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

**February 2006**

| BUDGET ACTIVITY | PE NUMBER AND TITLE |
|---|---|
| **2 - Applied Research** | **0602120A - Sensors and Electronic Survivability** |

| COST (In Thousands) | | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate |
|---|---|---|---|---|---|---|---|---|
| Total Program Element (PE) Cost | | 56267 | 51327 | 38428 | 39295 | 40792 | 41255 | 41683 |
| 140 | HI-POWER MICROWAVE TEC | 2948 | 4927 | 5812 | 6202 | 6220 | 6275 | 6323 |
| H15 | GROUND COMBAT ID TECH | 4602 | 5526 | 5940 | 6020 | 7891 | 7960 | 8020 |
| H16 | S3I TECHNOLOGY | 19662 | 17462 | 19457 | 19927 | 19235 | 19409 | 19561 |
| SA1 | Sensors and Electronic Initiatives (CA) | 17602 | 13899 | 0 | 0 | 0 | 0 | 0 |
| SA2 | BIOTECHNOLOGY APPLIED RESEARCH | 2638 | 3599 | 5669 | 5546 | 5796 | 5911 | 6029 |
| SA3 | COMBAT IDENTIFICATION COMPONENT TECHNOLOGIES (CA) | 8815 | 5914 | 0 | 0 | 0 | 0 | 0 |
| TS1 | TACTICAL SPACE RESEARCH | 0 | 0 | 1550 | 1600 | 1650 | 1700 | 1750 |

**A. Mission Description and Budget Item Justification:** The objective of this program is to research and evaluate technologies that will enhance the capabilities of the Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. Focus is on providing sensor, signal, and information processing technology for advanced reconnaissance, surveillance, and target acquisition (RSTA); ground-to-ground and air-to-ground combat identification (ID), and fire control systems, as well as the fuzing and guidance-integrated fuzing functions in future munitions; and significantly improving the survivability, lethality, deployability, and sustainability of FCS by devising high-power electronic components and technologies for compact, light-weight power and energy storage, conversion and conditioning, and radio frequency (RF)-microwave directed energy (RF-DE) weapons. Project 140 researches, develops, and evaluates Radio Frequency Weapon technology, as well as high power components. Project H15 will provide the ability for joint fires to locate, identify, track, and engage targets as necessary with overall goal of increasing lethality and survivability through the reduction of fratricide. Project H16 will provide the Soldier with decisive new capabilities to locate, identify, and engage battlefield targets in tactical and urban environments. In project SA2, the Army Research Laboratory in collaboration with Institute for Collaborative Biotechnology (ICB) industry partners will conduct applied research focused on biological sensors and biological photovoltaics for power generation. Work in SA2 will exploit breakthroughs in biotechnology basic research transitioning from the ICB, a University Affiliated Research Center, to enable Future Force capabilities in sensors, electronics and photonics. Projects SA1 and SA3 fund Congressional special interest items. Project TS1 is a new project that researches, develops, and evaluates space-based remote sensing, signal and information processing technology in collaboration with other DOD and Government Agencies to support space force enhancement and space superiority advanced technology integration into Army battlefield operating systems.

Work in this PE is related to and fully coordinated with efforts in PE 0602307 (Advanced Weapons Technology), PE 0602705 (Electronics and Electronic Devices), PE 0602709 (Night Vision Technology), PE 0602782 (Command, Control, Communications Technology), PE 0603772 (Advanced Tactical Computer Science and Sensor Technology), PE 0603006 (Command, Control, Communications Advanced Technology), and PE 0603008 (CommandElectronic Warfare Advanced Technology). 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 is performed by the Army Research Laboratory and the Communications-Electronics Research, Development, and Engineering Center, Ft. Monmouth, NJ, and US Army Space and Missile Defense Technical Center, Huntsville, AL.

