ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive Technology

COST (In Thousands)		FY 2004 Actual	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		114340	114108	64883	66668	63263	56814	57307	57726
C05	ARMOR APPLIED RESEARCH	18794	14223	9907	10185	10623	10743	10836	10915
H77	ADV AUTOMOTIVE TECH	55032	49006	15879	15982	16531	16716	16862	16985
H91	TANK & AUTOMOTIVE TECH	26343	32759	39097	40501	36109	29355	29609	29826
T26	GROUND VEHICLE TECHNOLOGIES (CA)	14171	18120	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 frontal armor at 60 lb/sq.ft. (or less) to protect against more severe threats. 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. Project H91 is investigating, evaluating and characterizing unique AP countermeasure warheads for intercepting CE and 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 farther term, vehicle energy and power levels will be increased to accommodate advanced electric weapons (such as 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 (PFNs) (such as 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 T26 funds Congressional special interest items. The PE is coordinated with the Marine Corps through the Naval Surface Warfare Center and with other ground vehicle developers within DARPA and the Departments of Energy, Commerce, and Transportation. Products of this program primarily transition to PE 0603005A (Combat Vehicle and Automotive Advanced Technology) 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 Tank-Automotive Research, Development and Engineering Center (TARDEC), Warren, MI, in collaboration with the Army Research Laboratory (ARL), Adelphi, MD.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	69638	71287	71005
Current Budget (FY 2006/2007 PB)	114108	64883	66668
Total Adjustments	44470	-6404	-4337
Net of Program/Database Changes			
Congressional Program Reductions	-1680		
Congressional Rescissions			
Congressional Increases	48700		
Reprogrammings			
SBIR/STTR Transfer	-2550		
Adjustments to Budget Years		-6404	-4337

Change Summary Explanation:

Twenty-four FY05 Congressional adds totaling $48700 were added to this PE.

FY05 Congressional adds with no R-2A:
($1438) Advanced Electric Drive, Project T26: This one-year Congressional add is to evaluate the potential impact of advanced electric drive technologies on vehicle performance, fuel economy & life-cycle costs, focusing on validation of hardware drive train configuration and hybrid control strategies. No additional funds are required to complete this project.

($7192) Advanced High Power Rechargeable Stored Energy Technology, Project T26: This one-year Congressional add is to advance the state of the art of lithium-ion batteries and ultra-capacitors that use affordable, high performance carbide, nitride, and metal alloy nano-composite materials with the appropriate power electronics, suitable for operations in temperature extremes for application to a modular hybrid electric vehicle power train. No additional funds are required to complete this project.

($959) Affordable, Low Temperature, High Performance Advanced Rechargeable Stored Energy Device Technologies for Future Army Combat Hybrid Electric Vehicles, Project T26: This one-year Congressional add is for the evaluation of advanced Li-ion battery systems No additional funds are required to complete this project.

($959) Compact Pulsed Power for Defense Applications, Project T26: This one-year Congressional add is to investigate a promising approach to pulse power storage and conditioning for military vehicles and other defense applications. No additional funds are required to complete this project.

($959) Mobile Thermal Perimeter Surveillance System, Project T26: This one-year Congressional add is to investigate technologies that will utilize thermal imaging properties for a perimeter surveillance system. No additional funds are required to complete this project.

($3836) Nano-Engineered Materials for High Performance Armor, Project T26: This one-year Congressional add is to conduct research in transparent materials for armor, consisting of investigations in processing and analysis of nano-ceramics. No additional funds are required to complete this project.

($959) Stoichiometric Explosive Detector System, Project T26: This one-year Congressional add is to perform research in the area of "bomb sniffing" technology for the Smart Truck III. No additional funds are required to complete this project.

