ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

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

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	81693	91483	53342	49321	50536	52086	53253	54447
C05	ARMOR APPLIED RESEARCH	8439	9408	9434	9576	9999	10078	10300	10526
H77	ADV AUTOMOTIVE TECH	33817	14175	13997	14254	14411	14527	14868	15218
H91	TANK & AUTOMOTIVE TECH	30140	32595	29911	25491	26126	27481	28085	28703
T26	Ground Vehicle Technologies (CA)	9297	10285						
T31	NAT'L AUTO CENTER APP RES INIT (CA)		25020						

A. Mission Description and Budget Item Justification: A. Mission Description and Budget Item Justification: This program Eement (PE) researches, investigates, and applies combat vehicle and automotive component technologies that enhance survivability, mobility, sustainability, and maintainability of Army ground combat and tactical vehicles. As combat vehicle systems become smaller and lighter, and tactical vehicles are more often exposed to combat conditions, 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, advanced lightweight opaque and transparent armors, Active Protection Systems (APS), and multi-spectral signature reduction. Project C05 focuses on designing, fabricating, and evaluating performance of integrated and appliqué lightweight armor packages (A-kits and B-kits) needed to provide lightweight combat vehicles protection against Chemical Energy (CE) and Kinetic Energy (KE) threats with less than one fourth the weight of conventional heavy armor. C05 also designs, fabricates, and evaluates structural and appliqué armors for tactical vehicles. Armor components that are matured and demonstrated for application to the Future Force and Tactical Wheeled Vehicle (TWV) and opportunities for current Force are described in PE 0603005A (Project 221). 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 by pursuing automotive-oriented technology programs that have potential benefit to military ground vehicles. Project H91 researches and investigates a variety of enabling technologies in the areas of hybrid electric propulsion, mobility, thermal management, intelligent systems, vehicle diagnostics, fuels/lubricants, and water purification. Future Force vehicles and new tactical vehicles are being designed with hybrid electric architectures, advanced high power density engines, and auxiliary power units that provide power for propulsion, control systems, communications, life support systems, electromagnetic (EM) armor, Soldier battery charging, and export to other systems. Project H91 investigates and evaluates hybrid electric propulsion and electronic vehicle component technologies, which are key enablers for achieving Future Force and enhanced Current Force capabilities. In the near term, Project H91 designs and fabricates components and conducts experiments to determine/validate performance of these devices and various subsystems that will be used in Future Force vehicles and, where possible, as improvements in current combat and tactical vehicles. Modeling & Simulation (M&S) of Hybrid Electric Vehicle (HEV) performance of military missions (duty cycles) under realistic combat and tactical environmental conditions is conducted in support of the TWV Survivability effort. Project H91 also designs and evaluates components for improved vehicle performance and mobility including active suspensions, motors, regenerative brakes, vehicle electronics, generators, controllers, hybrid electric architectures, inverters, and lightweight metallic and segmented track. It investigates and fabricates components for high temperature/power electronics, high energy density energy storage devices, JP-8 reformation and desulphurization as a fuel source for fuel cells, and Pulse Forming Networks (PFNs) (batteries, switches, inductors, and capacitors) required for electric vehicle mobility and survivability. Over the far term, this effort will focus on components that increase vehicle energy and power levels to accommodate advanced electric weapons (such as lasers, high power microwaves, and electric guns) and advanced electric-based protection systems. Project H91 also investigates the use of augmented and virtual reality technologies for incorporating data available from local unmanned system assets to enhance the Soldier's local situational awareness and vehicle control in dynamic environments.

It researches the effects of vehicle motion on the Soldier during combat or tactical vehicle operations and how these effects can be minimized. Project T26 funds congressional special interest items. TWV work performed within this program element is a mutual effort between the Army and Marines for the next generation Light Tactical Vehicle. The PE is coordinated with the U.S. Marine Corps through the Naval Surface Warfare Center and with other ground vehicle developers within Defense Advanced Research Projects Agency (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.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

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

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	92857	59304	56743	50409
Current BES/President's Budget (FY 2008/2009)	81693	91483	53342	49321
Total Adjustments	-11164	32179	-3401	-1088
Congressional Program Reductions		-2849		
Congressional Rescissions				
Congressional Increases		35700		
Reprogrammings	-11164	-672		
SBIR/STTR Transfer				
Adjustments to Budget Years			-3401	-1088

FY06 funds decreased to support higher priority efforts.