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

**February 2006**

| BUDGET ACTIVITY | PE NUMBER AND TITLE |
|---|---|
| **2 - Applied Research** | **0602120A - Sensors and Electronic Survivability** |

| **B. Program Change Summary** | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|
| Previous President's Budget (FY 2006) | 38433 | 32147 | 36102 |
| Current BES/President's Budget (FY 2007) | 56267 | 51327 | 38428 |
| Total Adjustments | 17834 | 19180 | 2326 |
| Congressional Program Reductions | | -390 | |
| Congressional Rescissions | | -530 | |
| Congressional Increases | | 20100 | |
| Reprogrammings | 17834 | | |
| SBIR/STTR Transfer | | | |
| Adjustments to Budget Years | | | 2326 |

FY05 $4.8 million increase attributed to a reprogramming in support of a classified program. FY05 $13.05 million increase attributed to a reprogramming in support of a supplemental item IED Defeat (Mohawk Stare)

Twelve FY06 Congressional adds totaling $20100 were added to this PE.

FY06 Congressional adds with no R-2A (appropriated amount is shown):
($1500) Advanced Detection of Explosives Program
($2800) Digital Radio Frequency Tags
($1500) Disposable Sensors for Battlefield and Urban Warfare
($1500) Network Enabled Combat Identification (CID)
($1700) Optical Combat Indentification System (OCIDS)
($1000) Persistent Multi-Dimensional Surveillance In Non-Permissive Environment
($1050) Project 12
($2000) Scalable High Efficiency Solid Laser
($1500) Small Airship Surveillance System
($1250) SmartCam 3D Technology
($3000) Urban Warfare Analysis Center
($1300) Wireless Networking and Smart Power for Small or Mini-UAVs

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

**February 2006**

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **2 - Applied Research** | **0602120A - Sensors and Electronic Survivability** | **140** |

| COST (In Thousands) | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate |
|---|---|---|---|---|---|---|---|
| 140 HI-POWER MICROWAVE TEC | 2948 | 4927 | 5812 | 6202 | 6220 | 6275 | 6323 |

**A. Mission Description and Budget Item Justification:** This project researches, develops and evaluates traditional and non-traditional RF and laser electronic attack. This includes traditional jammers and Radio Frequency (RF) Directed Energy Weapon (DEW) technology, as well as high power components that will significantly enhance the survivability and lethality of Future Combat Systems (FCS) platforms and related systems. The DEW effort studies both RF microwave and laser system capabilities and effects against various threats such as electronic off and on route mines, including improvised explosive devices (IEDs) and electronically guided and fuzed missiles/munitions. Realizing DEW capabilities for diverse targets at a variety of lethality levels and operational ranges on FCS requires optimizing the DEW system, and developing compact, high density power systems meeting stringent FCS weight and volume restrictions. System optimization relies on determining the most effective DEW parameters and system components needed to defeat classes of selected targets; i.e., studying the desired DE effects drives the DEW component and system design, including power. Required power system components include power generation and storage, high-temperature/high power devices, power converters, and power conditioning. The ongoing DE effects and power components work is coordinated with and, as appropriate, leveraged by DEW and power/energy programs in the Air Force, Navy, High Energy Laser Joint Technology Office, Defense Threat Reduction Agency, national labs, university consortia and relevant industry and foreign partners. 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 on this project is performed by the Army Research Laboratory in coordination with the US Army Research, Development and Engineering Command's Tank and Automotive Research, Development and Engineering Center (TARDEC), the Armaments Research, Development and Engineering Center (ARDEC), and the Communications and Electronics Research, Development and Engineering Center (CERDEC).

| **Accomplishments/Planned Program** | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|
| - Research and mature high power converters and enabling technology, such as high-temperature devices to achieve high-power and temperature operation for high power demand capabilities, including DEW, while meeting the stringent weight/volume requirements for FCS and related platforms for the Future Force. In FY05, investigated and matured high-temperature silicon carbide (SiC) power modules for >20 kW-level power conversion at 150 degrees Celsius (C) for motor control, vehicle power bus, and vehicle survivability and lethality systems. In FY06, continue maturation of high-temperature SiC power modules for >100 kW-level power conversion at 150 C for motor control, vehicle power bus, and vehicle survivability and lethality systems. In FY07, will investigate high-temperature SiC power modules for >200kW level power conversion at 150 C for motor control, for vehicle power bus and for vehicle survivability and lethality. This effort supports Tank and Automotive Research Development and Engineering Center (TARDEC) work on power generation, conditioning and control for hybrid electric vehicles and pulse power for Future Combat Systems. | 1394 | 1361 | 1168 |
| - Research and mature novel solid-state laser concepts, architectures and design components enabling High Energy Laser (HEL) Technology for Army-specific DEW applications. Exploit breakthroughs in laser technology and photonics basic research to meet the stringent weight/volume requirements for FCS and related platforms for the Future Force. In FY06, will investigate and mature the most promising laser ceramic materials for efficiency and effects, while fostering on-shore material development; design and breadboard efficient high-power laser based on highly concentrated neodymium-doped yttrium aluminum garnet (Nd:YAG) ceramics while implementing the latest in diamond-cooling technologies for advanced thermal management and beam quality improvement. In FY07, will investigate and demonstrate efficient, ultra-low-quantum-defect, high power "eye-safe" laser (~1.5 mm) with direct diode pumping by | 0 | 1440 | 2050 |