($1823) Unmanned Vehicle Control Technologies, Project T26: This one-year Congressional add is to explore intelligent software solutions that may facilitate adjustably autonomous robotic control. No additional funds are required to complete this project.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602601A - Combat Vehicle and Automotive Technology**	**C05**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
C05	ARMOR APPLIED RESEARCH	18794	14223	9907	10185	10623	10743	10836	10915

A. Mission Description and Budget Item Justification: This project investigates, designs and develops advanced armor materials, advanced structural armors ballistic defeat mechanisms, and armor packaging solutions to achieve lightweight, ballistically-superior armors/structures that will provide the last line of defense for Future Combat Systems (FCS) and Future Force vehicles. The effort also provides for analysis, modeling, and characterization of advanced armor solutions designed to protect against collateral damage from residual debris generated by the Active Protection (AP) threat defeat mechanisms. The major focus is on providing technology solutions that reduce weight, reduce space claims and lower the cost for protection against medium kinetic energy (KE) projectiles, chemical energy (CE) warheads, Explosively Formed Penetrators (EFPs) and blast fragments from mines. Goals are to provide base armor to defeat heavy machine guns and residual fragments from AP intercept events at 20 lbs/sq.ft. (or less); armor packages to defeat limited rocket propelled grenades (RPGs) and medium caliber KE at 40 lbs/sq.ft. (or less); and novel frontal armors to defeat heavier threats, initially at 80 lb/sq.ft. (or less) for FCS - reducing this to 60 lb/sq.ft. (or less) for future FCS spiral insertion/upgrades. The armor technologies designed and fabricated in this project complement innovative non-armor survivability component techniques that are funded in Project H91. In addition this project investigates low-burden solutions for the protection of current and tactical vehicles operating in war and operations-other-than-war, focusing on appliqué armor for protection from small arms and land mines (countermine applications). 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 Technology). Ballistic protection technologies developed under this project will be evaluated and incorporated into the Integrated Survivability Advanced Technology Demonstration (ATD) in PE 0603005A (Combat Vehicle and Advanced Automotive Technology). The goal of the IS ATD is to provide “convincing evidence” of the superiority of a “layered” approach to survivability. 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 Tank Automotive Research, Development and Engineering Center (TARDEC), Warren, MI, in collaboration with the Army Research Laboratory (ARL), Adelphi, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Armor: In FY04, investigated advanced armor solutions to protect from residual debris associated with AP threat defeat events, meeting the intermediate frontal weight efficiency goal (80lbs/sq.ft.); provided 1st generation electromagnetic (EM) armor solutions for defeat of medium CE weapons; evaluated 2nd generation EM armor solutions that address large CE threats and meet the intermediate weight efficiency goal of 80 lbs/sq.ft. In FY05, evaluate the FCS armor prototype (AX-1), in conjunction with the Integrated Survivability ATD demonstration to determine effectiveness when used with CE AP system. In FY06, will evaluate FCS armor prototype, in conjunction with field demonstrations of the static KE AP system and Close-In AP system, to determine if the structural armor package can withstand the residuals after AP intercept. In FY07, will complete FCS armor prototype ballistic evaluation and optimize advanced passive armors developed for small arms, medium KE, and fragment defeat; will evaluate and ballistically test 4th generation armor/structure candidate solutions.	13981	11091	6118	7446
Structural Armors: In FY04, built representative vehicle armor/structure sections as ballistic targets and conducted ballistic tests using FCS objective threats, and evaluated results of armor/structural capability at FCS vehicle design weights; evaluated integration of critical armor components; investigated armor/structural reliability; evaluated electromagnetic (EM) armor components for structural armor applications; improved physics and engineering based models and design tools. In FY05, 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.	3058	2254	0	0
Countermine: In FY04 investigated and developed active and passive armor appliqués that can be added onto the structure platform to enhance blast protection levels; conducted structural design studies and trades to better understand blast effects against various lower chassis design concepts; enhanced finite element modeling incorporating human occupation and seating; published assessment of alternative technologies and weight allocations for FCS platforms to defeat side attack mines, improvised explosive devices (IEDs), and penetration type mines. In FY05, refine design and reduce weight of kit protection concepts, evaluate mine resistance capabilities of developed FCS concept vehicles; collect live fire test data from mine strikes and model reactions against FCS concepts. In FY06, will demonstrate final add-on kit mine resistance solutions and experimentally validate developed blast models. In FY07, will demo improved lightweight blast/fragmentation appliqués for tactical and current force combat vehicle use with live-fire testing.	1755	878	500	500

