Aberdeen, MD, execute the project work.

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February 2007

|                             |   |  |  |  |
|-----------------------------|---|--|--|--|
| BUDGET ACTIVITY             | PE NUMBER AND TITLE                               |  |  |  |
| <b>2 - Applied Research</b> | <b>0602784A - MILITARY ENGINEERING TECHNOLOGY</b> |  |  |  |

| <u><b>B. Program Change Summary</b></u>       | FY 2006 | FY 2007 | FY 2008 | FY 2009 |
|---|---------|---------|---------|---------|
| Previous President's Budget (FY 2007)         | 50318   | 50098   | 50302   | 50811   |
| Current BES/President's Budget (FY 2008/2009) | 48789   | 51278   | 51120   | 52118   |
| Total Adjustments                             | -1529   | 1180    | 818     | 1307    |
| Congressional Program Reductions              |         | -3196   |         |         |
| Congressional Rescissions                     |         |         |         |         |
| Congressional Increases                       |         | 4750    |         |         |
| Reprogrammings                                | -1529   | -374    |         |         |
| SBIR/STTR Transfer                            |         |         |         |         |
| Adjustments to Budget Years                   |         |         | 818     | 1307    |

Three FY07 congressional adds totaling \$4552 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

- (\$2779) Army Power and Energy Initiative
- (\$958) National Fuel Cell Research for Military Application
- (\$815) Airborne Threats

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

**February 2007**

|   |                   |   |                     |                     |                     |                     |                              |                     |  |
|---|-------------------|---|---------------------|---------------------|---------------------|---------------------|------------------------------|---------------------|--|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> |                   | <b>PE NUMBER AND TITLE</b><br><b>0602784A - MILITARY ENGINEERING TECHNOLOGY</b> |                     |                     |                     |                     | <b>PROJECT</b><br><b>855</b> |                     |  |
| COST (In Thousands)                                   | FY 2006<br>Actual | FY 2007<br>Estimate   | FY 2008<br>Estimate | FY 2009<br>Estimate | FY 2010<br>Estimate | FY 2011<br>Estimate | FY 2012<br>Estimate          | FY 2013<br>Estimate |  |
| 855 TOPOGRAPHICAL, IMAGE INTEL & SPACE                | 11634             | 11318   | 14719               | 15438               | 16066               | 16748               | 17668                        | 18559               |  |

**A. Mission Description and Budget Item Justification:** The objective of this applied research project is to provide advanced technologies for storing, transforming, updating, and disseminating extremely large volumes of terrain and weather effects data at, or near, real-time and dynamic analysis and reasoning of this data to enable Future Force Command and Control Systems with superior knowledge of the battlespace terrain and environment. Work in this project significantly enhances the Army's geospatial data management and dissemination capabilities. Weather and atmospheric data is provided for this project through the Army Research Laboratory efforts funded in program elements (PE) 0601102A Project 52C and PE 0602784A Project H71. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

| <u>Accomplishments/Planned Program:</u>   | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
|---|----------------|----------------|----------------|----------------|
| Data Generation: In FY06, matured capabilities to geo-encode non-spatial sources to support planning and military decision-making process. In FY07, develop and refine technologies to detect and geo-locate chemical and biological agents and begin incorporating this capability into sensor technology that can be deployed in the battlespace environment. In FY08, will experiment with prototype sensors and develop methodologies to integrate the data collected into a geo-database. In FY09, will design and develop new capabilities that exploit sensor data from various sources (including Soldiers, imagery, and lidar) to rapidly generate minimum required geospatial data needed to support operations in various terrain (e.g., urban and complex terrain). | 1898           | 1783           | 2488           | 2615           |
| Data Management: In FY06, completed development and testing of imagery, elevation, and feature data integration methods and tools for transition to Army systems/services. In FY07, develop and test a geospatial data model that incorporates traditional terrain data types and also includes detailed tactical HUMINT data. In FY08, will develop and refine tools to correlate and fuse geospatial data from various sources (including tactical sensors and other sources) into a common geospatial database that supports multiple applications. In FY09, will implement new geospatial terrain and cultural data technologies, taxonomies and models to ensure interoperability and sharing of information.  | 4912           | 4455           | 5798           | 6076           |
| Data Analysis: In FY06, refined and evaluated prototype, stand-alone situation and threat analysis tools. In FY07, mature urban terrain reasoning tools that incorporate the effects of natural, man-made features, and human activities into urban course of action planning tools. In FY08, will develop a state of the art model for evidential reasoning that incorporates terrain and cultural conditions. In FY09, will complete experimentation and prototyping to include connection to Future Combat Systems brigade combat team. Will evolve standalone evidential reasoning model(s) from standalone to reachback services.  | 4824           | 4949           | 6433           | 6747           |
| Small Business Innovative Research/Small Business Technology Transfer Programs  |                | 131            |                |                |
| <b>Total</b>  | <b>11634</b>   | <b>11318</b>   | <b>14719</b>   | <b>15438</b>   |