Twenty-three FY07 congressional adds totaling $34218 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1054) Advanced Electric Drive
($1533) Liquid Desicant-Based Atmospheric Water Gen
($959) Nanofluids for Advanced Military Mobility Systems
($959) 50% Wgt Reduced, Multi-Hit Cap Transparent Armor
($2157) Adv Comp Materials Resch for Army Ground Vehicles
($959) Defect-Free Commercially Viable Si/C Semiconductor
($959) Lgt Weight Comp Brake for Armored Wheeled Vehicles
($1389) Multi-Sensor Payloads for Unmanned Systems
($958) Adv Mfg of Lightweight Materials & Components
($958) Component Optimization for Ground Systems (COGS)
($3690) Globally Accessible Manufacturing Activity (GAMMA)
($958) Ground Veh Reliability Prediction & Optimization
($2876) Hydrogen PEM Ambient Pressure Fuel Cell Med/Heavy
($958) HMMWV Hybrid Technology Conversion Kits (IIT)
($1870) Mat & User Eval of Hybrid Electric XM1124 HMMWVs
($958) Military Fuels Research Program
($958) Mobile Secure Wireless Sensor
($1390) Turbo Fuel Cell Engine
($1246) Transportable Synthetic Fuel Manufacturing Modules

($1294) Defense Transportation Energy Research
($3739) HAMMER
($1438) Plasma JP-8 Fuel Reformer
($958) Rapid Product Development and Deployment Portal

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

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

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
C05 ARMOR APPLIED RESEARCH	8439	9408	9434	9576	9999	10078	10300	10526

A. Mission Description and Budget Item Justification: A. Mission Description and Budget Item Justification: This project investigates, designs, and evaluates advanced armor materials, advanced structural armors, ballistic defeat mechanisms, and armor packaging concepts to achieve lightweight, ballistically-superior armors/structures that provide the last line of defense for the Future Force vehicles and Current Force combat and tactical vehicles. The effort also provides analysis, modeling, and characterization of advanced armor solutions designed to protect against existing and emerging threats, including collateral damage from residual debris generated by Active Protection (AP) threat defeat mechanisms. The Vehicle Armor Protection for Lightweight Combat Systems effort designs, fabricates, and evaluates performance of integrated and appliqué lightweight armor packages (A-kits and B-kits) or vehicle protection treatments 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. These will be used in Future Force vehicles as well as spun out to Current Force vehicles. 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 at 80 lb/sq.ft. for Future Force Vehicles (reducing this to 60 lb/sq.ft. for future insertion/upgrades). The Armor for Tactical Wheeled Vehicle (TWV) Survivability effort designs, fabricates, and evaluates structural and appliqué armors for tactical vehicles and investigates and characterizes effects of mine blasts on lightweight vehicles. Work conducted in this project provides armor components that are matured and demonstrated in the TWV Survivability effort described in PE 0603005A (Project 221), focusing on armor for protection from small arms and countermine applications, where possible, as add-on enhancements/upgrades. International cooperative research in mine blast characterization and vehicle response is also conducted. The armor technologies designed and fabricated in this project complement innovative non-armor survivability capabilities funded in Project H91. Efforts are fully coordinated with and complementary to work performed under program element (PE) 0602618A (Ballistic Technology) and PE 0602105A (Materials Technology). Products from this project generally transition to PE 0603005 for advanced demonstration. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, the Army's Tactical Vehicle Fleet Modernization Strategy, 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 2006	FY 2007	FY 2008	FY 2009
Vehicle Armor Protection for Lightweight Combat Systems: In FY06, fabricated advanced space frame structure and applied ceramic/metallic composite armor to the space frame design; demonstrated advanced appliqué armor; explored integration issues among ballistic, signature management; and related survivability technologies considering performance synergy durability, mounting approaches, manufacturability, and compatibility. In FY07, evaluate performance of future armor concepts for ballistic protection, demonstrate candidate armors against FCS objective threats to include small arms, medium caliber KE, and fragment defeat; apply and validate modeling and simulation tools; continue electromagnetic armor evaluations; and conduct experiments to determine the best solutions for integrating ballistic, signature management, and related survivability technologies. In FY08, will demonstrate optimized third generation armor (upgraded performance B armor package) and structure configurations; and conduct ballistic tests to verify final armor designs and integrate into second generation full sized concept vehicle structure (spaceframe demonstrator). In FY09, will mature revised future B armor options to meet changing threat and demonstrate structure configurations in the full-sized concept vehicle structure, Advanced	7937	8568	8792	8928

