ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2004

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602705A - ELECTRONICS AND ELECTRONIC DEVICES**

	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	61510	76809	41236	45919	43609	42780	43329
EM4	ELECTRIC COMPONENT TECHNOLOGIES (CA)	0	6971	0	0	0	0	0
EM6	HEATING AND COOLING TECHNOLOGIES (CA)	0	4357	0	0	0	0	0
EM7	POWER AND ENERGY COMPONENT TECHNOLOGIES (CA)	0	28987	0	0	0	0	0
H11	BATTERY/IND POWER TECH	32944	7087	12362	16702	13050	12172	12237
H94	ELEC & ELECTRONIC DEV	28566	29407	28874	29217	30559	30608	31092

A. Mission Description and Budget Item Justification: This program element provides enabling capabilities for the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities by researching and investigating technologies to perform precision deep fires against critical mobile and fixed targets, to provide exceptional all-weather, day or night, theater air defense against advanced enemy missiles and aircraft, and to provide electronic components, power components, frequency control and timing devices, display technologies, and low-cost, lightweight, high-energy density power sources for communications, target acquisition, and miniaturized displays, for applications such as the Future Combat Systems (FCS) and soldier systems. This program consists of research in the physical sciences essential to all land combat systems that contain any of the following component technologies: electronics, photonics, flexible displays, magnetic materials, ferroelectrics, microwave and millimeter-wave components, batteries, electromechanical systems (engine generator sets) and fuel cells. Supported systems include autonomous missile systems, advanced land combat vehicles, smart anti-tank munitions, electric weapons, secure jam-resistant communications, automatic target recognition (ATR), foliage-penetrating radar, and combat identification. It supports all of the science and technology thrust areas that employ electronic and portable power-source technology. Work in this PE is related to and fully coordinated with efforts in PE 0602120 (Sensors & Electronic Survivability), PE 0602782 (Command, Control, Communications Technology), PE 0602709 (Night Vision Technology), PE 0602783 (Computer and Software Technology), PE 0603008 (Command, Control, Communications Advanced Technology), and PE 0603772 (Advanced Tactical Computer Science and Sensor Technology). The program element contains no duplication with any effort within the Military Departments. 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 Army Communications and Electronics Research Development and Engineering Center Fort Monmouth NJ.

B. Program Change Summary	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2004)	59682	33694	42005
Current Budget (FY 2005 PB)	61510	76809	41236
Total Adjustments	1828	43115	-769
Congressional program reductions		-673	
Congressional rescissions			
Congressional increases		45640	
Reprogrammings	1828	-1852	
SBIR/STTR Transfer			
Adjustments to Budget Years			-769

Significant Change Explanation:
FY04 - Twenty FY04 Congressional Adds totaling $45640 were added to this PE.

FY04 Congressional adds with no R-2A:
($1879) E-Beam Reticle and Lithography Inspection, Project EM4: The purpose of this Congressional add is to investigate E-Beam reticles and lithography. No additional funding is required to complete this project.
($3946) Electronics and Electronic Devices, Project EM4: The purpose of this Congressional add is to research electronic devices. No additional funding is required to complete this project.
($939) Flexible Polymer Multilaminate Packaging, Project EM4: The purpose of this Congressional add is to research flexible polymer multilaminate packaging. No additional funding is required to complete this project.
($939) Heat Actuated Coolers for Portable Military Applications, Project EM6: The objective of this Congressional add is to research and develop injection pumps and micro-channel heat exchangers. No additional funding is required to complete this project.
($3288) Transcritical CO2 Environmental Control Unit, Project EM6: The objective of this Congressional add is to mature environmental control system components and demonstrate improved cooling technology. No additional funding is required to complete this project.
($1598) 1.5V Cylindrical Cell - Metal Oxide Cathode, Project EM7: The objective of this Congressional add is to mature lithium copper oxide and lithium-air batteries for CIA applications. No additional funding is required to complete this project.
($1127) 1.5V Alkaline Cylindrical Cell - Metal Oxide Cathode, Project EM7: The objective of this Congressional add is to mature an alkaline