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| the most advanced long-wavelength laser diodes and show correlation between predicted and measured effects on target materials. Applied research will be conducted by ARL in close collaboration with domestic ceramic (and other) material vendors and laser diode manufacturers. | | | |
| - Investigate, research and evaluate technologies related to DEW technology, electronic warfare (EW) survivability/lethality, and supporting high power components to enhance the survivability/lethality of Army Future Combat Systems platforms. In FY05, investigated RF DE effects on two types of off-route mines and three types of electronically-triggered IEDs, measured power/modulation needed to neutralize, and provided to CERDEC/ARDEC. Designed breadboard counter-IED neutralization demonstrator and evaluated in lab test. Verified/updated RF coupling algorithms in Directed RF assessment model for Joint Aircraft Survivability Program Office. In FY06, will collect, analyze and summarize RF effects data on Radio Controlled (RC) and non-RC Improvised Explosive Devices (IEDs); will investigate at least two remotely-controlled IEDs of interest to CERDEC; will design and fabricate counter off-route mine neutralization breadboard and evaluate in lab; and will research back-door, out-of-band coupling of RF energy into network components. In FY07, will evaluate feasibility of countermine concept by surveying technology to identify existing hardware vs requirements; will create models to help predict military effectiveness of proposed neutralization systems; will investigate low power microwave effects on routers, laptops, network switches and other network components will transition counter-mine system design to CERDEC next year; will determine power requirements for Enhanced Area Air Defense System and transition system design; and will measure susceptibility profiles (with respect to frequency, power, modulation, polarization) of network components to assess vulnerability of FCS network. | 1554 | 2126 | 2594 |
| Total | 2948 | 4927 | 5812 |

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

**February 2006**

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **2 - Applied Research** | **0602120A - Sensors and Electronic Survivability** | **H15** |

| COST (In Thousands) | | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate |
|---|---|---|---|---|---|---|---|---|
| H15 | GROUND COMBAT ID TECH | 4602 | 5526 | 5940 | 6020 | 7891 | 7960 | 8020 |

**A. Mission Description and Budget Item Justification:** This project researches and investigates emergent combat identification (CID) technologies for joint, allied and coalition air-to-ground and ground-to-ground mounted, dismounted, forward observer and forward air controller missions for the Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. Efforts research enabling technologies to demonstrate a common battlespace picture for joint coalition situation awareness, reduction of weight and cost of previously developed CID systems, and evaluation of multiband radio frequency (RF) tags as a CID enabler. This project researches embedded radio algorithm developments as well as soldier RF Tag hardware for multiband and aerial platform interoperability. This project increases the survivability and lethality of Coalition Forces by providing fusion of battlefield sensor and situational awareness data to identify friend from foe, thereby, reducing fratricide incidents across the battlefield. Additionally, this program investigates cost-effective sensors for use in threat warning systems for enhanced battlefield situation awareness and target cueing for Army ground combat vehicles. Coordination will be accomplished with other services, allies and coalition partners. MANPRINT will be addressed in all activities. Efforts in this PE are coordinated with PE 0603270 (EW Technology), PE 0602270 (EW Techniques), PE 0603772 (Advanced Tactical Computer Science and Sensor Technology), PE 0602783 (Computer and Software Technology), and PE 0602784 (Advanced Concepts and Simulation).