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Full Dimensional Ballistic Protection: In FY06, explore integration issues between ballistic, signature management, and related survivability technologies, considering durability, mounting approaches, performance synergy and compatibility. Collect and analyze data in support of characterization of visual signature for operational analysis. In FY07, conduct experiments to determine the best solutions integrating ballistic, signature management, and related survivability technologies, initiate visual signature characterization algorithm development and execute supporting perception experiments.	0	0	3289	2239
Totals	18794	14223	9907	10185

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H77	ADV AUTOMOTIVE TECH	55032	49006	15879	15982	16531	16716	16862	16985

A. Mission Description and Budget Item Justification: This project funds the National Automotive Center (NAC), which leverages commercial investments in automotive technology research and development. NAC conducts shared technology programs that focus on benefiting military ground vehicle systems. Component technologies being researched and investigated 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 two primary areas: Advanced Automotive Technology (AAT), and Future Tactical Truck System (FTTS) Advanced Concept Technology Demonstrator (ACTD). A major effort in AAT is Hybrid Electric Drive (HED) for tactical vehicles and light combat vehicles to improve fuel economy and mobility. This area also includes other fuel efficiency technologies, vehicle modernization, crew safety, maintenance, reliability, 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. Another major effort in ATT is fuel cell research, addressing both fuel cells and the equipment (re-formers) required to convert battlefield fuels to substances that a fuel cell needs to operate. The FTTS ACTD will 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 the 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 (Advanced Combat Vehicle Technology). Some activities of the NAC are supported by other government agencies via a Memorandum of Agreements (MOA) and Memorandum of Understandings (MOU). 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 Tank Automotive Research, Development and Engineering Center (TARDEC), Warren, MI.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Automotive Technology: In FY 04, continued Commercially Based Tactical Trucks (COMBATT) and Hybrid Electric COMBATT tests; updated Hybrid Electric (HE) design configuration and associated test for the Heavy Expanded Mobility Tactical Truck (HEMTT); instrumented the HEMTT ESP hydraulics with diagnostic sensors; tested concept vehicle (HE M113); developed/demonstrated enhanced vehicle power train for light tactical vehicles, worked with Project Manager (PM), Tactical Wheeled Vehicles to develop and implement a Risk Mitigation program for test, evaluation and manufacture of Re-Powered Light Tactical Vehicles (LTV). In FY05, test advanced propulsion systems/HE for light tactical vehicles; evaluate Hybrid Hydraulic (HH) systems on medium/heavy tactical vehicles; conduct test/ evaluation of subsystems and components comprising hybrid electric propulsion systems in ground vehicles; test HH Propulsion demonstrator; test HEMTT A3 Chassis and Independent Active Suspension Test Rig Component; test reliability & performance of COMBATT vehicles at the Severe Off-Road Vehicle Track; support PM, Tactical Vehicles in vehicle test/evaluation for Re-Powered Light Tactical Vehicles. In FY06, conduct developmental/operational test of Re-power LTV; conduct joint military operation/evaluation of SmarTruck tactical vehicle assessment of capabilities for Homeland Defense/Security automotive needs; continue technology integration/evaluation of hybrid powertrain technologies for M113 vehicles, focusing, on the Command Vehicle. In FY07, continue to conduct developmental/operational test of Re-power LTV; continue to conduct joint military operation/evaluation of SmarTruck tactical vehicle assessment of capabilities for Homeland Defense/Security automotive needs; continue technology integration/evaluation of hybrid powertrain technologies for M113 vehicles, focusing, on the Command Vehicle.	11644	11938	14879	14982

