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

**February 2004**

| BUDGET ACTIVITY | PE NUMBER AND TITLE |
|---|---|
| **3 - Advanced technology development** | **0603606A - Landmine Warfare and Barrier Advanced Technology** |

| | COST (In Thousands) | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate |
|---|---|---|---|---|---|---|---|---|
| | Total Program Element (PE) Cost | 28075 | 29662 | 25577 | 26696 | 27731 | 28622 | 32428 |
| 608 | COUNTERMINE & BAR DEV | 25450 | 21254 | 22628 | 23370 | 23817 | 24239 | 27668 |
| 64C | COUNTERMINE DEMONSTRATIONS (CA) | 0 | 5433 | 0 | 0 | 0 | 0 | 0 |
| 683 | ANTI-PERSONNEL LANDMINE (APL) ALTERNATIVES | 2625 | 2975 | 2949 | 3326 | 3914 | 4383 | 4760 |

**A. Mission Description and Budget Item Justification:** The primary goal of this program element (PE) is to mature and demonstrate the sensor technologies required to detect mines, minefields, and obstacles to enable assured mobility for the high operational tempo (OPTEMPO) Future Force, and, where feasible, exploits opportunities to enhance Current Force capabilities. It also will provide the US Army with the capability for in-stride detection and breaching, close-in detection, area clearance, and neutralization of landmines. This PE demonstrates the remote detection of minefields as well as individual landmine detection from handheld, ground, and aerial sensor systems; evaluates detection of both conventional and command detonated types of landmines (including improvised explosive devices (IEDs)), metallic and low/non-metallic; and emphasizes the use of wide-area multi-sensor fusion detection systems, coupled with small-area confirmation sensors. This multi-sensor approach has the potential to yield a high probability of landmine detection at very low false alarm rates. Efforts within this PE assess airborne mine detectors for contingency applications and mature lightweight plug-and-play detectors for use in mission specific applications. This PE explores alternative systems for anti-personnel landmines and innovative concepts for minefield clearance. Will conduct Advanced Concept Technology Demonstrations, Advanced Warfighting Experiments, and modeling and simulation activities to assess the effectiveness of system concepts. Efforts within this PE are closely coordinated with the U.S. Marine Corps. The program adheres to Tri-Service/Project Reliance Agreements on conventional air/surface weapons and ground vehicles. 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 PE contains no duplication with any effort within the military departments. Work in this PE is performed by the Communications-Electronics Research, Development and Engineering Center, Night Vision & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

| B. Program Change Summary | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|
| Previous President's Budget (FY 2004) | 28595 | 24552 | 25476 |
| Current Budget (FY 2005 PB) | 28075 | 29662 | 25577 |
| Total Adjustments | -520 | 5110 | 101 |
| Congressional program reductions | | -279 | |
| Congressional rescissions | | | |
| Congressional increases | | 5500 | |
| Reprogrammings | -520 | -111 | |
| SBIR/STTR Transfer | | | |
| Adjustments to Budget Years | | | 101 |

Change Summary Explanation: Funding - FY 2004 - Two Congressional adds totaling $5500 were added to this PE.

($1343) EDIT Advanced Landmine Detection, Project 64C. The purpose of this one year Congressional add is to demonstrate a handheld time-domain electro-magnetic sensor and imaging detector based on a Resonant Microstrip Patch Antenna technology. No additional funding is required to complete this project.

($3932) Advanced Demining Technology, Project 64C. The purpose of this one year Congressional add is to mature an integrated remote controlled mine detection and neutralization system used for demining operations. No additional funding is required to complete this project.

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

**February 2004**

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **3 - Advanced technology development** | **0603606A - Landmine Warfare and Barrier Advanced Technology** | **608** |

| COST (In Thousands) | | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate |
|---|---|---|---|---|---|---|---|---|
| 608 | COUNTERMINE & BAR DEV | 25450 | 21254 | 22628 | 23370 | 23817 | 24239 | 27668 |