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

**February 2007**

|   |                   |   |                     |                     |                     |                     |                              |                     |  |
|---|-------------------|---|---------------------|---------------------|---------------------|---------------------|------------------------------|---------------------|--|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> |                   | <b>PE NUMBER AND TITLE</b><br><b>0602784A - MILITARY ENGINEERING TECHNOLOGY</b> |                     |                     |                     |                     | <b>PROJECT</b><br><b>H71</b> |                     |  |
| COST (In Thousands)                                   | FY 2006<br>Actual | FY 2007<br>Estimate   | FY 2008<br>Estimate | FY 2009<br>Estimate | FY 2010<br>Estimate | FY 2011<br>Estimate | FY 2012<br>Estimate          | FY 2013<br>Estimate |  |
| H71      ATMOSPHERIC INVESTIG                         | 6472              | 6741  | 6676                | 6853                | 6927                | 6980                | 7134                         | 7290                |  |

**A. Mission Description and Budget Item Justification:** The objective of this project is to perform applied research for tactical weather and atmospheric effects algorithms, and for the integration of battlefield atmospheric environments simulations. The Army's transformation plan to the Future Force will require capabilities for battlefield commanders to make decisions based on tactical weather technology and impacts. This weather intelligence data will have to be not only accurate and timely, but distributed down to the lowest levels of command, which may include the individual Soldier. This project accomplishes this mission by transitioning technology to the Program Manager, Distributed Common Ground Station-Army (DCGS-A) through the Integrated Meteorological System (IMETS), through support to the Project Manager for Target Identification and Meteorological Systems (PM-TIMS) for field artillery systems, and to the Department of Defense (DoD) modeling community. It provides detailed model applications for various effects of the atmosphere on electro-optical and acoustic target detection, location, and identification. This project devises both physics-based decision aids and rule-based expert systems for assessing the impacts of weather on a very broad spectrum of friendly and threat weapons systems, sensors, platforms, and operations. These can be applied for mission planning, battlefield visualization, optimum weather sensor, and Reconnaissance Surveillance Target Acquisition (RSTA) sensor placement; route planning to maximize stealth and efficiency, tactical decision aids, and modeling and simulation of weather impacts for combat simulations and war games. This project supports the Army's transformation to the Future Force through future applications and platforms that support echelons at Brigade and below, down to the individual Soldier, and Defense Technology Objectives, Weather/Atmospheric Impacts on Sensor Systems, and On-Scene Weather Sensing and Prediction Capability. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory.

|   |                |                |                |                |
|---|----------------|----------------|----------------|----------------|
| <b><u>Accomplishments/Planned Program:</u></b>  | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
| Mature a new high resolution, short-range forecasting capability based on integrating new battlefield meteorological data sources (non-conventional meteorological sensors such as Unmanned Aircraft Systems (UAS), robotic sensors, etc.) into model initialization which will directly impact nowcast (very short-range forecast) accuracy over target areas and provide much higher resolutions over the theater of operations. Adapt and apply a research version of an operational forecast/meteorological model that can ingest data from meteorological satellites, UAS, and ground-based sensors. Research and verify the capability to host the model on battlefield processors, including battlefield fire support systems, to autonomously generate artillery meteorological messages and produce near real time decision aids. In FY06, delivered an initial Weather Running Estimate capable of ingesting conventional sources data for real-time updates of databases and forecast predictions supporting DCGS-A weather services during mission execution. In FY07, design and evaluate a Local Analysis and Prediction System (LAPS) capable of ingesting data from conventional and non-traditional data sources for nowcasting applications. In FY08, will integrate a complete Weather Running Estimate-Nowcast (WRE-N) capability for DCGS-A that will support the fidelity and timeliness of the forecasts. Will evaluate the use of Weather Research and Forecasting (WRF) model as part of the LAPS package within the WRE-N system for improved ability to ingest data from both conventional and non-traditional sources. In FY09, will formulate new methods to use microscale model output for critical micro-UAS flight parameters that can improve the launch, operation, and recovery of UAS assets. Research, design, and apply high resolution meteorological model improvements that account for fine scale structure in the urban boundary layer meteorology for an improved capability for predicting atmospheric effects. | 2356           | 2539           | 2573           | 2608           |
|   |                |                |                |                |