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Future Tactical Truck System (FTTS) ACTD: In FY04, awarded multiple contracts for 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; selected contractors to utilize M&S tools to analyze and optimize the MSV and UV vehicle concept design; conducted M&S efforts focused on the Hybrid powertrain, energy/power management, material handling, mobility, and ease of vehicle maintenance; defined and evaluated design, performance and operational trade space throughout the M&S cycle; used contractor test results of key subsystems and components to validate modeling results; held preliminary design reviews; in September awarded two M&S contracts to provide analysis for: mobility, Material Handling Equipment (MHE), physical architecture assessment, weight, concepts, transportability, operational effectiveness, cost, and pit stop design. In FY05, award up to four additional M&S contracts for the Utility Variant (UV); select contractor(s) to continue based on down select criteria; purchase vehicle hardware for demonstration. In FY06, will evaluate the vehicles to validate the M&S predictions of the performance and military utility of the MSVs and UVs; perform virtual prototyping and mobility modeling through the use of 3D models and analysis. In FY07, will support the user evaluation of the vehicles.	10299	9014	1000	1000
Mobility Vehicle Design: In FY04, established baseline 42V power generation, energy storage devices, and smart power architecture components; curtailed efforts since commercial sector abandoned the move to 42V standard.	500	0	0	0
Advanced Energy & Manufacturing Technology: This one-year Congressional add researched automotive power technologies for possible application in military land warfare systems. No additional funds are required to complete this effort.	2025	0	0	0
Advanced Electric Drive: This one-year Congressional add evaluated 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 effort.	1156	0	0	0
Advanced Manufacture of Lightweight Materials (AMLM): This one-year Congressional add focused on development of advanced lightweight materials for applications in military and commercial vehicles. No additional funds are required to complete this effort.	482	0	0	0
CALSTART Defense Advanced Trans: This one-year Congressional add facilitated 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 effort.	4918	0	0	0
Digital Humans & Virtual Reality: This one-year Congressional add designed tools for the analysis, optimization, and simulation of the human interface for current and evolving vehicle systems. No additional funds are required to complete this effort.	964	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Future Tactical Truck System (FTTS) Companion Trailer System(s): This one-year Congressional add funded research and development of a trailer to follow behind the FTTS. No additional funds are required to complete this effort.	1639	0	0	0
Hydrogen PEM Fuel Cell Heavy Duty: This one-year Congressional add researched building a vehicle 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 effort.	2411	0	0	0
Hydrogen PEM Ambient Pressure Fuel Cell Demonstration: This one-year Congressional add assembled a prototype proton exchange membrane (PEM) vehicle power plant for evaluation. No additional funds are required to complete this effort.	3278	0	0	0
Fuel Efficiency Technology: This one-year Congressional investigated 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 effort.	964	0	0	0
Next Generation Smart Truck: This one-year Congressional add tested automotive technologies for military and homeland security/counterterrorism applications. No additional funds are required to complete this effort.	4146	0	0	0
Army Truck Diagnostic System: This one-year Congressional investigated existing commercial vehicle electronics technologies that might be leveraged into Army tactical trucks and/or combat platforms to enhance capabilities. No additional funds are required to complete this effort.	1639	0	0	0
Auragen Vehicle Integrated Primary Electrical Resource (VIPER): This one-year Congressional add researched 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 effort.	3375	0	0	0
M-Gator Improvements: This one-year Congressional add investigated 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 effort.	964	0	0	0
Rapid Prototyping Technologies: This one-year Congressional add designed a metal spray system. No additional funds are required to complete this effort.	1350	0	0	0
Unmanned Vehicle Control Technologies: This one-year Congressional add studied improved control of unmanned vehicles and investigated human and vehicle interfaces. No additional funds are required to complete this effort.	1639	0	0	0