battery for CIA applications. No additional funding is required to complete this project.
($1315) Vehicle Battery Health Monitoring System, Project EM7: The objective of this Congressional add is to mature status monitoring systems for lead-acid batteries. No additional funding is required to complete this project.
($1409) Advanced Liquid Silicon Rechargeable Battery, Project EM7: The objective of this Congressional add is to mature a safe, non-flammable, high-energy density, polymer rechargeable battery for Land Warrior systems. No additional funding is required to complete this project.
($3193) Advanced Power, Project EM7: The objective of this Congressional add is research power management systems for Army Tactical Operation Centers, shelters, and generators. No additional funding is required to complete this project.
($2818) Center for Advanced Fuel Cell Technology (UND), Project EM7: The objective of this Congressional add is to mature new materials for fuel cells as well as new process developments. No additional funding is required to complete this project.
($2349) Cylindrical Zinc Air Battery for Objective Force Soldier, Project EM7: The objective of this Congressional add is to mature a higher performance zinc-air cylindrical cell for the Land Warrior hybrid battery. No additional funding is required to complete this project.
($3193) Dry Polymer Electrolyte Development for Safe Soldier Power, Project EM7. The objective of this Congressional add is to develop technology for extruding dry polymer battery electrodes. No additional funding is required to complete this project.
($4698) Enhanced Wireless Digital Communications for the Army's Urban First Responder, Project EM7: The objective of this Congressional add is develop a wireless RF-location and digital communication system for Homeland Security urban first responders and for the Army. No additional funding is required to complete this project.
($1315) Enhanced Wireless Digital Communications, Project EM7: The objective of this Congressional add is to develop wireless RF-location and digital communication system for Army urban first responders. No additional funding is required to complete this project.
($1353) Micro and Miniature Fuel Cells, Project EM7: The objective of this Congressional add is to produce demonstration systems for fuel cell systems that provide power for soldier applications. No additional funding is required to complete this project.
($1315) Portable Reforming on the Battlefield, Project EM7: The objective of this Congressional add is to develop a portable reforming system for a proton exchange membrane fuel cell (PEMFC) power source. No additional funding is required to complete this project.
($1409) Rechargeable Cylindrical Cell System – Lithium Ion / Nickel Metal Hydride, Project EM7: The objective of this Congressional add is to develop the fast recharge NiMH cell and fat "D" lithium ion cell for Army standard batteries. No additional funding is required to complete this project.
($1034) Soldier Fuel Cell System, Project EM7: The objective of this Congressional add is to develop mixed hydrides to improve hydrogen storage energy density. 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
2 - Applied Research	**0602705A - ELECTRONICS AND ELECTRONIC DEVICES**	**H11**

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H11	BATTERY/IND POWER TECH	32944	7087	12362	16702	13050	12172	12237

A. Mission Description and Budget Item Justification: This project conducts applied research to identify, advance and enhance emerging power generation and power management technologies for the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. There is a critical need for ultra-lightweight man portable power, chargers, and power management for the dismounted soldier in support of Land Warrior and Objective Force Warrior (OFW). Mobile electric power sources that are smaller and more fuel-efficient are key enablers for tactical sustainability and survivability. This project researches advancements in energy conversion, electrochemistry, and signature suppression technologies, including those for primary batteries, rechargeable battery hybrids, fuel cells, power management, and components for electromechanical power generation. It will provide (1) high energy and high power density hybrid power source components that combine the best features of individual power technologies, (2) rapid recharging systems, and (3) power management through low power design tools and software operating system dynamic power management. It will provide the OFW and other Future Force platform applications low weight and volume, safe, reliable, cost-effective power sources, reduced system power requirements, increased mission duration and reduced cost and logistics burdens. The Portable and Mobile Power Sources for the Future Force program will mature various emerging power source technologies to provide portable high energy, low weight power sources for Land Warrior, the Objective Force Warrior, and mobile electric power sources for Future Force platform applications.

