ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2004

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive 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		81562	125147	69638	71287	71005	63399	57364
C05	ARMOR APPLIED RESEARCH	18144	26598	14811	10303	10492	10680	10887
C84	AC84	1122	0	0	0	0	0	0
H77	ADV AUTOMOTIVE TECH	22498	55475	21158	16312	16263	16418	16729
H91	TANK & AUTOMOTIVE TECH	21984	28987	33669	44672	44250	36301	29748
HH8	VOICE INTERACTIVE DEVICE	1619	0	0	0	0	0	0
HH9	UNIVERSITY PROGRAM IN MOBILE ROBOTICS	1430	0	0	0	0	0	0
T21	21ST CENTURY TRUCK (T21)	11338	0	0	0	0	0	0
T26	GROUND VEHICLE TECHNOLOGIES (CA)	0	14087	0	0	0	0	0
T27	ADVANCED COATINGS RESEARCH	1047	0	0	0	0	0	0
T28	FASTENING AND JOINING RESEARCH	1238	0	0	0	0	0	0
T29	NBC AGENT WATER CONTAMINATION MONITORING	1142	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element (PE) researches, investigates and applies combat vehicle and automotive component technologies that will improve survivability, mobility, sustainability, and maintainability of Army ground combat vehicles. As combat vehicle systems become smaller and lighter to provide the necessary strategic deployability and tactical mobility, one of the greatest technological and operational challenges is providing adequate crew protection without reliance on heavy passive armor. This challenge will be met using a layered approach, including long-range situational awareness, multi-spectral signature reduction, Active Protection (AP) systems and advanced lightweight armor in place of heavy conventional armor. Project C05 focuses on designing an integrated lightweight armor suite of protection against Chemical Energy (CE) and medium Kinetic Energy (KE) threats with less than one fourth the weight burden of conventional heavy armor. Goals are to provide lightweight structural armor at 20 lb/sq.ft. or less to defeat heavy machine gun threats and 60 lb/sq.ft. or less frontal armor to protect against more severe threats. Project H91 is investigating testing and characterizing unique active protection countermeasure warheads for intercepting tank fired CE & KE threats. Project H91 also investigates hybrid electric propulsion and electronic vehicle component technologies, which are key enablers for achieving Future Combat Systems (FCS) and Future Force capabilities. In the near term, FCS vehicles will be designed with hybrid electric architectures, providing power for propulsion, communications and control systems, life support systems, and electromagnetic (EM) armor. In the far term, vehicle energy and power levels will be increased to accommodate advanced electric weapons (e.g.

lasers, high power microwaves and electric guns) and advanced electric-based protection systems. Project H91 provides components for improved vehicle performance and mobility, including active suspensions, motors, regenerative brakes, vehicle electronics (VETRONICS), generators, controllers, hybrid electric architectures, inverters and lightweight track. It also investigates and matures high temperature/power electronics, high energy density energy storage devices, and components of pulse forming networks (PFN) elements (batteries, switches, inductors and capacitors) required for electric vehicle mobility and survivability. In addition, Project H91 addresses sustainability and maintainability, with efforts in advanced military fuels and lubricants; vehicle diagnostics; and on-vehicle water generation and water purification. This project also addresses the systematic integration and assessment of these technologies in lightweight conceptual platforms using advanced virtual prototyping capabilities. Project H77 funds the National Automotive Center (NAC). The goal of the NAC is to leverage large commercial investments in automotive technology research and development, pursuing automotive-oriented technology programs that have potential benefit to military ground vehicles. This PE adheres to Tri-Service Reliance Agreements on advanced materials, fuels and lubricants, and ground vehicles, with oversight and coordination provided by the Joint Directors of Laboratories. The PE is coordinated with the Marine Corps through the Naval Surface Warfare Center and with other ground vehicle developers within the Departments of Energy, Commerce, Transportation, and DARPA. The program element contains no duplication of any similar effort within the Military Departments. Products of this program transition primarily to PE 0603005A for maturation and incorporation into demonstration platforms/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). Work in this PE is performed by TARDEC, Warren, MI.