REconfigurable Spaceframe(ARES).				
Armor for Tactical Vehicle Survivability: In FY06, performed testing of multiple transparent armor solutions for application to all vehicles; developed and classified a comprehensive current and future threat list for use in evaluating various survivability components; fabricated an appliqué mine resistance armor kit solution and experimentally validated blast models and simulations. In FY07, evaluate advanced armor materials for tactical vehicles; evaluate performance of a lightweight blast/fragmentation appliqué under live-fire conditions. In FY08, will continue assessment of new armor solutions for implementation in the associated PE 0603005A TWV Survivability effort. In FY09, will conduct final armor assessments of potential candidates for spiral insertion.	502	613	642	648
Small Business Innovative Research/Small Business Technology Transfer Programs.		227		
Total	8439	9408	9434	9576

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

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

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H77 ADV AUTOMOTIVE TECH	33817	14175	13997	14254	14411	14527	14868	15218

A. Mission Description and Budget Item Justification: 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, government, and industry, that focus on benefiting military ground vehicle systems. Component technologies being researched and investigated in this project support the combat and tactical vehicles in the Army's Current and Future Modular Force. 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 and light combat vehicles to improve fuel economy and mobility. Another major effort in AAT is fuel cell research, addressing fuel cell design and the equipment required to convert battlefield hydrocarbon fuels to hydrogen needed for fuel cell operation. AAT also includes efforts that address fuel efficiency, vehicle modernization, crew safety, maintenance, reliability, diagnostics and prognostics, network centricity, wireless communications, 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. The FTTS ACTD implements and evaluates a number of advanced automotive technologies, which the Army and commercial sector have matured over the last decade, into tactical support vehicles for Future Combat System (FCS) and the Future Modular Force. The ACTD provides two variants of demonstrator vehicles for evaluation in a military unit field environment. ACTD test results will validate performance models, refine user requirements for tactical trucks, and reduce risk of insertion of certain advanced technologies into current and future tactical vehicle platforms such as the future Army/Marine light tactical vehicle. Some activities of the NAC are supported by other government agencies via Memoranda of Agreement (MOA) and Memoranda of Understanding (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 2006	FY 2007	FY 2008	FY 2009
Advanced Automotive Technology: In FY06,conducted joint military operation and evaluation of SmarTruck tactical vehicle capabilities for Homeland Defense/Security automotive needs; completed technology integration and evaluation of hybrid powertrain technologies; initiated mobile micro-grid technology development program; developed evaluation of new vehicle structures under varied loads; analysis of rollover characteristics; and analysis of dynamic stability of Tactical Wheeled Vehicles (TWV). In FY07, implement embedded diagnostics on current tactical vehicle platforms; integrate wireless sensor capabilities to provide oil analysis, tire pressure, and battery analysis; initiate integration of hybrid-hydraulic hybrid technology on TWV; develop inline oil sensing technology to provide condition data including viscosity, oxidation, lubricant contaminants; initiate vehicle integration efforts for fuel cell Auxiliary Power Unit (APU). In FY08, will: initiate development of thermoelectric power modules using wasted exhaust heat to power low current sensing devices on relevant TWV platforms; develop inline oil sensing technology to provide condition data including viscosity, oxidation, lubricant contaminants; expand hybrid-hydraulic hybrid technology effort to include demonstration on a light tactical vehicle platform; expand fuel cell Auxiliary Power Unit (APU) development to include on-vehicle demonstration. In FY09, will: evaluate thermoelectric power modules using wasted exhaust heat to power low current sensing devices on relevant TWV platforms; initiate technology evaluation of	12981	12962	13997	14254