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 Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- Portable and Mobile Power for the Future Force: Research hybrid power sources and power management technologies in order to decrease soldier load, increase power capabilities, decrease battery costs, and address tactical mobile electric power needs. Investigate component power technologies that will provide higher energy, reduced weight, quiet, more fuel and cost efficient power sources, generators, silent mobile power sources, charger, and power management systems. In FY03, designed fuel cell component system for fuel reformer and direct fuel conversion; demonstrated system level smart charger technology for mobile platforms with 2.5 hour recharge for LI7 battery; demonstrated a 4 pound, 200 Watt-hour/kilogram (Wh/kg) metal-air/lithium battery hybrid power source with a 300 Wh/kg re-fuel; simulated power profiles and system specific static power management procedures. In FY04, investigate 10 kilowatt proof-of-concept system components leading to quiet, smaller, and fuel-efficient generator; investigate a safe 2 pound 170 Wh/kg lithium-ion polymer rechargeable LP10 battery; investigate and mature power management approaches for soldier systems. In FY05, will investigate system level smart charger technology with 2 hour recharge integrated for LP10 battery. Will investigate a lighter weight 3.5 pound, 250 Wh/kg battery hybrid power source with a 350 Wh/kg re-fuel. Will investigate fuel cell reformer components for 1-2 kilowatt system for scout vehicle silent watch. Will investigate and mature logistic fueled Stirling engine generator components for silent soldier power. Will mature power management techniques to reduce operating system power draw for soldier systems by 50%.	4326	6911	12362
- Logistics Fuel Reformer Development Program: This one year congressional add integrated microchannel reformer technology components into an integrated system for both a man-portable methanol fuel reformer and a multi-kilowatt sulfur-laden fuel reformer. No additional funding is required to complete this project.	1666	0	0
- Center for Advanced Fuel Cell Technology: This one year congressional add researched micro fuel cell technologies to include (1) new electrolytes and catalysts, (2) improved membranes, and (3) heat and water management. No additional funding is required to complete this project.	1907	0	0
- Soldier Fuel Cell System: This one year congressional add evaluated a prototype fuel cell hydrogen storage system under various combat scenarios. No additional funding is required to complete this project.	1002	0	0
- Cylindrical Zinc Air Battery for Land Warrior Applications: This one year congressional add investigated and integrated the Cylindrical Zinc Air Battery for Land Warrior. No additional funding is required to complete this project.	955	0	0

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Improved High Rate Alkaline Cell (or CFx): This one year congressional add incorporated cells into batteries and tested under various simulated equipment load scenarios. No additional funding is required to complete this project.	955	0	0
- Rechargeable Cylindrical Cell System - Lithium Ion/Nickel Metal Hydride: This one year congressional add tested and evaluated Rechargeable Cylindrical Cell System under extreme temperatures. No additional funding is required to complete this project.	955	0	0
- Dry Polymer Extrusion for Battery Cathode and Electrode Research: This one year congressional add researched high conductivity electrodes and electrolytes that will be incorporated in cells for testing and evaluation. No additional funding is required to complete this project.	3530	0	0
- Extrusion on Multilaminate Battery Packaging: This one year congressional add incorporated multilaminate film packaging into lithium-ion cells for test and evaluation. No additional funding is required to complete this project.	4292	0	0
- Solid State Polymer Battery for Land Warrior System: This one year congressional add investigated lithium-ion cells with newly developed high-conductivity polymer electrolyte. No additional funding is required to complete this project.	955	0	0
- Liquid Silicone Lithium Rechargeable Battery: This one year congressional add investigated additives to decrease the flammability of electrolytes. No additional funding is required to complete this project.	1431	0	0
- Zinc Air Power Sources for ABN, SOFs & USMC: This one year congressional add developed the BA-8180 zinc air batteries for use as an extended life power sources for military communications equipment. Batteries were provided to the USMC, Army airborne, and SOF and are now being used in South West Asia. No additional funding is required to complete this project.	973	0	0
- Miniature and Micro Fuel Cells: This one year congressional add investigated materials and stacks for miniature and micro fuel cell applications. No additional funding is required to complete this project.	3339	0	0
- Portable Hybrid Electric Power Systems: This one year congressional add investigated methanol concentration measurement and control issues, system balance-of-plant optimization and control, direct methanol fuel cell/Lithium-ion hybridization issues, and model development including both detailed and system-level models. No additional funding is required to complete this project.	1334	0	0
- Intell Power Control for Sheltered Sys: This one year congressional add investigated small, modular, and intelligent power distribution systems. The effort demonstrated a remote monitoring and control integrated power management system for a vehicle shelter, and studied the potential power management of unmanned ground systems, unmanned ground vehicles, and on-the-move vehicular systems. No additional funding is required to complete this project.	3624	0	0