B. Program Change Summary	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2004)	79952	80910	71108
Current Budget (FY 2005 PB)	81562	125147	69638
Total Adjustments	1610	44237	-1470
Congressional program reductions		-8598	
Congressional rescissions			
Congressional increases		55850	
Reprogrammings	1610	-3015	
SBIR/STTR Transfer			
Adjustments to Budget Years			-1470

Significant Changes.
FY 2004 - Twenty-five FY04 Congressional adds totaling $55850 were added to this PE.

FY04 Congressional Adds with no R-2As:
($1034) Advanced Coatings Research, Project T26: The purpose of this one-year Congressional Add is to focus on coating systems to increase process flow and allow application with minimum equipment and environmental impacts. No additional funds are required to complete this project.

($940) Advanced Coatings Research to Extend the Service Life of Vehicles/Equipment, Project T26: The purpose of this one-year Congressional add is to develop coatings which will resist Nuclear, Biological and Chemical (NBC) contamination and offer the possibility of self-correction of surface damage. No additional funds are required to complete this project.

($3381) Ballistic Missile Technology, Project T26: The purpose of this one year Congressional add is to fund research in ballistic missile technology. No additional funds are required to complete this project.

($3851) Combat Vehicle Mobility System, Project T26: The purpose of this one-year Congressional add is to develop component technology to improve the mobility and survivability of Army ground vehicle systems. No additional funds are required to complete this project.

($1643) Fuel Preporator, Project T26: The purpose of this one-year Congressional add is to conduct testing to identify and evaluate manufacturers of filter systems that claim to improve fuel efficiency, remove entrapped air from the fuel, and improve emissions. No additional funds are required to complete this project.

($940) Hybrid HMMWV Technology Insertion Program, Project T26: The purpose of this one-year Congressional add is to develop, integrate and field test a Li-Ion battery pack at the module level in the lab and at the vehicle level in the hybrid HMMWV. No additional funds are required to complete this project.

($940) Moldite, Project T26: The purpose of this one-year Congressional add is to evaluate Moldite, a lightweight moldable composite material, for ground vehicle system and component applications and recommend potential prototype applications/evaluations. No additional funds are required to complete this project.

($940) Soldier Mobility Program, Project T26: The purpose of this one-year Congressional add is to improve soldier mobility in combat & tactical situations, and DoD civilian / Military Police mobility for logistical support and perimeter security patrol. No additional funds are 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	**0602601A - Combat Vehicle and Automotive Technology**	**C05**

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
C05	ARMOR APPLIED RESEARCH	18144	26598	14811	10303	10492	10680	10887