fuel cell APU; complete qualification for alternative fuels program for ground vehicle systems; expand mobile micro-grid technology development program with large scale technology demonstration; continue crash modeling and safety design for TWV's.				
Future Tactical Truck System (FTTS) ACTD: In FY06, initiated and completed build of (1) Maneuver Sustainment Vehicle (MSV) demonstrator and (2) Utility Vehicles (UVs); completed safety certification testing for the MSV; initiated safety certification testing for the UV vehicles; began Military Utility assessment of the MSV. In FY07, finalize safety certification testing for the UV; complete the Military User Assessment (MUA) with both the MSV and UV vehicles; support the MSV and UV vehicles during a residual phase during which further user evaluation will be conducted. Results of the FTTS ACTD will feed requirements for development of the Army/Marine light tactical vehicles.	1000	1000		
Hydrogen PEM Fuel Cell Heavy Duty: This one-year congressional add developed a fuel cell bus with exportable power for use in the Army Mobile Microgrid Demonstration. No additional funds are required to complete this project.	1917			
Center for Tribology and Coating: This one-year congressional add continued research on lubricants to provide increased wear protection for vehicle systems and sub-systems in high-wear environments. No additional funds are required to complete this project.	1725			
Distributed Transportable Synthetic Fuel Manufacturing Modules: This one-year congressional add continued development of an air-transportable synthetic fuel production system. No additional funds are required to complete this project.	958			
Light Utility Vehicle (LUV): This one-year congressional add continued development of the LUV in support of FTTS efforts. No additional funds are required to complete this project.	3354			
Defense Transportation Energy Research: This one-year congressional add supported an Army-university-industry research coalition dedicated to research and technology development on fuels, fuel cells and auxiliary units. No additional funds are required to complete this project.	2012			
Gaming Technology Software Initiative (GTSI): This one-year congressional add integrated vehicle engineering simulation and advanced interactive visualization to create a multi-functional tool and integration point for next-generation vehicular technology. No additional funds are required to complete this project.	958			
HAMMER (Hydraulic Hybrid, Advanced Materials, & Multi-fuel Engine Research): This one-year congressional add developed infinitely variable transmissions and series hydraulic drive systems for enhanced mobility and fuel economy. No additional funds are required to complete this project.	1725			
Plasma JP-8 Fuel Reformer: This one-year congressional add developed a plasma reformer to meet the Army's needs for the on-board reformation of transportation fuels. No additional funds are required to complete this project.	1533			
Rapid Product Development and Deployment Portal: This one-year congressional add focused on the education and training needs of defense contracting entities and their supply chain, highlighting capabilities of current and emerging technologies for military use. No additional funds are required to complete this project.	1437			
Ultra Light Cargo Vehicle: This one-year congressional add integrated and demonstrated the Light Utility Mobility Enhancement System (LUMES) . No additional funds are required to complete this project.	3259			
Stoichiometric Explosive Detector System : This one-year congressional add continued integration of a stoichionatric explosive detector system onto an operational demonstrator platform. No additional funds are required to complete this project.	958			
Small Business Innovative Research/Small Business Technology Transfer Programs.		213		

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602601A - Combat Vehicle and Automotive Technology**	**H91**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H91	TANK & AUTOMOTIVE TECH	30140	32595	29911	25491	26126	27481	28085	28703