Military Wheeled Vehicle Electronic Architecture Integration: This one-year Congressional add investigated existing commercial software and hardware technologies that might 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 effort.	1639	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Energy & Manufacturing Stored Energy Technology: This one-year Congressional add is to evaluate the feasibility of incorporating advanced power technologies into military land warfare systems, to include the legacy, interim, and objective force vehicles. No additional funds are required to complete this project.	0	2068	0	0
SmarTruck: This one-year Congressional add is to provide various vehicle platforms to test, integrate, and to showcase cutting-edge automotive technologies with military and homeland security/counter terrorism applications. No additional funds are required to complete this project.	0	4039	0	0
Military Wheeled Vehicle Electronic Architecture Integration: This one-year Congressional add is to investigate software (including Movement Tracking Systems SW functionality) interfaces for military vehicle situational awareness, maintenance, and logistics reporting. No additional funds are required to complete this project.	0	2440	0	0
Rapid Prototypeing: This one-year Congressional add is to research a soldier friendly re-manufacturing software suite and a robust metal spray deposition system. No additional funds are required to complete this project.	0	1406	0	0
CALSTART Defense Advanced Transportation Technology Program: This one-year Congressional add is to facilitate the development of commercial hybrid trucks, support the Hybrid Truck Users Forum, and assist in the accelerated development of hybrid electric vehicles. No additional funds are required to complete this project.	0	937	0	0
Army Trailer Technology Insertion (TTI): This one-year Congressional add is to investigate and evaluate suspension systems, propulsion alternative, pintle alternatives, material options and power source methodologies for the Future Tactical Companion Trailer. No additional funds are required to complete this project.	0	2392	0	0
Center for Tribology and Coatings: This one-year Congressional add is to investigate new coating technologies to legacy and future vehicle systems. No additional funds are required to complete this project.	0	1406	0	0
Distributed Transportable Synthetic Fuel Manufacturing Modules: This one-year Congressional add is to develop conceptual microchannel process technology reactor design for the third step of synthetic fuel manufacturing (hrdrocracking). No additional funds are required to complete this project.	0	1406	0	0
Flexible JP-8 (Single Battlefield Fuel) Pilot Plant Program: This one-year Congressional add is to continue the investigation into the use of synthetic and investigate the feasibility of a modular fuel plant that would produce synthetic fuel in-theater, using existing stranded natural gas reserves. No additional funds are required to complete this project.	0	4218	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Future Hybrid Vehicle Systems: This one-year Congressional add is to develop and commercialize M&S tools and applications, supporting the development of Future Hybrid Vehicle Systems. No additional funds are required to complete this project.	0	1406	0	0
Light Utility Vehicles: This one-year Congressional add is to continue follow-on fuel cell ATV development. No additional funds are required to complete this project.	0	2215	0	0
Multipurpose Utility Vehicle-Reconfigurable: This one-year Congressional add is to investigate a smaller, lighter, more versatile, more maneuverable internally transportable tactical vehicle which could be used in deployments throughout the world. No additional funds are required to complete this project.	0	1310	0	0
Unmanned Vehicles Surveillance & Sensor System: This one-year Congressional add is to research intelligent software solutions that may facilitate adjustable autonomous robotic control. No additional funds are required to complete this project.	0	937	0	0
Wireless Sensors for Vehicle Maintenance: This one-year Congressional add is to research for wireless sensors that apply to diagnostics/prognostics and logistics functions. No additional funds are required to complete this project.	0	937	0	0
Advanced Vehicle Life Consumption and Maintenance Prognostic System: This one-year Congressional add is to collect data and analyze the fatigue life of selected components/subsystems of the Stryker ICV (1-6 vehicles). No additional funds are required to complete this project.	0	937	0	0
Totals	55032	49006	15879	15982