A. Mission Description and Budget Item Justification: This project investigates, designs and tests integrated armor component technologies and armor packaging to achieve lightweight, ballistically-superior integrated structures and armor that will provide the last line of defense for Future Combat Systems (FCS) and Future Force vehicles. The effort provides the analytical basis for understanding and predicting the effectiveness of various armor systems and examines the vehicle armor systems required to protect against collateral damage from debris generated by the Active Protection (AP) system threat defeat. The major focus is on providing armor component technologies with reduced weight, reduced space claim and lower cost for protection against medium kinetic energy (KE) projectiles, chemical energy (CE) warheads, Explosively Formed Penetrators (EFP) and blast fragments from mines. Goals are to provide base armor to defeat heavy machine guns and residual fragments from AP threat defeat at 20 lbs/ sq.ft. or less; armor packages to defeat limited rocket propelled grenade (RPG) and medium caliber KE at 40 lbs/sq.ft. or less; and novel frontal armors to defeat heavier threats at 80 lb/sq.ft. or less for FCS Increment 1 and FCS spiral insertions. The goal for frontal armor will be to reduce the weight efficiency to 60 lb/sq.ft. or less for FCS Increment 2. The armor technologies designed and fabricated in this project complement innovative non-armor survivability component techniques that are funded in project AH91. In addition, this project investigates low-burden solutions for the protection of tactical vehicles in war and operations-other-than-war, focusing on appliqué armor for small arms and land mine protection. International cooperative research in mine blast characterization and vehicle response is also conducted. Efforts are fully coordinated and complementary to work performed under PE 0602618A (Ballistic Technology) and PE 0602105A (Materials). 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 TARDEC, Warren, MI in collaboration with Army Research Laboratory, Adelphi, MD.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
Advanced Armor - In FY03, provided advanced armor solutions and model data for defeat of AP residual debris; evaluated armor solutions that address medium caliber KE and CE threats that meet the intermediate frontal weight efficiency goal of 80lbs/sq ft or less; provided 1st generation electro magnetic (EM) armor solutions for defeat of CE weapons. In FY04, evaluate 2nd generation EM armor solutions that address large CE threats and meet the intermediate weight efficiency goal of 80lbs/sq ft.	15370	1912	0
Countermine - In FY03, evaluated lightweight ballistic solutions for mine blast protection and developed representative applied modeling and simulation (M&S) tools. In FY04, test and evaluate mine protection armor configurations, obtain improved mine blast test data, and validate M&S. In FY05, will complete testing and evaluation of FCS mine resistant lower hull appliqué concept(s) integrated into FCS prototype designs; use finite element models to evaluate FCS prototype vehicle designs against multiple mine scenarios to assess capabilities beyond single blast events.	2774	1726	891
Structural Armors - In FY04, build representative vehicle section ballistic targets; range test these fully integrated 3rd generation armor/structure designs against FCS objective threats, and evaluate results of armor/structural capability at FCS vehicle design weights; evaluate integration of critical armor components; test armor/structural reliability; evaluate EM armor components for structural armor applications; improve physics and engineering based models and design tools. In FY05, will conduct ballistic range tests to optimize and validate the best achievable integrated armor packages for lightweight combat vehicle platforms, including defeat of advanced RPG and future medium cannon KE projectiles; complete design and fabrication of advanced full scale ballistic structure/platform.	0	14967	13920
Full Spectrum Active Protection Close-in Layered Shield (FCLAS) - FCS Support: The purpose of this one year Congressional add is to fund demonstration of a FCLAS system that provides close-in, full hemispherical protection for ground combat and tactical vehicles against Rocket Propelled Grenades. No additional funds are required to complete this project.	0	7237	0
Small Business Innovative Research/Small Business Technology Transfer Programs	0	756	0
Totals	18144	26598	14811

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

February 2004

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602601A - Combat Vehicle and Automotive Technology**	**H77**

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H77	ADV AUTOMOTIVE TECH	22498	55475	21158	16312	16263	16418	16729