A. Mission Description and Budget Item Justification: A. Mission Description and Budget Item Justification: This project researches, investigates, and evaluates a variety of innovative and enabling technologies in the areas of vehicle concepts, virtual prototyping, power, thermal management, propulsion, mobility, survivability, vehicle diagnostics, fuels, lubricants, water purification, intelligent systems, and other component technologies for application to current and future combat and tactical vehicles. Future Force vehicles and new tactical vehicles are being designed with hybrid electric architectures, advanced high power density engines, and auxiliary power units that provide power for propulsion, control systems, communications, life support systems, electric-based weapons and protection systems, Soldier battery charging, and exportable power. The Hybrid Electric Vehicle (HEV) Components effort designs, fabricates, and evaluates critical components for energy storage (batteries), power distribution and power management, and conducts experiments to determine/validate performance of the components and various subsystems for use in FCS, future tactical vehicles, and, where possible, as improvements in current combat and tactical vehicles. Components developed under this effort are often incorporated into the Power & Energy Systems Integration Laboratory (P&E SIL), funded in PE 0603005A, Project 441, for evaluation and systems maturation. The HEV Experimentation and Assessment effort develops a technical approach to quantify battery state of charge within 5 percent error and the evaluation of the impacts of various power management strategies on fuel economy. The Pulse Power effort focuses, in the near to mid-term, on providing high energy/high power density components, and devices for Pulse Forming Networks (PFNs) and Pulse Power Supplies (PPS), which are enablers for several advanced electric-based weapon and protection systems, including Electromagnetic Armor (EMA). It designs and fabricates components for high temperature, high power electronics, high energy density energy storage devices, and PFNs. The JP-8 Reformation for Military Fuel Cells effort focuses on JP-8 reformation and desulphurization to provide hydrogen on which fuel cells can operate. The goal of the Propulsion/Prime Power effort is to design engines and generators and their components with significantly improved performance characteristics, efficiencies, and power densities. 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 reduce logistics burdens associated with sustainment of manned and unmanned combat and tactical vehicles. The Vehicle Survivability effort provides advanced component technologies that contribute to a layered vehicle survivability approach to address emerging threats. This effort includes design and evaluation of active protection and hit-avoidance components, signature reduction materials, tracking/detection components for unmanned systems, laser protection materials, and advanced lightweight structures and opaque and transparent armors. This work complements, but does not duplicate, work performed under PE 0602601A, Project C05 (Armor Applied Research). The Water Generation, Recovery, and Purification effort focuses on reducing the logistics footprint by leveraging emerging technologies. The program designs enhanced water production technology, which can be embedded in combat and tactical platforms to support the individual Soldier and/or create distributed modular water production units. The Intelligent Systems Technology Research effort investigates improved operations of manned platforms through the application of sensing and autonomy technologies developed for unmanned systems. It performs applied research in control technologies incorporating drive-by-wire and autonomous mobility in combat and tactical vehicles; use of augmented and virtual reality to help the Soldier better control vehicles in highly dynamic environments; innovative approaches for extreme mobility of small to medium Unmanned Ground Vehicle (UGV) systems to include legged locomotion; minimizing vehicle motion effects for combat and tactical vehicle crews. Efforts in this project are closely coordinated the Army Research Laboratory (ARL), the Defense Advanced Research Projects Agency (DARPA), the U.S. Army Engineer Research, Development, and Engineering Center, Edgewood Chemical biological Center, and the Army Medical Department. 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 2006	FY 2007	FY 2008	FY 2009