**A. Mission Description and Budget Item Justification:** This project matures countermine technologies for integration into future Army systems. Specific activities include remote detection of minefields by aerial sensor systems and individual landmine detection by handheld and vehicle-based sensor systems and neutralization of individual mines. The landmines being addressed include conventional and command detonated, including improvised explosive devices (IEDs), metallic and low/non-metallic construction. This project will evaluate the potential for wide-area multi-sensor fusion detection systems, coupled with slower small-area confirmation sensors, to yield a high probability of mine detection at very low false alarm rates. Will evaluate airborne multispectral mine detection sensors and mature them for lightweight plug-and-play use on unmanned aerial vehicles (UAVs) in mission specific applications. The goal is for robust approaches to finding surface-laid and buried mines in temporally and spatially varying vegetation, soil, weather, and diurnal conditions. This project has the potential to provide advanced countermine capabilities to the mounted and dismounted soldier by adapting commercial or emerging technologies for standoff mine detection and neutralization. Detection technologies include, but are not limited to, wide band radar, acoustic, laser, explosive detection sensors, infrared and visual imagery, radio frequency, signal processing, electronic and physical mine marking. Neutralization technologies include chemical reactants, electromagnetic energy, and kinetic energy. The intent is to provide increased operational tempo and survivability for US Forces prior to their entry into harm's way. This project also evaluates area clearance systems under the Joint Area Clearance (JAC) Advanced Concept Technology Demonstration (ACTD) as a means to determine the best system for rear area and supply route clearance operations. These efforts support ACTDs, Army Warfighting Experiment, modeling and simulation assessments and defines potential system effectiveness. 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 PE contains no duplication with any effort within the military departments. Work in this PE is performed by the Communications-Electronics Research, Development and Engineering Center, Night Vision & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

| **Accomplishments/Planned Program** | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|
| Lightweight Airborne Multispectral Mine Detection System (LAMD) Program: In FY03, matured the mine detection aided target recognition (ATR) leveraged from the Marine Corps' Multi-Spectral Tactical UAV Program (Cobra Minefield Detection Program), hardware, workstations, and communication protocols to support the Airborne Standoff Minefield Detection System (ASTAMIDS) acquisition program managed by Program Manager Close Combat Systems (PM-CCS). Provided an active sensor as a plug and play candidate for ASTAMIDS upgrades for scatterable surface minefield detection and false alarm mitigation. Transitioned LAMD technology (WESCAM Advanced EOIR with Countermine Filter Wheel, RX detection algorithm, Triple Window Filter detection algorithm) to PM CCS in support of a successful ASTAMIDS Milestone B decision. | 5328 | 0 | 0 |
| Autonomous Mine Detection Sensors Program: In FY03, selected and evaluated sensor suite concept to be used against small anti-personnel landmines from a man portable robotic platform. In FY04, mature and demonstrate potential robotic standoff and forward looking dismounted technologies for anti-personnel mines. In FY05, will continue maturation and demonstration efforts; mature those technologies that have the greatest potential to meet requirements; demonstrate system prototypes for performance and application in relevant environments; build prototypes based on previous demonstrations; integrate technologies on Training and Doctrine Command (TRADOC) identified robotic platforms; and evaluate security of robotic control networks. | 3005 | 5440 | 5070 |
| FCS Standoff Mine Detection System: In FY03, demonstrated the potential for revolutionary improvements of operational tempo (OPTEMPO) in mined areas with the use of very lightweight forward looking airborne sensors on small unmanned aerial vehicles (UAVs) that detect anti-tank mines on roads and provide, through downlink, data to Future Force vehicles. In FY04, transition the two-color 6.2 airborne sensor; integrate the sensor on a stabilized vertical takeoff and landing (VTOL) platform and demonstrate performance. This effort also will advance aided target recognition (AiTR) efforts and integrate them on organic aerial vehicles (OAV) for demonstration. In FY05, will establish baseline performance of bolt-on forward looking ground vehicle sensor and fusion AiTRs. Improve fusion AiTRs; and link airborne sensors with ground vehicle suite to demonstrate performance of the combined mine detection approach. | 990 | 5690 | 5610 |