A. Mission Description and Budget Item Justification: This project funds the National Automotive Center (NAC), which leverages the large commercial investments in automotive technology research and development. NAC conducts shared technology programs that focus on benefiting military ground vehicle systems. Component technologies being matured in this project support the Army's current and future combat and tactical vehicle fleets. Improvements in the current force are expected to rely heavily on leveraging commercial technologies for advances in operational capabilities and cost. The NAC serves as a catalyst, linking industry, academia and government agencies for the maturation and exchange of automotive design and component technologies. The NAC core program is focused in three primary areas: Advanced Automotive Technology (AAT), Future Tactical Truck System (FTTS) Advanced Concept Technology Demonstrator (ACTD) and Mobility Vehicle Design (MVD). A major effort in AAT is Hybrid Electric Drive (HED) for tactical vehicles and light combat vehicles to improve fuel economy and mobility. Past work has included: Hybrid Electric Commercially Based Tactical Trucks (COMBATT), HED Heavy Expanded Mobility Tactical Truck (HEMTT) and in-hub motor HED 8X8 vehicle. This area also includes other fuel efficiency technologies, vehicle modernization, crew safety, maintenance, diagnostics and prognostics, logistics improvement and manufacturing innovation with an overall goal of improving performance and endurance of ground vehicle fleets and reducing vehicle design, manufacturing, production, operating and support costs. FTTS ACTD is a new initiative to incorporate a number of advanced automotive technologies, that the Army and commercial sector have been maturing in recent years, into tactical support vehicles for the FCS and Future Force. The ACTD will provide a number of FTTS demonstrator vehicles for evaluation in a military unit field environment. ACTD test results will validate FTTS modeling estimates, refine FTTS User requirements, reduce the FTTS program risk and reduce risk of technology transfer to current platforms. Additional funds for the ACTD are contained in PE 0603005A, project 440. MVD is investigating the use of emerging commercially developed electrical systems at 42VDC, 120 VAC for use in Army vehicle applications. Some activities of the NAC are supported by other government agencies via a Memorandum of Agreement (MOA). 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 TARDEC, Warren, MI.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
Advanced Automotive Technology: In FY 03, continued Commercially Based Tactical Trucks (COMBATT) and Hybrid Electric COMBATT testing; updated Hybrid Electric design configuration and associated testing for the HEMTT; continued advanced research of the 8X8 to enhance power converter; completed instrumentation of HEMTT ESP hydraulics with diagnostic sensors; tested concept vehicle (Hybrid Electric M113) at Aberdeen Test Center (ATC); worked with PM community to standardize A-kit and B-kit installations for embedded diagnostics on Brigade Combat Team vehicle fleet. In FY04, continue testing of advanced propulsion systems, including hybrid electric for light tactical vehicles, at Yuma Test Center (YTC) and potentially at ATC; continue to evaluate hybrid hydraulic systems on medium and heavy tactical vehicles; and conduct extensive tests and evaluations of subsystems and components which comprise hybrid electric propulsion systems in ground vehicles. In FY05, will continue testing and evaluating the synergistic effects of hybrid electric subsystems and components, primarily for light and medium tactical vehicles at YTC and ATC, when integrated with mission specific hardware/electronics and provide these technologies/systems as potential candidates for inclusion in FCS. This testing will include: the Hybrid Hydraulic Propulsion system demonstrator will be at ATC; the HEMTT A3 Chassis Dyno Testing and the Independent Active Suspension Test Rig Component Development testing at the Oshkosh facility; reliability & performance testing of the COMBATT vehicles and the Severe Off-Road Vehicle (SORV) at YPG; and Contractor Shakedown Testing: GM & Daimler-Chrysler, 5 each of the COMBATT Vehicles at their respective facilities.	15202	9070	11049

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
Future Tactical Truck System (FTTS) ACTD: In FY04 award multiple contracts that will focus on key component technology selections and subsystem designs through Modeling and Simulation (M&S) of the Maneuver Sustainment Variant (MSV) and the Utility Variant (UV) vehicles for the FTTS ACTD. Four to six contractors will utilize M&S tools to analyze and optimize the MSV and UV vehicle concept design. The modeling will focus on the Hybrid powertrain, energy/power management, material handling, mobility, and ease of vehicle maintenance. The capabilities provided will be fed into operational models to determine the impact new technologies have on the Soldier's ability to complete the mission. Design, performance and operational trade space will be defined and evaluated throughout the M&S cycle. During late FY04 Contractor testing of key subsystems and components will be utilized to validate modeling results. Preliminary design reviews will be held. In FY05, will complete the final Government analysis; complete the design of the multiple maneuver sustainment and utility vehicle demonstrators/prototypes; evaluate the vehicles to validate the M&S predictions of the performance and military utility of the different MSVs and UVs; and perform virtual prototyping and mobility modeling through the use of 3D models and analysis. The number of contractors will be reduced with an emphasis on completing contractor subsystem and component testing prior to the Critical Design Review CDR. The M&S facilitates the Critical Design Review before the fabrication of the MSV and the UV. Vehicle hardware will be purchased. This effort supports the maturation of technologies in PE 603005 Project 440 by determining the optimal system integration and subsystem layout of the vehicles through M&S before physical fabrication begins.	0	11791	9109
Mobility Vehicle Design - In FY03, completed requirements analysis and design for use of emerging commercially developed systems at 42VDC, 120 VAC. In FY04, establish baseline 42V power generation, energy storage devices, and smart power architecture components. In FY05, will mature power distribution, power modules, and smart switching technologies.	700	500	1000
Advanced Energy & Manufacturing Technology: The purpose of this one-year Congressional add is to research automotive power technologies for possible application in military land warfare systems. No additional funds are required to complete this project.	0	2025	0
Advanced Electric Drive: The purpose of this one-year Congressional add is to determine the potential impact of Advanced Electrical Drive Technologies on vehicle performance, fuel economy and life-cycle costs. No additional funds are required to complete this project.	0	1157	0
Advanced Manufacture of Lightweight Materials (AMLM): The purpose of this one-year Congressional add is to focus on the development of advanced lightweight materials for applications in military and commercial vehicles. No additional funds are required to complete this project.	0	482	0