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**February 2007**

| BUDGET ACTIVITY  | PE NUMBER AND TITLE                               |             |             | PROJECT     |
|--|---|-------------|-------------|-------------|
| <b>2 - Applied Research</b>  | <b>0602784A - MILITARY ENGINEERING TECHNOLOGY</b> |             |             | <b>H71</b>  |
| Investigate critical value thresholds for weather impacts on friendly & threat systems for the rule-based Integrated Weather Effects Decision Aids & develop physics-based atmospheric effects models for operational combat mission planning, simulations, and sensor/weapon development. Mature the Sensor Performance Evaluator for Battlefield Environments (SPEBE) and tri-service Target Area Weapons Software as key acoustic and electro-optic decision aids. Integrate distributed client applications on mobile devices for "first in" decision aids and for "over watch" of lower echelons. Devise access to weather on embedded Soldier and system processors. Integrate vegetation and terrain effects and infrasonic frequencies into SPEBE to support intelligence analysis. In FY06, integrated an acoustic and seismic decision aid into a library of analysis modules tailored for user applications for better understanding of the effects of sound on military requirements for sense and avoid. In FY07, integrate UAS route planning decision aids based on effects of winds, terrain, and weather hazards on platform and sensor performance. Design UAS mission route flight optimization capability including enroute adjustments to account for atmospheric conditions. Adapt neural network acoustic propagation model into SPEBE to achieve a faster solution. In FY08, will employ automated Weather Intelligence-Routing (WIN-R) UAS flight optimization capability enabling automated route adjustments based on detected atmospheric effects. In FY09, will construct an acoustic model predicting the effects of single urban structures on detection and avoidance capabilities. Will explore machine-to-machine capability options for autonomous UAS flight control using WIN-R technology that will eliminate the need for the man-in-the-loop. Will integrate wideband enhancements to Tri-Service MODTRAN. Will integrate night-time illumination model improvements into Tri-Service Target Acquisition Weapons Software (TAWs) | 2072  | 2081        | 2105        | 2141        |
| Integrate high resolution boundary layer meteorological (met) measurements with models to improve condition prediction in urban/complex terrains. Enable continuous assimilation of real time, 3D Light Detection And Ranging (LIDAR) remotely sensed wind data into micro-scale urban complex terrain wind models for near real time, 3D picture of the atmosphere. Achieve 25:1 or greater compression of 2D, 3D, and 4D met databases. Devise/verify algorithms for optimum met sensor placement. Perform detailed measurements of the urban met environment for modeling use. In FY06 measured, characterized and analyzed meteorological data over urban/complex terrain that increase understanding of atmospheric phenomena and effects. Investigated automation techniques for optical signature sorting of aerosol particles to more quickly identify threat agents. In FY07, investigate the use of super-continuum LIDAR for remote spectral identification of chemical/biological threat agents. Will explore the potential of using parameterized slope flow effects in a microscale wind model for greater fidelity and accuracy. Will evaluate urban wind field models through field experiments for optimum met sensor placement. In FY08, will prepare a microscale wind model for urban domains initialized with WRE-N and WRF model output with computationally efficient data assimilation methods. Will investigate the capture efficiency of single particle aerosol extraction technologies and explore urban field measurement data against urban wind flow predictive models. In FY09, will employ stable boundary layer to improve existing high resolution boundary layer meteorological models. Will simulate and evaluate use of a microscale wind model as an integrated part of the DCGS-A weather system. Will develop and integrate a Doppler LIDAR Analysis Toolkit (DLAT) for semi-autonomous data assimilation and processing. Will investigate an integrated aerosol separation and bioassay instrument for detecting bio-aerosols. | 2044  | 2101        | 1998        | 2104        |
| Small Business Innovative Research/Small Business Technology Transfer Programs   |   | 20          |             |             |
| <b>Total</b>   | <b>6472</b>                                       | <b>6741</b> | <b>6676</b> | <b>6853</b> |