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 is performed by the Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

| **Accomplishments/Planned Program** | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|
| - Combat Identification (CID) Technologies: In FY05, conducted technical, operational, and military utility testing of Radio Frequency (RF) tags in conjunction with Synthetic Aperture Radar/Moving Target Indicator (SAR/MTI) radar to provide passive CID. In FY06, identify the best approach for implementing Geometric Pairing (GP) and RF Tag/Interrogator CID functionality and crypto into application specific integrated circuits. In FY07, will design GP and RF Tag hardware for the Ground Soldier System ensemble to demonstrate dismounted integration concepts and technical performance characteristics; will conduct first technical testing of GP situation awareness and RF Tag concepts. Work on this effort is also accomplished under PE/Project 63270/K16. | 546 | 1426 | 2067 |
| - Cueing Sensor: In FY06, investigate algorithms for on-the-move frame registration, clutter suppression, and specific threat classification for active protection threat cueing sensor; develop focal plane arrays with required array uniformity, operability, sensitivity in the desired spectral bands. In FY07, will develop cueing sensor algorithms and processing; perform live-fire test of prototype sensors and systems. Work on this effort is also accomplished under PE/Project: 62270/442; 63270/K15; 63772/243. | 0 | 2140 | 2847 |
| - Fusion Based Knowledge for the Future Force: In FY06, investigate and evaluate fusion architectures, algorithms, representations, and data mining capabilities; initiate software generation in situation development; evaluate fusion capabilities by expanding to a moderate-sized set of reports (structured, semi-structured and unstructured situational input); demonstrate 3K reports/hr processed (scenario-specific performance, and sophisticated spatial/temporal reasoning); demonstrate data retrieval integrated with search engine. In FY07, will implement blackboard, abductive and other reasoners with increasingly realistic knowledge sources; will demonstrate prototype for fusion inferencing integrated with Intelligence planning; will demonstrate information retrieval across at least 3 sources. | 0 | 1960 | 1026 |

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| - Coalition Combat Identification Advanced Concept Technology Demonstration (ACTD): In FY05, conducted international exercise (United States, United Kingdom, France, Italy, Germany) using Battlefield Target Identification (BTID), Radio Based Combat Identification (RBCI) and Radio Frequency (RF) tags; tested RBCI operating in Advanced SINCGARS Improvement Program (ASIP) Single Channel Ground Airborne Radio System (SINCGARS) with Digital Knee-Board interface, integrated on an Apache and unmanned aerial vehicle; demonstrated ground based RBCI during the final ACTD operational exercise. | 4056 | 0 | 0 |
| Total | 4602 | 5526 | 5940 |

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

**February 2006**

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **2 - Applied Research** | **0602120A - Sensors and Electronic Survivability** | **H16** |

| COST (In Thousands) | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate |
|---|---|---|---|---|---|---|---|
| H16 S3I TECHNOLOGY | 19662 | 17462 | 19457 | 19927 | 19235 | 19409 | 19561 |