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
CALSTART Defense Advanced Trans: The purpose of this one-year Congressional add is to facilitate joint programs and communication between the DOD, the private sector, and state and regional governments to develop advanced heavy-duty vehicle technologies focused on hybrid drive trains and fuel cells. No additional funds are required to complete this project.	0	4918	0
Digital Humans & Virtual Reality: The purpose of this one-year Congressional add is to develop tools and capabilities for the analysis, optimization, and simulation of the human interface for current and evolving vehicle systems. No additional funds are required to complete this project.	0	964	0
Future Tactical Truck System (FTTS) Companion Trailer System(s): The purpose of this one-year Congressional add is to fund research and development of a technologically advanced trailer to follow behind the FTTS. No additional funds are required to complete this project.	0	1639	0
Hydrogen PEM Fuel Cell Heavy Duty: The purpose of this one-year Congressional add is to build a power plant to undergo durability testing and conduct product improvement redesign effort based on the test results. No additional funds are required to complete this project.	0	2411	0
Hydrogen PEM Ambient Pressure Fuel Cell Demonstration: The purpose of this one-year Congressional add is to assemble the first prototype proton exchange membrane (PEM) power plant for verification and validation tests. No additional funds are required to complete this project.	0	3278	0
Fuel Efficiency Technology: The purpose of this one-year Congressional add is to investigate a pre-reforming concept for processing logistic fuels used in ground vehicle fuel cell auxiliary power units. No additional funds are required to complete this project.	0	964	0
Next Generation Smart Truck: The purpose of this one-year Congressional Add is to test, integrate, and showcase cutting-edge automotive technologies with military and homeland security/counterterrorism applications. No additional funds are required to complete this project.	0	4146	0
Army Truck Diagnostic System: The purpose of this one-year Congressional add is to identify existing commercial vehicle electronics technologies that can be leveraged into Army tactical trucks and/or combat platforms to enhance core capabilities. No additional funds are required to complete this project.	0	1639	0
Auragen Vehicle Integrated Primary Electrical Resource (VIPER): The purpose of this one-year Congressional add is to research and develop under-hood power generating systems capable of producing 3-12 kilowatts of AC power compatible with combat and tactical vehicles with a drive system. No additional funds are required to complete this project.	0	3375	0

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
M-Gator Improvements: The purpose of this one-year Congressional add is to identify and prove out improved electric- and hybrid-electric drivetrains for the John Deere M-Gator series of ultra light mobility platforms. No additional funds are required to complete this project.	0	964	0
Rapid Prototyping Technologies: The purpose of this one-year Congressional add is to design and develop a robust metal spray system and to mature process planning and reverse engineering software. No additional funds are required to complete this project.	0	1350	0
Unmanned Vehicle Control Technologies: The purpose of this one-year Congressional add is to develop improved control of unmanned vehicles and investigate the best human and vehicle interfaces. No additional funds are required to complete this project.	0	1639	0
Military Wheeled Vehicle Electronic Architecture Integration: The purpose of this one-year Congressional add is to identify existing commercial software and hardware technologies that can interface with Army tactical truck electronic architectures to facilitate the movement and manipulation of on-board data. No additional funds are required to complete this project.	0	1639	0
COMBATT - This one-year Congressional add evaluated and matured technologies on commercial light truck platforms that enhanced vehicle's performance while demonstrating the benefits of hybrid propulsion. No additional funds are required to complete this project	3346	0	0
Smart Truck - This one-year Congressional add tested and evaluated emerging automotive/military technologies on commercially based platforms that could be used for homeland defense. No additional funds are required to complete this project.	3250	0	0
Small Business Innovative Research/Small Business Technology Transfer Programs	0	1524	0
Totals	22498	55475	21158