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

**February 2007**

|   |                   |   |                     |                     |                     |                     |                              |                     |  |
|---|-------------------|---|---------------------|---------------------|---------------------|---------------------|------------------------------|---------------------|--|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> |                   | <b>PE NUMBER AND TITLE</b><br><b>0602784A - MILITARY ENGINEERING TECHNOLOGY</b> |                     |                     |                     |                     | <b>PROJECT</b><br><b>T40</b> |                     |  |
| COST (In Thousands)                                   | FY 2006<br>Actual | FY 2007<br>Estimate   | FY 2008<br>Estimate | FY 2009<br>Estimate | FY 2010<br>Estimate | FY 2011<br>Estimate | FY 2012<br>Estimate          | FY 2013<br>Estimate |  |
| T40 MOB/WPNS EFF TECH                                 | 16136             | 15560   | 17565               | 17747               | 17942               | 18087               | 18485                        | 18892               |  |

**A. Mission Description and Budget Item Justification:** The objective of this applied research project is to provide technologies for rapid upgrading, construction, and repair of in-theater airfields; for overcoming battlespace gaps through prediction, definition, avoidance, or defeat; for expedient force protection during contingency operations; for rapid port enhancement. This research supports development of the Future Force by providing physics-based representations of mobility, obstacle, and barrier placement, survivability, and weapons effects in urban terrain modeling and simulation. Additionally, the project matures technologies that increase the survivability of critical assets from conventional and terrorist weapons, and maneuver support of deployed forces, while reducing their logistical footprint. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

| <b>Accomplishments/Planned Program:</b>   | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
|---|----------------|----------------|----------------|----------------|
| Force Protection: In FY06, developed, tested, and delivered algorithms to the Anti Terrorism Planner software (200 plus registered users) and the J34's Joint Antiterrorism/Force Protection Portal for assessing the effectiveness of blast/fragment protection upgrades to structures in contingency environments that increased the resistance of structures by 90 percent to 200 percent above current minimal protection. In FY07, develop algorithms for survivability design and assessment tools; produce low-cost, threat specific modular protective systems for large areas at about 1/5th the cost per square foot of advanced composite and ceramic armors; initiate effort to develop technologies to provide protective materials and configurations against large caliber rockets and mortars, light artillery, and 50-caliber arms; and initiate effort to gain improved understanding of geophysical phenomenology to support detecting buried targets. In FY08, will create novel layered protective materials to defeat 50-caliber arms and develop procedures for numerical evaluation of protective materials through multi-scale modeling. Produce Automated Target Recognition (ATR) for tunnel and tunneling activity detection for use by Joint Task Force - North in their interdiction mission. In FY09, will provide protective systems and retrofits to defeat large caliber rockets, light artillery, and 50-caliber arms. Develop sensor/geophysical algorithms for disturbed material signatures to be utilized by sensors that detect buried objects. Initiate effort to provide expedient protection against artillery and small missiles relying heavily on the Computational Protection Testbed. | 5033           | 6809           | 6456           | 6987           |
| Enable Theater Access/Joint Rapid Airfield Construction: In FY06, selected and tested rapid repair materials for paved airfield surfaces. In FY07, select and test shear-resistant stabilizers and dust control additives for semi-prepared C-17 airfield surfaces. Rapid Port Enhancement In FY06, finalized design of Lightweight Modular Causeway System (LMCS) and completed the Small Port Throughput Simulation Model and supported Joint Enable Theater Access initiatives. In FY07, support Joint Enable Theater Access-Sea Ports of Debarkation Advanced Concept Technology Demonstration (ACTD) in conducting full-scale LMCS component testing and demonstration. In FY08, will provide technical designs and drawings to enable final fabrication and/or modifications as necessary to the ACTD system that will be tested in a controlled field environment, including two full-scale LMCS sections and the JETA-SPOD Analysis Tool. ERDC engineers and scientists will monitor fabrication of the systems and provide Quality Assurance/Quality Control for the full-scale LMCS and will also provide design details and drawings for an Emplacement and Recovery System to be used on multiple launch platforms for the LMCS test series. In FY09, ERDC will support ACTD user evaluations by providing continued technical expertise,   | 4063           | 3767           | 6938           | 7865           |

