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

**February 2006**

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

| | COST (In Thousands) | 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 | 110057 | 92857 | 59304 | 56743 | 50409 | 51536 | 53086 |
| C05 | ARMOR APPLIED RESEARCH | 13217 | 9766 | 9513 | 9507 | 9593 | 9999 | 10078 |
| H77 | ADV AUTOMOTIVE TECH | 49940 | 35071 | 15083 | 15106 | 15279 | 15411 | 15527 |
| H91 | TANK & AUTOMOTIVE TECH | 29745 | 38458 | 34708 | 32130 | 25537 | 26126 | 27481 |
| T26 | Ground Vehicle Technologies (CA) | 17155 | 9562 | 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 and tactical vehicles. As combat vehicle systems become smaller and lighter, 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 for protection against Chemical Energy (CE) and medium Kinetic Energy (KE) threats with less than one fourth the weight burden of conventional heavy armor, in addition to designing and evaluating appliqué armors for tactical vehicles. 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 investigates, evaluates and characterizes unique AP countermeasure concepts for intercepting CE and KE threats before they reach the target vehicle. Project H91 also investigates hybrid electric propulsion and electronic vehicle component technologies, which are key enablers for achieving Future Combat System (FCS), Future Force and enhanced Current Force capabilities. In the near term, FCS and new tactical vehicles will be designed with hybrid electric architectures and advanced high power density engines that will provide power for propulsion, communications and control systems, life support systems, electromagnetic (EM) armor, soldier battery charging, and export to other systems. 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 also designs and matures 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 develops high temperature/power electronics, high energy density energy storage devices, JP-8 reformation and desulphurization as a fuel source for fuel cells, and components of Pulse Forming Networks (PFNs) (batteries, switches, inductors and capacitors) required for electric vehicle mobility and survivability. Project H91 also researches, designs, and evaluates intelligent agents, adaptive automation, and user-friendly interfaces that optimize the soldier's span of control over manned and unmanned assets increasing the warfighter's efficiency in mission performance. It performs applied research in tactical behaviors and human detection and deterrence for Unmanned Ground Vehicles (UGVs) allowing them to act more intelligently during maneuvers involving tactical formations and stealthy operations as well as protecting themselves from intruders. 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 assessment and integration 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 U.S. 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.

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| **2 - Applied Research** | **0602601A - Combat Vehicle and Automotive Technology** |

| **B. Program Change Summary** | FY 2005 | FY 2006 | FY 2007 |
|---|---|---|---|
| Previous President's Budget (FY 2006) | 114108 | 64883 | 66668 |
| Current BES/President's Budget (FY 2007) | 110057 | 92857 | 59304 |
| Total Adjustments | -4051 | 27974 | -7364 |
| Congressional Program Reductions | | -489 | |
| Congressional Rescissions | | -937 | |
| Congressional Increases | | 29400 | |
| Reprogrammings | -4051 | | |
| SBIR/STTR Transfer | | | |
| Adjustments to Budget Years | | | -7364 |

FY 07 decrease of -7.4 million attributed to realignment of funding to higher priority requirements.

Sixteen FY06 Congressional adds totaling $29400 were added to this PE.

FY06 Congressional adds with no R-2A (appropriated amount is shown):
($2000) Advanced Affordable JP-8 PEM Fuel Cell Components for Army APU and Ground Vehicle Applications
($2100) Advanced Electric Drive
($500) Liquid Desicant-Based Atmospheric Water Generation
($1000) Nanofluids for Advanced Military Mobility Systems
($2000) Nano-Engineered Multi-Functional Transparent Armor
($2100) Unmanned Vehicle Control Technologies

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

**February 2006**

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

| COST (In Thousands) | 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 | 13217 | 9766 | 9513 | 9507 | 9593 | 9999 | 10078 |