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H91	TANK & AUTOMOTIVE TECH	21984	28987	33669	44672	44250	36301	29748

A. Mission Description and Budget Item Justification: This project investigates, matures and tests innovative vehicle concepts, mobility, critical power, propulsion, survivability, and other component technologies for future combat vehicles. The project also addresses: military fuels and lubricants and water recovery/purification. Hybrid Electric and Electric vehicle technologies are key enablers for achieving Future Combat Systems (FCS) and Future Force capabilities. Future combat vehicles will be designed with hybrid electric architectures, providing power for propulsion, communications and control systems, and life support systems. In the mid-term, electrothermal chemical (ETC) guns and electromagnetic (EM) armor will be available. In the longer term, vehicle energy and power levels will be increased to accommodate advanced electric weapons (e.g., lasers, high power microwaves, and electric guns) and advanced electric-based protection systems. The Hybrid Electric/Electric Vehicle effort designs, fabricates and tests critical components for energy storage and power distribution. Mature components developed under this effort can be incorporated into the Hardware-In-The-Loop Systems Integration Laboratory (funded in PE 0603005A, project 441) for testing and evaluation. The Pulse Power effort focuses on providing high energy/high power density components (including film capacitors, solid-state switches and pulse charging circuitry for EM armor, ETC gun and EM gun) and design of pulse forming networks (PFNs), which are enablers for the advanced weapon and protection systems. These two efforts support the Office of the Secretary of Defense (OSD) Power and Energy Initiative, which is one of the top 3 DoD S&T priorities. The Vehicle Concepts Modeling and Simulation (M&S) effort investigates novel vehicles (both manned and unmanned), constructs realistic virtual prototypes, conducts trade studies, and makes performance predictions and analyses. Work in this project is performed in collaboration with the U.S. Army Engineer Research and Development Center located at Vicksburg, Mississippi. The goal of the Propulsion/Prime Power effort is to design engines and generators and their components with significantly improved performance characteristics and efficiencies. In the near term, increasing the power density is a key objective; in the farther term focus is on achieving even higher power densities and maturing fuel cell technology. The Mobility effort focuses on improving drive component performance and reliability (e.g., running gear, tracks and suspensions), fuels and lubricants, bridging, minefield breeching, and gap crossing technologies to enable high OPTEMPO and to reduce logistics burdens associated with manned and unmanned combat and tactical vehicles. The Vehicle Survivability effort provides component technologies that contribute to an integrated vehicle survivability approach. This effort includes design and testing of active protection and hit-avoidance components, signature reduction materials, pedestrian tracking/detection components for unmanned systems, laser protection materials, and advanced lightweight structure and base armor. This work complements, but does not duplicate, work performed under the armor exploratory development project (C05). The Water Recovery/Purification and Generation effort focuses on reducing the logistics footprint by leveraging emerging technologies and basic research being conducted by DARPA. The program will demonstrate enhanced water purification technology which can be embedded in combat platforms and support the individual soldier that have the capability of purifying any water source regardless of contaminants. The goal is to reduce water distribution requirements (projected to be 30% of the total daily sustainment requirement of the Future Force) through three approaches: 1) innovative purification of traditional water sources; 2) water recovery from exhaust; and 3) water recovery from atmospheric humidity. Activities are closely coordinated with TRADOC's Mounted and Dismounted Battlespace Battle Labs, Unit of Action Maneuver Battlelab, the Directorate of Combat Developments for Transportation, Quartermaster, Program Executive Office for