**A. Mission Description and Budget Item Justification:** The objective of this project is to provide the future Soldier with decisive new capabilities to locate, identify, and engage battlefield targets in tactical and urban environments. This project is focused on applied research of advanced sensors, signal processing, and information technologies to enable these capabilities for the Future Combat Systems (FCS) and other emerging thrusts. The ultimate impact and utility of this work will be to protect our Soldiers and to greatly increase their lethality and range and speed of engagement. Emphasis is on solving critical Army-specific battlefield sensing and information management problems such as dealing with false targets, complex terrain (including urban applications), movement of sensors on military vehicles, etc. Cost reduction is a key focus. Significant areas of research include: low cost sensors designed to be employed in large numbers as unattended ground sensors (UGS) for force protection, homeland defense, minefield replacements, counter terrorism operations, and munitions; fusion of diverse sensors such as acoustic, seismic, magnetic, radar, infrared (IR), visible imagers, etc.; low cost acoustic, seismic and magnetic sensors that can passively detect and track battlefield targets such as tanks, helicopters, etc., and locate gun fire; sensor technologies for the detection and tracking of humans, especially in urban terrain; high performance multi-function radio frequency (RF) systems that allow target acquisition, combat identification (ID), active protection, surveillance, and communications systems consolidated into a single system, reducing system cost and size; passive and active RF sensors capable of high-resolution imaging to detect targets hidden in foliage, smoke and fog; ultra wideband radar work will enable buried mine detection and target imaging through dense foliage and will greatly enhance robotic mobility; aided/automatic target recognition (ATR) to allow sensors to autonomously locate and identify targets; opto-Electronic (OE) interconnects and processors are being built to greatly speed the movement of information within and between electronic digital processing units to facilitate smart sensors, adaptive sensors, and sensor fusion; advanced battlefield sensor and information processing to conduct a dynamic and real time situational assessment to present a common picture of the battlespace focused on low echelon commanders; advanced information processing methods to provide automatic information technologies that utilize widely dispersed sensor and legacy information sources; sensor and eye protection against laser threats, and (algorithms for acoustic sensors mounted on a soldier's helmet to localize source of gunfire. Work is coordinated with outside organizations, particularly the Night Vision Electronic Sensors Directorate, other Research and Development Engineering Centers (RDECs) and the Defense Advanced Research Projects Agency (DARPA). This work is related to and fully coordinated with efforts funded in PE 0602709A (Night Vision Technology), PE 0603710A (Night Vision Advanced Technologies), and PE 0603001A (Warfighter Advanced Technology). This work supports the following Army Programs: FCS, Future Force Warrior (FFW), and Networked Sensors for the Future Force (NSfFF) Advanced Technology Demonstration (ATD), Multi-Function Starting Sensors Suite (MFS3), and the Cave and Urban Assault Advanced Concept Technology Demonstration (ACTD)The cited work is consistent with the 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 area is performed by the Army Research Laboratory (ARL).