| **Accomplishments/Planned Program (continued)** | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|
| Mine Detection False Alarm Reduction for Improved OPTEMPO: In FY03, evaluated scanning technologies and mine detection confirmation technologies to include wide band frequency radar and quadrupole resonance sensors for false alarm reduction performance on small overpass unmanned ground vehicles. Conducted testing of the Wichmann ground penetrating radar (GPR) 1.2 meter wide slanted antenna against anti-tank mines. Conducted ground pressure distribution testing of wide profile low pressure tires and rims for overpass capability and integrated low profile Advanced Wideband GPR on experimental unmanned ground vehicle (XUGV). Using the Wichmann radar, completed first round of blind testing at temperate and arid test sites, demonstrated 100x improvement in false alarm rate with high probabilities of detection. In FY04, mature and evaluate these sensor mine detection technologies, ATRs, and signal processing techniques associated with each technology to improve robustness. Integrate the most promising combination scanning/confirmation capabilities on a surrogate recon vehicle to demonstrate overpass capability and false alarm reduction performance. | 7708 | 9110 | 0 |
| The Joint Area Clearance (JAC) ACTD: In FY03, conducted operational demonstrations and a military assessment of candidate clearance systems. In FY04, transition technologies found to have military utility to Program Manager Close Combat Systems and Marine Corps Systems Command. | 2393 | 510 | 0 |
| Mine Neutralization for Assured Mobility. In FY05, mature and demonstrate concepts for minefield neutralization such as small shaped charges or directed small arms fire to cover a wide variety of mine types including both anti-tank and anti-personnel mines, and reduce the logistics burden for neutralization hardware for the Army. | 0 | 0 | 3060 |
| Airborne IED/Mine Detection. In FY05, design, mature and demonstrate sensors appropriate for aerial detection of buried and surface mines and improvised explosive devices (IEDs) from helicopters and unmanned aerial vehicle (UAV) platforms with an emphasis on infrared and TV change detection. Mature algorithms to automate the Change Detection Work Station (CDWS) to improve throughput rates. | 0 | 0 | 4908 |
| Countermine On The Move. In FY05 will complete the maturation of a faster wideband ground penetrating radar integrated with a nuclear quadrupole resonance confirmation sensor for higher rates of advance. Perform operational assured mobility simulations of countermine systems comprising interactive components such as unmanned aerial vehicles, manned aircraft, and forward looking sensors. | 0 | 0 | 3980 |
| Electromagnetic-wave Detection and Imaging Transceiver Landmine Detection: This one-year Congressional add demonstrated the combat utility of a handheld detector integrated with the newly matured Micro-electromechanical Systems (MEMS) accelerometer for self contained sensor-head tracking. No additional funding was required to complete this project. | 1722 | 0 | 0 |

| **Accomplishments/Planned Program (continued)** | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|
| Landmine Detection Using Terahertz Radiation Technology: This one-year Congressional add demonstrated a high power (peak and average) compact and portable, particle accelerator based, THz radiation source that produces THz imagery. No additional funding was required to complete this project. | 957 | 0 | 0 |
| Advanced Demining Technology: This one-year Congressional add demonstrated a remotely operated mine detection and mine clearing system. No additional funding was required to complete this project. | 3347 | 0 | 0 |
| Small Business Innovative Research/Small Business Technology Transfer Programs | 0 | 504 | 0 |
| Totals | 25450 | 21254 | 22628 |

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

**February 2004**

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **3 - Advanced technology development** | **0603606A - Landmine Warfare and Barrier Advanced Technology** | **683** |

| COST (In Thousands) | | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate |
|---|---|---|---|---|---|---|---|---|
| 683 | ANTI-PERSONNEL LANDMINE (APL) ALTERNATIVES | 2625 | 2975 | 2949 | 3326 | 3914 | 4383 | 4760 |

**A. Mission Description and Budget Item Justification:** This project is part of the Antipersonnel Landmine Alternatives (APLA) effort and provides technology demonstrations of alternative systems that minimize the risk of injury or loss to non-combatants from exposure to anti-personnel landmines (APLs). This includes alternatives to anti-personnel sub-munitions used in mixed anti-tank (AT) landmine systems. The alternatives will include distributed anti-personnel surveillance systems (autonomous seismic, acoustic, and day/night imaging sensor systems), command and control systems (networked, wireless, sensor communications, and information management tools) to be used with man-in-the-loop overwatch fires. Will evaluate and mature alternatives in parallel in order to provide similar capabilities that are currently provided by APLs and APL sub-munitions in mixed Anti-Tank systems. Will use distributed simulation to evaluate new concepts and modify doctrine. Will construct and evaluate model components and system architectures at the system level in field tests. 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 PE contains no duplication with any effort within the military departments. Work in this PE is performed by the Communications-Electronics Research, Development and Engineering Center, Night Vision & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

| **Accomplishments/Planned Program** | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|
| Anti-Personnel Landmine Alternatives. In FY03, matured component technologies, and addressed interoperability issues and the transition to Program Managers. In FY04, mature technologies, establish detection and identification distances against dismounted troops, and initiate a study for the concept on networked personnel detection nodes. In FY05, will complete maturation of secure inter-field and intra-field radios for weapons control, explore alternative miniature low cost communications devices, complete the concept study, and demonstrate a networked personnel detection node in a relevant environment. | 2625 | 2889 | 2949 |
| Small Business Innovative Research/Small Business Technology Transfer Programs | 0 | 86 | 0 |
| Totals | 2625 | 2975 | 2949 |