Ground Combat and Support Systems, ARL; DARPA and the Red River Army Depot. 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 PE is performed by TARDEC, Warren, MI.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
Hybrid Electric/Electric Vehicle: In FY03, tested and evaluated high-power semi-conductor motor controllers for FCS. In FY04, build and evaluate advanced high power (10kW), high temperature silicon and silicon carbide (SiC) hybrid converters; obtain state-of-the-art energy storage and power generation components (advanced batteries, capacitors, switches, converters, etc.), characterize performance and condition these components to provide the data and the validated components to be incorporated into the Power and Energy (P&E) Hardware in the Loop System Integration Lab (SIL). In FY05, will test and evaluate SiC for use in high voltage rectifiers, converters, and motor drives for a more compact FCS Increment 2 hybrid power management system for FCS; demonstrate higher power and energy density in Li-ion batteries; increase the maturity of these critical technologies to enable system level integration and demonstrations, continue to characterize performance and condition additional state-of-the-art components for validation and incorporation into the P&E SIL and assess Li-Ion battery with improved performance (fire retarding material, power/thermal management, and higher power density). This is a collaborative TARDEC and ARL effort.	500	8150	12909
Pulse Power - In FY04, investigate, design and characterize novel silicon solid state device concepts for technology that will allow for integration of revolutionary survivability and lethality capabilities on deployable ground combat vehicles; design and validate high-action, fast rise-time output switches capable of State-of-the-Art (SOA) Power Density Levels; investigate, develop and evaluate high-performance dielectric materials and novel packaging/manufacturing techniques to increase the energy density of SOA fast-discharge, high-voltage capacitors; fabricate and evaluate SOA high-power density power converters. In FY05, will investigate and mature SiC solid state device concepts for improved output switches and for reduced size pulse charger inverter/rectifier circuits; mature high-performance dielectric materials to further increase the energy density of fast-discharge, high-voltage capacitors; mature novel, modular silicon solid-state output switch concepts; investigate and evaluate advanced thermal management approaches for high temperature operation. This is a collaborative TARDEC/ARL effort.	0	7025	5741

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
Vehicle Concepts Modeling and Simulation (M&S): In FY03, matured physics based platform and terrain models for advanced manned and robotic ground vehicle subsystems; completed baseline and validation experiments for moving vehicle operations; and provided FCS concepts, trade studies and performance predictions/input to performance predictions. In FY04, mature physics based mobility and durability models for advanced manned and robotic ground vehicle platforms and their associated complex urban, all-season terrain environment. Model the tire, snow and 3-D soil interactions between the terrain and the vehicles running in real-time. Work in this project is performed in collaboration with the U.S. Army Engineer Research and Development Center located at Vicksburg, Mississippi. In FY05, will mature the understanding of adverse effects of moving vehicle operations and promising passive and active mitigation strategies; generate FCS spiral and incremental upgrade vehicle concepts and performance predictions, including powertrain vibration characteristics; develop method of generating real-time 3-D terrain databases from 2-D terrain elevation profiles, and integrate snow and soil models and add semi-frozen and thawing capabilities.	3765	2013	3050
Propulsion/Prime Power: In FY03, completed design analysis of FCS 4.5 Net HP/cu-ft power density test stand engines in support of FCS Increment I. In FY04, conduct full performance characteristics and 50 hour laboratory NATO durability testing for FCS engine. In FY05, will enhance FCS engine performance and durability to achieve the 6 Net HP/cu-ft system power density and improve FCS engine configuration to achieve 400 hours of laboratory NATO durability testing and for integration into a complete FCS MGV propulsion package; investigate feasibility of opposed piston engine concept to produce 8 hp/cu-ft power density propulsion system; investigate and characterize current fuel cell technology state-of-the-art capabilities and limitations for combat vehicle prime power source consideration; and conduct analysis of design variations in opposed piston engine configurations.	3000	1950	4950