| **Accomplishments/Planned Program** | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|
| - Mature underpinning technologies for low-cost unattended ground sensors (UGS) for homeland defense, counter-terrorism, FCS and the future soldier. Implement and mature advanced passive acoustic/seismic algorithms to detect, track and ID targets for UGS. Investigate level 0/1 sensor fusion algorithms using collocated, multi-modal sensing phenomenology's including acoustic, seismic, magnetic, electric field, passive Infra Red (PIR), and Radio Frequency (RF) in order to increase probability of target detection and reduce false alarm rates. In FY05 provided mature Army Acoustic Algorithm to CERDEC for use in Networked Sensors for the Future Force Advanced Technology Demonstration; provided mature sensor nodes and algorithms and transition to Cave & Urban Assault Advanced Concept Technology Demonstration. In FY06, evaluate multi-modal database and fusion algorithms using RF, magnetic, electric field, seismic and | 5415 | 6369 | 6795 |
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| acoustic sensor technologies required for providing baseline personnel and human activity detection capability to the Human Infrastructure Detection & Exploitation (HIDE) in Urban Operations Army Technology Objective and other programs. In FY07, will evaluate performance of fusion algorithms at the node level; will devise and mature algorithms for persistent sensing and change detection in urban areas using low cost disposable sensor nodes. | | | |
| - Research, mature and validate electro-optical techniques and components to detect/identify targets in clutter and to protect sensors and eyes from threat laser sources on the battlefield; mature low cost Laser Detection and Ranging (LADAR) and target recognition techniques for 3rd generation Forward Looking Infrared (FLIR) in support of CERDEC program for FCS sensors; and redesign optical devices and explore new nonlinear optical materials. In FY05, applied moving target indicator (MTI) algorithms for force protection applications, collected data for devising change detection algorithms, investigated hyperspectral algorithms for target and personnel detection, implemented a super-resolution technique for ATR applications, and matured a standard dataset and metrics of synthetic targets for classification algorithms. Built, characterized, and evaluated additional components, including mirrors of amalgam composition. In FY06, will investigate advanced force protection concepts and implementations, adapt classification, hyperspectral, and change detection algorithms for various applications, and study the fusion of multi-band IR sensors for target detection; and mature and evaluate magneto-optical and electro-optical switches for fast shuttering of optical systems. In FY07, will design and evaluate fusion algorithms for multi-band IR sensor target detection, integrate advanced multi-target tracking techniques to enhance force protection and adapt ATR methods for multi-modal fusion. Design and evaluate multi-element magneto-optical switches and characterize response time. | 2007 | 3316 | 4472 |
| - Mature technical underpinnings of ultra wideband (UWB) radar for several key Army requirements including surface and buried mine detection, thru the walls sensing, robotic perception and underground sensing. Validate advanced computational electromagnetic algorithms and estimate performance of proposed radar systems as well as predict target signatures. Characterize target and clutter scattering behavior in support of advanced image formation and detection algorithm development. Transfer predictions and algorithms to wide area mine detection, thru the wall sensing and robotic programs. In FY05, characterized synthetic aperture radar (SAR) data from Army mine detection experiments and developed a suite of detection algorithms for prescreening the data. In FY06, implement and evaluate an advanced, affordable UWB radar in support of unmanned ground vehicle (UGV) perception requirements. In FY07, mature advanced thru the wall imaging capabilities consistent with a randomized, distributed array implementation concept. | 2528 | 2711 | 2681 |
| - Mature Multi Function Radio Frequency System (MFRFS) for use on small ground and air vehicles and future Soldier technologies. Mature understanding of phenomenology for an integrated RF sensor that performs radio, radar, and control functions to allow communications, combat-ID, target acquisition/track, active protection, and munition command guidance for use on small ground and air vehicles. Mature Aluminum-Gallium-Nitride-based semiconductor Ultra Violet (UV) optoelectronics for covert line-of-sight and non-line-of-sight communications and for photo-luminescent detection of bio-threats. Mature models and evaluate networked sensor concepts in support of netted fires to allow dynamic updating of weapons in-flight. In FY05, as part of a risk mitigation strategy, integrated FCS MFRFS prototype antenna. Acquired clutter and target data in evaluating FCS MFRFS antenna performance. Completed data collection for urban clutter environment to support robotic imaging and FCS active protection systems. Investigated enhanced UV emitter efficiency and transitioned this technology into unattended-ground-sensor UV communications experiments and bio-agent detection architecture at Edgewood Chemical and Biological Center(ECBC). In FY06, will implement four channel MFRFS receiver design, and test and demonstrate several FCS waveforms in realistic clutter environment; prototype and demonstrate close in active protection radar; and design RF imaging and collision avoidance radar for robotic perception. Will transition to ECBC, UV emitters with enhanced efficiency into Army bio-sensor R&D programs. In FY07, will develop FCS MFRFS radar model for use in analyzing the radar limitations in adverse environments, and prototype and demonstrate RF imaging and collision avoidance radar for robotic perception. Explore high-brightness active regions for LEDs and lasers operating at wavelengths below 300 nanometers for UV covert communications and bio-agent detection. | 2409 | 2571 | 2831 |

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|---|---|---|---|
| - Improve the low echelon commander's situational understanding in complex/urban terrain by maturing infrastructure and validating algorithms, filters and agent technologies to reduce cognitive load by fusing information. In FY05, transitioned web-enabled enhanced service-based tools with integrated organizational capability utilizing autonomous asset management and tactical decision aids that reduce both cognitive load and uncertainty. In FY06, will devise a local fusion node that serves as a host for organic air and ground sensor suites that correlates/fuses the local picture from a suite of highly mobile manned and semi-autonomous sensor nodes within an adhoc networking environment. In FY07, will devise for end-user evaluation an integrated warrior software ensemble that provides multi-media based spot/salute report, semi-autonomous platform control, distributed interaction, video source subscription, capture, annotation, and publication to include GPS/compass based blue force/asset tracking. | 2507 | 2495 | 2678 |
| Oak Bard | 4796 | 0 | 0 |
| Total | 19662 | 17462 | 19457 |

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

**February 2006**

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **2 - Applied Research** | **0602120A - Sensors and Electronic Survivability** | **SA2** |

| COST (In Thousands) | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate |
|---|---|---|---|---|---|---|---|
| SA2 BIOTECHNOLOGY APPLIED RESEARCH | 2638 | 3599 | 5669 | 5546 | 5796 | 5911 | 6029 |