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Block II Stryker Environmental Control Units: This one year congressional add developed prototype transcritical carbon dioxide based cooling system which was installed and tested in an up-armored HMWWV vehicle. No additional funding is required to complete this project.	1700	0	0
Small Business Innovative Research/Small Business Technology Transfer Programs	0	176	0
Totals	32944	7087	12362

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February 2004

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602705A - ELECTRONICS AND ELECTRONIC DEVICES**	**H94**

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H94	ELEC & ELECTRONIC DEV	28566	29407	28874	29217	30559	30608	31092

A. Mission Description and Budget Item Justification: This project conducts applied research in electronics and electronic devices to support advanced power and energy generation and storage, Command, Control, Communications, Computers (C4) and Intelligence, Surveillance and Reconnaissance (ISR) technologies for the Future Combat Systems (FCS) and the Future Force. This research supports thrusts aimed at enhanced battlefield situational awareness, increased vehicle mobility, reduced acquisition cost, and reduced operations and support costs.

Areas of investigation include: Low noise clock and oscillators; lasers and focal plane arrays for eye safe laser radar and standoff target acquisition sensors like forward looking infrared (FLIR); micro-electromechanical systems (MEMS) for multi-function radio frequency (RF) applications as well as smart munitions; advanced RF modules to support radars and communications systems, high temperature high power inverter circuits for electric drives; prognostics and diagnostics to reduce logistics demands; micro-power generators, and advanced batteries, fuel reformers, and fuel cells for hybrid power sources for individual soldier applications and FCS. The fabrication of novel structures on new electronic materials, such as langasite for oscillators or molecular beam epitaxy (MBE) of superlattices, will be a key enabler for more affordable devices with new capabilities. These fabrication techniques require a more complete understanding of fundamental properties, growth techniques, and processing of new materials. These new materials and structures also require the development of new design and layout techniques, more sensitive and flexible test and analysis capabilities, and new means of packaging to protect the devices and promote control of heat and atmosphere while enabling transport of signals and power. These challenges can only be overcome with judicious application of a basic understanding of the physics and chemistry of the electronic processes. This project also funds the flexible display initiative. This project will serve to enhance the survivability, lethality, and mobility of future Army platforms by enhancing their survivability electronics suite, increasing ranges, while decreases time lines, for target acquisition sensors, and evolving more efficient, controllable power sources, and displays. This program element contains no duplication with any effort within the Military Departments. 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 2003	FY 2004	FY 2005
- Mature components and software for C4 technology. Mature affordable design concepts for an integrated radio frequency sensor which performs radio, radar, and control functions to allow communications, combat identification (ID), target acquisition and track, active protection, and munition command guidance through a single antenna for use on small ground and air vehicles. Perform research in advanced tactical software tools for mobile, ad hoc network access control, intrusion detection, and authentication techniques for the Future Force. In FY03, integrated solid state modules into Electronic Scan (Escan) antenna. Identified vulnerabilities in mobile ad hoc networks and devised cooperative intrusion detection approach that minimizes bandwidth required to protect Future Force Networks. In FY04, complete design and testing of planar, polarimetric radiating elements for wide bandwidth mmW arrays; and identify automated deployment techniques and verify their robustness through experiments. In FY05, complete True Time Delay beam steering in 2 dimensions for widebandwidth, high-resolution RF sensors and provide techniques and software codes for autonomous use in the field to prevent intrusions and to repel attacks.	1762	1550	1600
- Investigate micro and nano technology for small low cost highly reliable RF MEMS switches, resonators and filters for multifunction. In FY03, fabricated Aluminum Nitride (AlN) resonators for high frequency filter applications. In FY04, establish reliability testing of 1st generation AlN MEMS resonators and design 2nd generation resonators for high frequency filter applications. In FY05, examine the performance of E-Beam lithography in patterning nanoscale RF structures for FCS and future Soldier communications.	750	1150	1125
- Investigate and mature silicon carbide (SiC) power device and high-temperature packaging technologies to enable high power density, high-temperature converters for motor drive applications for FCS. In FY03 fabricated SiC power devices, custom high-temperature AlN substrates/modules and investigated/showed power sharing capability among paralleled SiC devices for high-temperature power conversion and world's first high-temperature bi-directional SiC switch for motor drive applications. In FY04, fabricate and validate a10 kilowatt (kW) silicon carbide (SiC)-based high-temperature modified matrix converter (MMC) for alternating current (AC) motor control and 50 kW high-temperature SiC diode power modules for direct current - direct current (DC-DC) conversion applications. In FY05, implement a high-temperature controller circuit for 10 kW matrix converter.	1800	1600	375