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
Vehicle Survivability (Active Protection/Minefield Breeching/Laser Protection/Hit Avoidance): In FY03, conducted dynamic countermeasures range tests of potential chemical energy and kinetic energy threat defeat countermeasure configurations against multiple dynamic horizontal and overhead threats; conducted joint demonstration of marking systems with the Navy. In FY04, determine optimum ground pressure to trigger recently emplaced as well as age affected mines; finalize surrogate instrumented mine configuration and subsurface ground pressure measurement devices; validate blast models with current test data to ensure accurate results/resolution; and develop preliminary designs for a laser-protected targeting sight using highly modified digital camera technology as the primary sensor. In FY05, will use modeling and simulation to conduct trade-off analysis between lightweight material solutions and blast dissipation techniques for scaleable and modular configurations capable of withstanding the blast effect of mines; finalize optical system designs that meet the targeting requirements and the integration plans for the frequency agile protection; complete technology evaluations to determine applicability of existing Hit Avoidance technology to the regional protection concept; and finalize sub-system requirements and construct Hit Avoidance Regional Protection System model.	1559	1586	2455

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
Mobility for Manned and Unmanned Vehicles - In FY03, completed fuel economy dynamometer testing validating fuel economy benefits, conducted fleet testing of novel fuels and lubricants; implemented software to download the Petroleum Oil and Lubricants (POL) Analyzer sensor data into oil analysis database; and constructed virtual prototypes of future light tactical bridging configurations. In FY04, award multiple contracts to investigate lightweight automated modular gap defeat concepts compatible with FCS requirements, in collaboration with the U.S. Army Engineer Research and Development Center located at Vicksburg, Mississippi; evaluate the use of advanced mobility technologies (i.e., hybrid electric drive, active suspension, etc.) for Armed Robotic Vehicle (ARV). In FY05, will develop and analyze lightweight automated modular gap defeat concepts; evaluate automated emplacement techniques and gap sensor technology; develop gap defeat models; initiate the fabrication of test components; support the joint expeditionary mindset through augmentation of the ONR project for the development of non-standard bridging to include lightweight deck panels as a gap defeat concept; investigate technologies for providing an anti-tamper radius that surrounds an unmanned system, including enemy tracking and detection as well as non-lethal deterrent measures; and enhance the mobility characteristics of the ARV to ensure that the unmanned assets have equivalent mobility to the manned vehicles of the future force.	1845	2616	1832
Water recovery/purification - In FY03, conducted water recovery tests from exhaust prototype, with collection and purification system integrated and mounted on a HMMWV. In FY04, conduct a test track demonstration of water recovery from exhaust system on the NLOS-C Lancer demonstration vehicle and investigate optimal designs for water recovery from atmospheric humidity. In FY05 will conduct a structured technology demonstration of water recovery from exhaust system on the NLOS-C Lancer demonstration vehicle to validate system maturity, water production, and water quality; and develop technology and demonstrate laboratory breadboard system to establish proof of concept for water recovery from atmospheric humidity.	3000	4878	2212
Crew Integration & Automation Testbed (CAT): In FY03, in support of the CAT ATD, evaluated the use of 3D audio systems for the control and situational awareness of robotic and dismounted unmanned system assets; tested and evaluated speech recognition technology for speaker independence, natural language understanding and expanded control to unmanned systems while working high noise environment.	3192	0	0
Advanced Mobile integrated Power System (AMPS): In FY04, investigate and mature 42V power generation, energy storage devices, and smart power architecture components; and perform alternate concepts evaluation using modeling and simulation. In FY05, adapt and mature power flexbus low power distribution and modular low power modules and investigate and mature smart switching power management.	0	486	520

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
Combat Vehicle Mobility System - Combat Vehicle Mobility System - This one-year Congressional Add matured component technology to improve mobility and survivability of the Army's ground vehicle systems. No additional funding is required to complete this project.	3415	0	0
Military Wheeled Vehicle Electronic Architecture Integration (EAI) - This one-year Congressional Add designed and created an interface to serial databus architecture, such as J1939 and J1708, for current vehicles such as HMMWV, which will enable the vehicle platform to be equipped with critical capability like embedded diagnostics/prognostics. No additional funding is required to complete this project.	1708	0	0
Small Business Innovative Research/Small Business Technology Transfer Programs	0	283	0
Totals	21984	28987	33669