**A. Mission Description and Budget Item Justification:** The objective of this project is to support maturing biotechnology, which is being conducted at the Army's Institute for Collaborative Biotechnology (ICB), an University Affiliated Research Center. The ICB is focused on advancing the survivability of both the soldier and weapons systems through fundamental breakthroughs in the area of biotechnology. This project will exploit breakthroughs in biotechnology basic research transitioning from the ICB to enable revolutionary Future Force capabilities in sensors, electronics and photonics. Areas of research include bio-array sensors, biomimetics, proteomics, genomics, DNA research and development, and control of protein and gene expression. Efforts include designing and performing multi-scale dynamic and predictive modeling to understand the biologically-inspired "sense and respond" systems (integrated system of sensor, information processing and response mechanism) and their components. ARL in collaboration with the ICB industry partners will conduct applied research focused on biological sensors and biological power generation. This applied research effort will ensure that the basic science developed at the ICB is directed towards and transitioned to Army devices and systems. The process of transformation requires revolutionary advances in performance of Army weapons systems, including improvements in engineered systems impacting soldier survivability. The ICB will conduct unclassified basic scientific research in: sensors, electronics and information processing, and technical fundamentals enabling development of advanced capabilities in these application areas. The Army seeks to provide the interdisciplinary fundamental knowledge and technical capabilities to manipulate biological systems and components, and to exploit biologically derived products and processes for both the soldier and engineered systems and platforms. 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 (ARL).

| **Accomplishments/Planned Program** | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|
| - Institute for Collaborative Biotechnology - In FY05, identified mature emerging opportunities at the ICB in areas such as bio-molecular based detector arrays for new sensors, biological power sources for reduced logistics demand, and biomimetics and biomimetics processing that led to new electro-optic materials, chemical detectors and multifunctional smart materials. Explored feasibility of microbial fuel cells for low power sensor applications. In FY06, will investigate the use of the biologically-based and inspired sensors and materials to design and fabricate "sense and respond" system components; will devise and experimentally validate a laboratory scale biological sensor, which will be more selective, compact and provide a significantly reduced logistical burden. Evaluate and optimize microbes for use in microbial fuel cells. In FY07, will design breadboards to integrate the components and incorporate biologically-inspired control and networking capability for "sense and respond" systems; will evaluate the biological sensor in a relevant environment and transition to Edgewood Chemical Biological Center and/or Natick Soldier Center. Fabricate laboratory breadboard microbial fuel cells and optimize power output for low power sensor applications. | 2638 | 3599 | 5669 |
| Total | 2638 | 3599 | 5669 |

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

**February 2006**

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **2 - Applied Research** | **0602120A - Sensors and Electronic Survivability** | **TS1** |

| COST (In Thousands) | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate |
|---|---|---|---|---|---|---|---|
| TS1 TACTICAL SPACE RESEARCH | 0 | 0 | 1550 | 1600 | 1650 | 1700 | 1750 |

**A. Mission Description and Budget Item Justification:** This new project researches and evaluates space-based technologies that will enhance ground capabilities of the Future Force and where feasible, exploit opportunities to enhance the Current Force capabilities. Focus is on space based remote sensor, signal, and information processing technology for space-to-ground applications for advanced intelligence, surveillance and reconnaissance, battle command and communications, target acquisition, position/navigation, threat warning, and space superiority technology for force protection. This space based applied research leverages other DOD space science and technology to support space force enhancement cooperative satellite payload development for advanced technology integration into battlefield operating systems. This includes applied research in persistent intelligence, surveillance and reconnaissance and dedicated communications for in theater high altitude long loiter payload applications. In addition, this project researches and evaluates ground-to-space superiority technologies against remote sensor and communications capabilities, and space object identification and characterization. The cited work is consistent with Strategic Planning Guidance, The Army Science and Technolgy Master Plan (ASTMP), The Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Space and Missile Defense Technical Center in Huntsville, AL.

| **Accomplishments/Planned Program** | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|
| In FY07, research and evaluate space-based remote sensing and information processing technologies to conduct space-to-ground intelligence, battle command, and target acquisition applications from small tactical satellites and high altitude long loiter platforms. Evaluate feasibility to leverage other DOD science and technology for space superiority cooperative technology development to counter in theater remote sensing and communications threats. | 0 | 0 | 1550 |
| Total | 0 | 0 | 1550 |