HEV Components: In FY06, advanced high frequency silicon carbide (SiC) switch design and evaluated high voltage 150 kW DC-DC converter against FCS performance specifications; conducted a study on the efficiency improvements of motor drives through innovative pulse width modulation algorithm; increased Li-ion battery power and energy densities; continued to assess battery performance/potential and began integration of technologies into the P&E SIL; assessed impact of mine blast on Li-ion battery module. In FY07, validate significant performance and capability enhancements to SiC components (60 percent increase for inverters and a 250 percent increase for DC-DC converts in power density) and special high-power/high-energy Li-ion batteries (20 percent increase in power density), allowing for integration into a complete, compact hybrid power management system; design and fabricate SiC Metal Oxide Semiconductor Field Effect Transistor (MOSFET) motor drive and conduct experiments determining whether components, sub-systems, and systems can operate successfully at the required 110 degrees C without degradation in vehicle performance. This is a collaborative TARDEC and ARL effort. In FY08, will design and fabricate high power density DC-DC converter (8kW/l) using SiC MOSFET; demonstrate innovative thermal management technique achieving heat rejection rates of 300 W/cm2 and high inlet coolant temperatures (1100 C) compatible with SiC technologies; conduct computational fluid dynamics analysis on cooling systems to optimize their integration in vehicle platforms. In FY09, will evaluate and optimize viable sub-system cooling approaches such as spray cooling, sub-ambient cooling system, hybrid cooling loop technologies; identify and develop mitigation techniques for component and subsystem electromagnetic Interference (EMI) issues resulting from high switching speeds and high frequencies (50 kHz).	11196	9540	4684	4662
Hybrid Electric Vehicle Experimentation and Assessment: In FY07, quantify battery state of charge within and evaluate impacts of various power management strategies on fuel economy; exercise the test methodology to provide data for the TWV program. Develop and validate M&S tools to predict hybrid electric drive cycle performance with analysis of data on relevant performance characteristics to support all potential TWV HEVs and the TWV Fleet Modernization Strategy. M&S will also support test operating procedure development with simulation excursions and support duty cycle development. Additionally M&S will be used to analyze the Army/Marine Corps next generation tactical vehicle variants to determine the optimal set of advanced propulsion system architectures to meet variant OMS/MP requirements in support of the Amry/Marine Corps next generation tactical vehicle.		6000		
Pulse Power: In FY06, fabricated significantly enhanced performance of modular Si and SiC solid state switches by refining and evaluating device design and current sharing techniques; reduced the size of pulse charger inverter/rectifier circuits with transformer core improvements; enhanced energy density of fast-discharge, high-voltage capacitors with the use of diamond-like carbon (DLC), and film improvements via new chemistries and antioxidants; and designed and evaluated advanced ceramic high temperature thermal management techniques. In FY07, refine component designs, integrate, and test to validate 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. In FY08, will increase pulse width of Si and SiC switches by 10X, increase power density of converters by 3X, and increase power density for batteries and capacitors by 2X to provide compact power conditioning and energy/power storage for applications such as EM gun, laser, and other directed energy weapons. In FY09, will demonstrate first generation pulse switches, power converters, and power, and energy storage.	5613	5206	2177	3317
JP-8 Reformation for Military Fuel Cells: In FY06, initiated development of key components of the reformation system (JP-8 desulfurizer, reformer, thermal management, and control) that meet reformate hydrogen gas purity requirement for both proton exchange membrane (PEM) fuel cells and solid oxide fuel cell (SOFC) for power generation applications. In FY07, start initial integration of system components into a functional brass board and test the "best in class" optimized JP-8 reformer equipped with desulfurization, thermal management, and system control logic. In FY08, will conduct comparison evaluations of fuel cell power modules, PEM's, High	3000	1627	5806	3900