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**February 2007**

**BUDGET ACTIVITY**  
**2 - Applied Research**

**PE NUMBER AND TITLE**  
**0602784A - MILITARY ENGINEERING TECHNOLOGY**

**PROJECT**  
**T40**

guidance, and training to military units selected to test and evaluate the LMCS residuals. The residuals will include an Emplacement and Recovery System, two sections of LMCS (approximately 100 feet), and the associated mooring system. ERDC personnel will also prepare design modifications for the LMCS that arise from this series of tests and provide these design modifications to the Transition Manager. Initiate effort to develop the capability to rapidly identify and repair austere landing zones for vertical lift intra-theater access.

Maneuver Support/Gap Defeat: In FY06, integrated reconnaissance technologies for characterizing critical features of terrain gaps less than 4 meters wide and conducted evaluations of gap crossing technologies in simulated environments; created a force response element that represents the soil/snow for any motion system operating in real time simulated environments. Hardened Combined Effects Penetrator Warheads In FY07, finalize algorithms to predict performance of ARDEC's Multi-Threat Objective Projectile (M-TOP) against urban targets. In FY08, will participate in M-TOP redesign using the ERDC-developed, DOD-accredited penetration model, PENCRV3D. Will participate in the M-TOP integrated demonstration by providing the instrumented structural target and weapons effects analysis. Future Force Breaching in MOUT. In FY09, will in cooperation with ARDEC, develop and transition a lightweight, single-stage explosive wall breaching system to Project Manager Close Combat Systems (PM-CCS) for SDD.

Geospatial Research and Engineering Support: In FY06, developed capability for transferring additional high-priority Battlespace Terrain Reasoning and Awareness (BTRA) maneuver-related information products to One SAF Objective System (OOS) and other applications, introduced extensions for computer-generated forces behaviors supporting training and course of action development and analysis. Determined feasibility of interpreting sensor data to characterize critical infrastructure. In FY07, produce and refine products/procedures for interoperability; expand scaling as required based on set of BTRA information products; incorporate additional behaviors and related components as necessary to support training and course of action development and analysis. In FY08, will create an Urban Tactical Decision Aid for planning the best mix of infantry and small unmanned ground vehicles for clearing a building. In FY09, will develop bridging analysis Tactical Decision Aid for determining necessary bridging assets to conduct gap crossing and defeat solutions and will support Geospatial Battle Management Language (GEOBML) syntax in support of the Battlespace Terrain Reasoning and Awareness - Battle Command (BTRA-BC) Army Technology Objective(ATO).

Total

|  |       |       |       |       |
|--|-------|-------|-------|-------|
|  |       |       |       |       |
|  | 5223  | 2677  | 2483  | 1697  |
|  | 1817  | 2307  | 1688  | 1198  |
|  | 16136 | 15560 | 17565 | 17747 |

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|---|-------------------|---|---------------------|---------------------|---------------------|---------------------|------------------------------|---------------------|--|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> |                   | <b>PE NUMBER AND TITLE</b><br><b>0602784A - MILITARY ENGINEERING TECHNOLOGY</b> |                     |                     |                     |                     | <b>PROJECT</b><br><b>T41</b> |                     |  |
| COST (In Thousands)                                   | FY 2006<br>Actual | FY 2007<br>Estimate   | FY 2008<br>Estimate | FY 2009<br>Estimate | FY 2010<br>Estimate | FY 2011<br>Estimate | FY 2012<br>Estimate          | FY 2013<br>Estimate |  |
| T41 MIL FACILITIES ENG TEC                            | 4834              | 5034  | 4206                | 4085                | 3976                | 3778                | 3722                         | 3617                |  |