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Design highly stable, low-acceleration sensitivity, low-noise oscillators, by integrating the high quality factor of photonic resonators and conventional microwave components for improved Future Combat System radar systems engaging in slow moving target detection. In FY03 assessed noise characteristics for fiber optic opto-electronic oscillator (OEO) and model performance. In FY04, evaluate performance of microsphere based OEO with performance suitable for moving target indicator (MTI) sensors. In FY05, test phase locked cavity based stabilized local oscillator (STALO) with RF front ends.	2900	2400	1900
- Investigate new component materials, structures and EM issues to enhance the performance of Millimeter Wave (mmW) components and active devices, such as vacuum electronic (VE) devices and millimeterwave integrated circuits (MMICs), and to enhance integration. In FY03, completed phase II fabrication of Ka- and Q band millimeter VE tubes. In FY04, devise VE tubes for millimeter power modules (MMPMs) for EW and radar applications. In FY05, integrate VE tube with semiconductor amplifier and power supply in MMPMs and characterize. Evaluate new components to support design of next generation mmW active apertures.	1700	1880	2319
- Research and design improved, millimeter-wave solid-state devices based on new device materials and structures to achieve higher output power, power-added-efficiency, linearity, and dynamic range for increased operation and detection range in systems such as FCS, unmanned aerial vehicle (UAV) and soldier system. In FY03, evaluated prototypes in two-dimensional (2D) Escan and created enhanced design with new higher dynamic range MMICs from FCS-Comms program. In FY04, assess performance of microwave/millimeter wave wide bandgap (WBG) devices and circuits. In FY05, complete transmit/receive (T/R) module incorporating wide bandgap (WBG) based MMICs to support tactical unmanned aerial vehicles (TUAV) synthetic aperture radar/moving target indicator (SAR/MTI) radar.	1400	800	1500
- Investigate technology for advanced batteries, fuel reformers and fuel cells to be used in hybrid power sources for the future force warrior, future combat systems (e.g., electromagnetic armor and smart munitions. In FY03, showed early feasibility of a Li/air battery chemistry for very high specific energy battery charger. In FY04, formulate and evaluate new catalysts for efficient hydrocarbon reformation for fuel cells. In FY05, provide technology for an advanced high-energy rechargeable battery with low flammability/ good charge retention at high temperatures and for a lithium air (Li/air) battery and for fuel cell systems utilizing carbonaceous fuels. (This work is in support of project AH11.)	1400	1500	1500