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
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COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H91	TANK & AUTOMOTIVE TECH	26343	32759	39097	40501	36109	29355	29609	29826

A. Mission Description and Budget Item Justification: This project researches, investigates, and evaluates innovative vehicle concepts, mobility, power, propulsion, survivability, and other component technologies for application to current and future combat vehicles and capability upgrades to current vehicles. The project also addresses water generation, recovery and purification as well as military fuels and lubricants. Hybrid Electric and Electric Vehicle technologies are key enablers for achieving Future Combat Systems (FCS) Future Force capabilities and bringing critical platform enhancements to current platforms through upgrades. Future combat vehicles are being designed with hybrid electric architectures, providing power for propulsion, communications and control systems, survivability and leathality. The Hybrid Electric/Electric Vehicle effort designs, fabricates and evaluates critical components for energy storage and power distribution and management. Components developed under this effort are often incorporated into the Power & Energy (P&E) Systems Integration Laboratory and the Mobile Dynamic Test Rig (both funded in PE 0603005A, Project 441 (Combat Vehicle Mobility) for evaluation and systems maturation. The Pulse Power effort focuses on providing high energy/high power density components and designs of Pulse Forming Networks (PFNs), which are enablers for the advanced electric-based 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 three DoD S&T priorities. The goal of the Propulsion/Prime Power effort is to design engines 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 for manned and unmanned vehicles focuses on improving drive component performance and reliability (e.g., running gear, tracks and suspensions), fuels and lubricants, minefield clearance, counter obstacle bridging, and gap crossing technologies to enable high OPTEMPO and to reduce logistics burdens associated with manned and unmanned combat and tactical vehicles. Work in this project is performed in collaboration with the U.S. Army Engineer Research and Development Center located at Vicksburg, Mississippi. 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, 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 Applied Research Project (C05). The Water Generation, Recovery and Purification effort focuses on reducing the logistics footprint by leveraging emerging technologies. The program will demonstrate enhanced water production technology, which can be embedded in combat platforms to support the individual soldier, and/or create distributed modular water production units. 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 the Army Research Laboratory (ARL) and the Defense Advanced Research Projects Agency (DARPA). 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 Tank Automotive Research, Development and Engineering Center (TARDEC), Warren, MI.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Hybrid Electric/Electric Vehicle: In FY04, built and evaluated advanced high power (10kW), high temperature silicon and silicon carbide (SiC) hybrid converters; characterized performance of state-of-the-art energy storage and power generation components (advanced batteries, capacitors, switches, converters, etc.), data and incorporated validated components into the (P&E) Hardware in the Loop (SIL). In FY05, test and evaluate SiC for use in high voltage rectifiers, converters, and motor drives for a more compact hybrid power management system for FCS; demonstrate higher power/energy density in Lithium Ion (Li-ion) batteries; improve 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 batteries with improved performance (fire retarding material, power/thermal management, and higher power density). In FY06, will demonstrate higher power energy converters; will enhance SiC capabilities for high voltage rectifiers, converters, and motor drives; will increase Li-ion battery power, energy densities and performance; continue to assess critical technology performance and potential and begin integration into the P&E SIL with multiple configurations to determine the optimal solution. In FY07, will validate in P&E SIL significant performance and capability enhancement of SiC components (rectifiers, converters, and motor drives) and Li-ion batteries for integration into a complete, compact hybrid power management system; demonstrate integration of components, sub-systems and systems operation at one hundred degrees centigrade without degradation to components. This is a collaborative TARDEC and ARL effort.	7475	16034	14948	15089

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Pulse Power - In FY04, investigated, designed and characterized novel silicon solid state device concepts for technologies that will allow for integration of revolutionary survivability and lethality capabilities on deployable ground combat vehicles; designed and validated high-action, fast rise-time output switches capable of State-of-the-Art (SOA) power density; investigated, developed and evaluated high-performance dielectric materials and novel packaging/manufacturing techniques to increase the energy density of SOA fast-discharge, high-voltage capacitors; fabricated and evaluated SOA high-power density power converters. In FY05, investigate and evaluate 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; develop novel, modular silicon solid-state output switch concepts; investigate and evaluate advanced thermal management approaches for high temperature operation. In FY06, will significantly enhance the capabilities of modular SiC solid state switches while reducing the size of pulse charger inverter/rectifier circuits; will continue to increase the energy density of fast-discharge, high-voltage capacitors; and will design and develop advanced high temperature thermal management techniques. In FY07, will achieve performance, enhancement and size reduction goals for SiC solid-state switches, pulse charger inverter/rectifier circuits, fast-discharge, high-voltage capacitors, and advanced thermal management technologies. This is a collaborative effort between TARDEC and ARL.	6435	5400	5463	6326