**A. Mission Description and Budget Item Justification:** The objective of this applied research project is to deliver sustainable, cost efficient, and effective facilities; and provide installation operations required to support the Future Force. The project focuses on advanced facilities and operations technologies directly supporting training, readiness, force projection, force protection, homeland security, and urban operations. Facility enhancement technologies contribute to cost reductions in the Army facility life cycle process (infrastructure planning, assessment, design, construction, revitalization, sustainment, and disposal), and the supporting installation operations. This work improves the ability of installations to support forces to meet transformation goals, improves designs for close battle training facilities, and enhances security of Soldiers, families, and civilians. Technologies evolving from this work include integrated planning and design tools for CONUS facilities and forward bases, models predicting airborne dispersed chemical, biological, and radiological (CBR) effects on facilities and occupants; sustainable facility management; and collaborative decision support. In addition, technologies from this work will support analysis of cultural and facility issues in urban operations. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

| <u>Accomplishments/Planned Program:</u>  | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
|--|----------------|----------------|----------------|----------------|
| Facility Engineering: In FY06, established performance related requirements for building envelopes for airborne CBR protection. In FY07, complete protocols for determining boundary conditions (building exterior and interior) and boundary condition models for use by facility designers and operators to protect DoD facilities from air borne chemical and biological agents. In FY08, will develop and evaluate prototype Carbon Nanotube (CNT)-based filaments, membranes, and coatings that have 2-fold to 10-fold improvement in performance (strength, weight) over existing materials (e.g. steels, polymers) for installation infrastructure materials. In FY09, will develop and validate predictive models and algorithms for durability of fiber reinforced polymer (FRP) composites for facilities and equipment, based on mechanisms of deformation and degradation. | 1849           | 1867           | 1537           | 1889           |
| Facility Modeling and Simulation/Fort Future: In FY06 defined framework for incorporating facility use and cultural factors for tactical decision aids. Integrated modeling and simulation capability to rapidly assess and rehearse end-to-end deployments from multiple installations. In FY07, model buildings and cultural aspects of urban terrain in computationally efficient form. In FY08, will develop methods to enable units to rapidly understand local power relations and anticipate local responses for stability, security, transition, and reconstruction (SSTR) operations in heterogeneous communities. In FY09, will develop analysis and predictive capabilities to enable units to gain cultural competence relevant to their mission   | 2985           | 3167           | 2669           | 2196           |
| <b>Total</b>   | <b>4834</b>    | <b>5034</b>    | <b>4206</b>    | <b>4085</b>    |

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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> |                   | <b>PE NUMBER AND TITLE</b><br><b>0602784A - MILITARY ENGINEERING TECHNOLOGY</b> |                     |                     |                     |                     | <b>PROJECT</b><br><b>T42</b> |                     |  |
| COST (In Thousands)                                   | FY 2006<br>Actual | FY 2007<br>Estimate   | FY 2008<br>Estimate | FY 2009<br>Estimate | FY 2010<br>Estimate | FY 2011<br>Estimate | FY 2012<br>Estimate          | FY 2013<br>Estimate |  |
| T42 COLD REGIONS ENGR TECH                            | 4334              | 4550  | 4680                | 4761                | 4812                | 4850                | 4957                         | 5046                |  |

**A. Mission Description and Budget Item Justification:** The objective of this applied research project is to provide warfighters with an accurate and timely understanding of the battlespace environment's effect on personnel, platforms, sensors, and systems in order to develop improved tactics, techniques, procedures, and plans that ensure information superiority, situational awareness, and force projection. Specifically, this project seeks solutions for minimizing or eliminating the adverse effects of dynamically changing terrain states on sensing capabilities, engineer construction, and tactical maneuver conducted by the Army. To achieve this, effective decision-making tools such as models, simulations, and mission planning and rehearsal factors are required that accurately predict the state of the ground, near-surface atmospheric conditions, and system performance in complex environments. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