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Investigate eye-safe scannerless three-dimensional (3-D) imaging laser radar for both long-range FCS and short-range unmanned ground and air vehicle applications. In FY03, showed a scannerless laser radar breadboard system in the lab. In FY04, integrate eye-safe components, laser and detector operating at 1.5 um, into LADAR breadboard system. In FY05, show an improved eye-safe version, field test, and collect data to show functionality for target acquisition and robotic navigation.	2300	475	475
- Investigate multi-color infrared (IR) imaging cameras, small pixel focal plane arrays (FPAs) capable of both passive infrared (IR) and active laser detection and acousto-optical tunable filter (AOTF) based hyperspectral imagers for target detection and identification for FCS, countermine, active protection, and other Army applications. In FY03, characterized improved long wave IR detector array devised for airborne buried mine detection tests, analyzed and reported on mid wave and long wave IR radiometric measurements of muzzle flash and kinetic energy (KE) penetrator rods in flight for active system development. In FY04, show improved long-wave IR AOTF for hyperspectral imaging. In FY05, show provision of mid-wave IR azimuth and elevation tracking information to radar kinetic energy projectile tracker for FCS vehicle survivability active protection system.	3378	2000	2100
- Research semiconductor superlattice and quantum dot materials for high operating temperature, high-performance IR detectors and mid-wave infrared (MWIR) quantum cascade lasers to reduce the cost of FCS and other Army sensors. In FY03 showed continuous-wave operation at temperatures reachable by inexpensive thermoelectric coolers. In FY04, show operation of quantum dot detectors at temperatures significantly higher than required for present state-of-the-art high-performance IR detectors, showing potential for lower-cost sensors. In FY05, show low defect density antimony-based superlattice material for future high operating temperature IR detectors.	2353	2400	2450
- Investigate optical limiter designs with promising nonlinear materials in realistic, emulated Army imaging devices for enhanced survivability. In FY03, characterized highly nonlinear reverse saturable absorbing (RSA) dyes in low f-number testbeds. In FY04 fabricate and characterize the nonlinear properties of phase change materials (such as fast switches), sacrificial materials. In FY05 characterize mercury mirrors, engineered RSA materials, two-photon absorbing materials and highly nonlinear optical materials (such as large organic molecules).	350	1000	1000

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Investigate a broad base of extremely quick, accurate, and novel photonic architectures to enable detection of hazardous substances to enhance soldier survivability. In FY04, characterize miniaturization of sensor based on Photoacoustic spectroscopy and the leveraged use of quantum cascade lasers technologies for detection of hazardous chemicals. In FY05, demonstrate concept of remote particle sizing using inversion of scattering from broad-band laser source for remote sensor applications.	0	1450	1530
- Investigate, design and fabricate a micro electro mechanical system (MEMS) based micro-power generator for producing electricity for the dismounted soldier and micro-cooling technology that can be applied to both soldier applications as well as FCS power module thermal management. In FY04, investigate, design, and mature processes to provide: 3D micro-turbine blades and passive micro-cooling systems [300 watts/centimeters squared (W/cm2)]. In FY05, fabricate and show high-temperature high-speed 3D micro-turbine blades; identify other viable approaches to micro-power generation and cooling; and show micro-cooling systems capable of 500 W/cm2.	0	1000	3000
- Investigate and evaluate prognostics and diagnostics (P&D) algorithms; design, fabricate and evaluate micro-electro-mechanical systems (MEMS) and other sensors; and design, code, and evaluate database for the integration into decision systems to extend sensor rationalization and minimize downtime via condition-based maintenance. In FY04, design and show combined MEMS and nanotechnology sensor concept models. In FY05, conduct validating experiments on MEMS/nanotechnology sensors.	0	2400	3000
- The flexible display initiative will establish a university led center to devise flexible display science and technology for FCS and future Soldier applications. In FY04 devise flexible display backplane, electronics and materials. In FY05, mature flexible display technology to devise prototypes. Applied research will be conducted by the center in collaboration with the ARL, industry, and other university partners.	0	3680	5000
- Flat Panel Displays/Flexible Display Initiative: In FY03 and FY04, the objective of this Congressional add is to improve the quality of equipment and materials available from U.S. suppliers for flat panel display technologies; to identify and insert improvements into manufacturing, pre-production and pilot facilities; and to establish standards and manufacturing benchmarks for the flat panel display industry.	6779	3769	0
- Display and Development and Evaluation Laboratory: The objective of this one-year Congressional add was to conduct research in the fabrication and characterization of luminescent materials, components, and prototype display devices for flexible displays; and to create a database of information on display technologies and vendors. No additional funding is required to complete this project.	1694	0	0

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Small Business Innovative Research/Small Business Technology Transfer Programs	0	353	0
Totals	28566	29407	28874