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Vehicle Concepts Modeling and Simulation (M&S): In FY04, developed enhanced physics-based mobility models for advanced manned and robotic ground vehicle platforms operating in complex and urban terrains; modeled tire, snow and 3-D soil interactions between terrain and the vehicle running in real-time in collaboration with the U.S. Army Engineer Research and Development Center in Vicksburg, MS; completed experiment on sensory mismatch effects on human performance and started pilot study on motion mitigation techniques using gridded artificial horizon; developed robotic concepts for the FCS Armed Robotic Vehicle (ARV). In FY05, enhance understanding of adverse effects and passive and active mitigation strategies of moving vehicle operations; develop method of generating real-time 3-D terrain databases from 2-D terrain elevation profiles; incorporate hybrid electric power train models into real-time mobility models and perform war fighter experiment to determine duty cycle. In FY06, will develop concepts incorporating technology improvements to the current force and spiral upgrades for FCS as well as new, innovative vehicle systems; will continue to evolve mobility models, terrain models, and motion effects mitigation techniques; perform experiments validating motion mitigation techniques concepts.	1844	1895	2984	0
Propulsion/Prime Power: In FY04, conducted full performance characteristics and 50 hour laboratory NATO durability testing for FCS candidate engine, providing a risk mitigation for achieving the volume/power requirements for the FCS vehicles. In FY05, assess remaining FCS candidate engine performance and durability to achieve the full 6 hp/cu.ft. System power density in a 4-cylinder configuration and begin investigation of alternate engine concepts to produce an 8 hp/cu.ft. power density propulsion system.	1786	1448	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Vehicle Survivability (Active Protection/Minefield Clearance/Laser Protection/Hit Avoidance): In FY04, determined optimum ground pressure to trigger recently emplaced, as well as age-affected, mines; finalized surrogate instrumented mine configuration and subsurface ground pressure measurement devices; validated blast models with current test data to ensure accurate results; and developed preliminary designs for a laser-protected targeting sight using highly modified digital camera technology as the primary sensor. In FY05, evaluate lightweight materials and blast dissipation techniques to develop scalable design configurations capable of withstanding the blast effect of mines; utilize modeling and simulation to assess requirements compliance; finalize designs that meet the targeting requirements and integration plans for frequency agile protection; characterize and optimize signature management components. In FY06, complete design and fabricate prototype countermine mission modules; add GPS to the sensor fusion situational awareness system and demonstrate. Add templates for threat detection to alert uses to threats relevant to peacekeeping operations. KE Active protection alternative warhead development. In FY07, implement Fuzzy Logic based image fusion for recalibration and alignment of sensors after vibration and mechanical shock. Complete threat templates and conduct final field evaluation of Sensor Fusion system. Continue KE Active protection alternate warhead development. Evaluate existing hit avoidance technology for a regional protection concept; select subsystem concepts and develop interface/platform baseline requirements for simulation and modeling.	1453	2675	1639	2027
Mobility for Manned and Unmanned Vehicles - In FY04, evaluated and selected multiple contactors to investigate FCS compatible lightweight, automated modular gap defeat concepts for ARVs. In FY05; award multiple contracts to develop lightweight, automated modular gap defeat concepts; evaluate automated emplacement techniques and gap sensor technology; develop gap defeat models; initiate the fabrication of test components; enhance ARV mobility to ensure equivalent mobility to the manned vehicles of the future force. In FY06, will downselect to one contract to develop a breadboard prototype to demonstrate gap defeat technology. In FY07, conduct evaluation of; operational safety, improved autonomous navigation, mobility concepts, tactical behaviors for unmanned systems, and improved diagnostics/prognostics in unmanned systems.	2396	1685	2964	5736

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Water recovery/purification - In FY04, conducted a test track demonstration of water recovery from exhaust system on the NLOS-C Lancer vehicle and investigated designs for water recovery from atmospheric humidity. In FY05, will develop, fabricate, and evaluate 3 HMMWV-mounted water-from-exhaust units for field experimentation to validate system maturity, water production, and water quality; develop technology and demonstrate laboratory breadboard system to establish proof of concept for water recovery from atmospheric humidity. In FY06, will complete water-from-exhaust HMMWV field experiment; develop, fabricate, and demonstrate a water-from-air device that integrates the humidity concentration cycle with the water condensation cycle. In FY07, will develop and fabricate a water-from-exhaust system for the platform deemed most appropriate by CASCOM and PEO CS & CSS. Will develop, fabricate and evaluate in a relevant environment a water from air demonstrator.	4468	1896	4477	4516
Fuel Cell Power Initiative: In FY05, conduct laboratory assessment of the state of the art in fuel cell technology to quantify capabilities and limitations for combat vehicle power source consideration; award study contract(s) for the most power-dense conventional internal combustion and fuel cell power packages; develop COTS fuel cell and reformer modeling for early M&S validating. In FY06, will award contracts for dual approaches to desulfurization and reformer component development; will develop component requirements for proton exchange membrane and solid oxide fuel cell for Auxiliary Power Unit applications; and will advanced fuel cell stack and reformer M&S. In FY07, will select the best reformer development and desulfurization approaches and begin hardware development for evaluation.	0	1238	6622	6807
Advanced Mobile integrated Power System (AMPS): In FY04, investigated 42 Volt power generation, energy storage devices, and smart power architecture components; performed alternative concept evaluations using M&S. In FY05, adapt and refine power flexbus low power distribution and modular low power modules and investigate; and investigate smart switching power management.	486	488	0	0
Totals	26343	32759	39097	40501