Temperature PEMs (HTPEM), and SOFCs to identify technology gaps in thermal management, load following capabilities, power management, system integration, and overall system requirements. In FY09, will test brass board system for 1000 hrs of continuous operation to establish the key requirements to meet form, fit, and functionality of the complete reformer/fuel cell power module; identify preferred manufacturing techniques, and develop cost estimates for commercial production and vehicle life cycle costs based on reduced fuel consumption and reduced engine speeds resulting from using fuel cells.				
Propulsion/Prime Power: In FY06, completed the Opposed Piston Opposed Cylinder (OPOC) analysis and design, and completed high speed combustion analysis. In FY07, initiate surrogate engine fabrication for the OPOC engine. In FY08, will complete fabrication of the OPOC engine and perform optimization, performance testing and 50 hour NATO durability test demonstration. Initiate concept analyses and designs for low heat rejection, oil cooled, high speed, and high power density engine design. Initiate concept analyses and design of a closed loop controlled fuel injection system for heavy fuel operation to achieve constant power. In FY09, will fabricate high speed engine test rig to demonstrate 6000-7000 RPM diesel operation (60 percent over current engines); fabricate and evaluate full authority fuel injection system on test high power density engine.	1931	2381	7594	4103
Mobility: In FY06, conducted evaluations at the Maneuver Support Center (MANSCEN) of gap defeat breadboard prototypes; completed unmanned ground vehicle tactical behavior architecture designs; evolved mobility models, terrain models, and motion effects mitigation techniques; performed experiments validating motion mitigation techniques concepts, modeled complex obstacles, and executed power duty cycle experiment; identified technical and economic barriers to using a single lubricant based on input from key original equipment manufactures, oil, and additive formulators, and military integrators; and tested current Army arctic engine oil (candidate single lubricant) under high temperature conditions and identified key areas for improvement. In FY07, working with industry, further investigate the technical and economic barriers to single lubricant development; identify key test and evaluation requirements to understand and verify technical barriers; collect relevant economic information; and conduct initial cost analysis. In FY08, will complete technical investigations and conduct final cost analysis; complete technical and economic feasibility report.	5563	1366	1374	
Vehicle Survivability (Active Protection/Ballistic Protection /Laser Protection /Minefield Clearance): In FY06, completed, design and fabricated prototype countermine (CM) mission modules prototypes; revised blast modeling and simulation database; added Global Positioning System to the sensor fusion situational awareness system; added templates for threat detection to alert users to threats; evaluated low cost signature management techniques; and conducted initial concept studies for next generation tactical platform protection technologies. In FY07, mature CM mission modules prototypes and develop interface/platform baseline requirements and conduct advanced trials; perform simulation and modeling of advanced survivability technologies for tactical vehicles. In FY08, will purchase long lead materials and begin fabrication of advanced survivability technologies, to include active, ballistic, and laser protection, to address emerging threats. In FY09, will continue fabrication and begin component testing and evaluation, assessing advances against current and potential future asymmetric threats.	1794	4130	3142	3194
Water generation, recovery, and purification: In FY06, completed water-from-exhaust HMMWV evaluations under test track conditions; designed, fabricated, and demonstrated a water-from-air device mounted on a Heavy Expanded Mobility Tactical Truck to evaluate performance on a moving vehicle and identify the environmental operational envelope. In FY07, conduct field experimentation and modeling and system analysis of water from air device. In FY08, will develop and test alternative disinfection technology and analyze rate and transformation of water contaminants in order to reduce health risks and improve water quality. In FY09, will determine likely contaminates of concern and their concentrations; evaluate the performance and health and safety impacts of new water purification membranes.	1043	1730	2070	2205
Intelligent Systems Technology Research: In FY07, conduct M&S to investigate improvements to the mobility and local situational		256	3064	4110

awareness tasks of manned ground vehicles from the application of sensing and autonomy developed for unmanned ground vehicles; begin an analysis based on user requirements for a small robot incorporating legged locomotion to support dismounted operations in complex terrain. In FY08, will determine design approaches for displays involving a mix of live video and computer generated graphics, and solutions for the transfer of mobility control between manned driving and autonomous driving modes for manned vehicles, complete the analysis of a small-legged robotic system, and conduct modeling and simulation to explore design approaches; develop embedded real-time dynamic mobility models to predict manned and unmanned vehicle responses and prevent unsafe mobility situations while under robotic control. In FY09, will explore effects of vehicle motion on crews utilizing autonomous navigation capabilities and enhanced local situational awareness and refine concepts and transition results and recommendations for augmented reality and embedded dynamic mobility models.				
Small Business Innovative Research/Small Business Technology Transfer Programs.		359		
Total	30140	32595	29911	25491