| <b><u>Accomplishments/Planned Program:</u></b>   | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
|--|----------------|----------------|----------------|----------------|
| Terrain State: In FY06, completed formulation for all-season, all-terrain, 3-dimensional soil modeling for input to ground platform and terrain mechanics simulations; completed model parameterization for vegetation and ground surface processes for tactical terrain analysis. In FY07, formulate new model of energy and mass exchange for exterior urban surfaces to support target surveillance and reconnaissance; validate models of radiant temperatures of urban exterior surfaces. In FY08, will establish and validate approaches such as real-time analysis techniques for sensor performance to greatly improve computational efficiency for carrying out terrain-state calculations. In FY09, will assess the use of risk-based analyses in employing terrain-sensitive platforms. | 3280           | 3310           | 3001           | 3014           |
| Signature Physics: In FY06, completed wide area infrared targeting template based on terrain-weather phenomena for wide range of targets and backgrounds. In FY07, formulate new approaches to multi-sensor fusion (e.g., acoustic and seismic) and optimization based on characteristics of a complex battlespace environment. In FY08, will design and evaluate tactical decision aids supporting multi-mode sensor missions with templates of geoenvironmental effects. Will develop algorithms to identify disturbed soil signatures based on sensor modality and geo-environment. In FY09, will design and evaluate sensor data fusion aids based on predicted environmental effects.   | 1054           | 1206           | 1679           | 1747           |
| Small Business Innovative Research/Small Business Technology Transfer Programs   |                | 34             |                |                |
| <b>Total</b>   | <b>4334</b>    | <b>4550</b>    | <b>4680</b>    | <b>4761</b>    |

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

**February 2007**

|   |                   |   |                     |                     |                     |                     |                              |                     |  |
|---|-------------------|---|---------------------|---------------------|---------------------|---------------------|------------------------------|---------------------|--|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> |                   | <b>PE NUMBER AND TITLE</b><br><b>0602784A - MILITARY ENGINEERING TECHNOLOGY</b> |                     |                     |                     |                     | <b>PROJECT</b><br><b>T45</b> |                     |  |
| COST (In Thousands)                                   | FY 2006<br>Actual | FY 2007<br>Estimate   | FY 2008<br>Estimate | FY 2009<br>Estimate | FY 2010<br>Estimate | FY 2011<br>Estimate | FY 2012<br>Estimate          | FY 2013<br>Estimate |  |
| T45 ENERGY TEC APL MIL FAC                            | 2790              | 3377  | 3274                | 3234                | 3180                | 3120                | 3060                         | 3037                |  |

**A. Mission Description and Budget Item Justification:** The objective of this applied research project is to provide technologies necessary for secure, energy efficient, sustainable military installations, emphasizing energy and utility systems protection from, and in response to, evolving threats such as chemical, biological, and radiological (CBR) attacks. Advanced energy technologies and processes are also applied to the Army's industrial base to maintain its cost-effective readiness for munitions production, training, and in the theater of operations to reduce logistical footprint. In addition, technologies from this work provide a better understanding of the battlespace environment as it relates to critical infrastructure. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

| <b>Accomplishments/Planned Program:</b>  | <u>FY 2006</u> | <u>FY 2007</u> | <u>FY 2008</u> | <u>FY 2009</u> |
|--|----------------|----------------|----------------|----------------|
| Systems Response to Threats: In FY06, validated CBR analysis tools in a controlled test facility. In FY07, compare tool analyses to an instrumented Army facility using simulated chemical and biological agents. In FY08, will develop predictive models and algorithms making use of activation energies for deformation and degradation mechanisms based on chemistry (moisture absorption, hygro-thermal effects, and crack growth) for prediction of mechanical properties and durability of fiber reinforced polymer (FRP) composites for facilities and equipment. Will conduct initial research into development of new models governing impacts of waterborne chemical and biological agents on aged pipes and chlorine. In FY09, will evaluate and test simulation algorithms based on failure modes and mechanistic models under interactive conditions. Will also complete development of new models governing chemical agents with aged pipes and chlorine. Will develop new dynamic models governing chemical and biological agent fate and transport in a water distribution environment. | 1081           | 1673           | 1809           | 3234           |
| Installation Modeling and Simulation/Fort Future: In FY06, extended simulations for power, water, and fuel infrastructure analysis to forward staging areas. Urban Reasoning and Battlespace Analysis: In FY06, matured methodology to infer utility system topology including simulations to evaluate suitability of infrastructure to support end-to-end deployment activities. In FY07, extend methodology to work with incomplete data sets. Network Enabled C2: In FY07, develop algorithms capable of inferring utility network layout from partial information. Develop algorithms to update the utility network layout as additional information is acquired. In FY08, will develop analysis tools capable of identifying and summarizing a utility network's impact on military operations in urban terrain (MOUT).   | 1709           | 1665           | 1465           |                |
| Small Business Innovative Research/Small Business Technology Transfer Programs   |                | 39             |                |                |
| <b>Total</b>   | <b>2790</b>    | <b>3377</b>    | <b>3274</b>    | <b>3234</b>    |