**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 will provide the last line of defense for the Future Combat System (FCS), Future Force vehicles and Current Force vehicles (where possible as enhancements/upgrades). The effort also provides analysis, modeling, and characterization of advanced armor solutions designed to protect against emerging threats to include collateral damage from residual debris generated by the Active Protection (AP) threat defeat mechanisms. The major focus is on providing 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. 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 and Future Force Vehicles (reducing this to 60 lb/sq.ft. (or less) for future FCS insertion/upgrades). The armor technologies designed and fabricated in this project complement innovative non-armor survivability capabilities funded in Project H91. In addition this project investigates low-burden appliqué armor solutions for the protection of Current Force combat and tactical vehicles, focusing on add-on armor for protection from small arms, land mines and counter Improvised Explosive Device (IED) applications. International cooperative research in mine blast characterization and vehicle response is also conducted. 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, 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 2005 | FY 2006 | FY 2007 |
|---|---|---|---|
| Advanced and Structural Armors: In FY05, evaluated the FCS armor concept in conjunction with the Integrated Survivability Advanced Technology Demonstration (ATD) to determine effectiveness when used with CE AP system; optimized and validated the performance of armor packages for lightweight test platforms in ballistic range tests; demonstrated multi-shot capability with an electromagnetic armor package; validated the structural armor packages for lightweight combat vehicle platforms, including defeat of advanced RPG and future medium cannon KE projectiles; and completed design and fabrication of advanced full scale ballistic structure/platform. | 12317 | 0 | 0 |
| Countermine: This effort leverages ongoing efforts in Advanced Lightweight Vehicle Armor Protection. In FY05, refined design for conceptual appliqué armor kits to provide desired resistance to mine blast effects at reduced weights for FCS concept vehicles; collected live fire test data from mine strikes and modeled reactions against FCS concepts. In FY06, fabricate an appliqué mine resistance armor kit solution for FCS and experimentally validate M&S blast models. In FY07, will demonstrate a lightweight blast/fragmentation appliqué in live-fire evaluations. | 900 | 500 | 500 |
| Advanced Lightweight Vehicle Armor Protection: In FY06, fabricate advanced space frame structure and apply armor to the space frame design; demonstrate advanced appliqué armor; explore integration issues among ballistic, signature management, and related survivability technologies considering durability, mounting approaches, performance synergy, manufacturability and compatibility. In FY07, will | 0 | 8766 | 8376 |
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| complete exploration and evaluate performance of FCS armor concepts for ballistic protection, demonstrate candidate armors against objective threats to include small arms, medium 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. | | | |
| Tactical Vehicle Survivability: In FY06, perform testing of multiple transparent armor solutions for application to all vehicles; identify a comprehensive current and future threat list for use in evaluating various survivability components. In FY07, will evaluate advanced armor materials for tactical vehicles. | 0 | 500 | 637 |
| Total | 13217 | 9766 | 9513 |

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

**February 2006**

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

| COST (In Thousands) | | 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 | 49940 | 35071 | 15083 | 15106 | 15279 | 15411 | 15527 |

**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 fleet 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. Another major effort in AAT is fuel cell research, addressing fuel cells 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, 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, whach the Army and commercial sector have matured over the last decade, into tactical support vehicles for Future Combat System (FCS) and the Future 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. Some activities of the NAC are supported by other government agencies via a 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 2005 | FY 2006 | FY 2007 |
|---|---|---|---|
| Advanced Automotive Technology: In FY05, evaluated advanced propulsion systems/Hybrid Electric (HE) for light tactical vehicles; evaluated Hybrid Hydraulic (HH) propulsion system on medium/heavy tactical vehicles; conducted evaluation of subsystems and components comprising hybrid electric propulsion systems in ground vehicles; evaluated HH propulsion demonstrator; evaluated Heavy Expanded Mobility Tactical Truck (HEMTT) A3 Chassis and Independent Active Suspension Test Rig Component; evaluated reliability and performance of Severe Off Road Vehicle (SORV) at the SORV Track; supported Project Manager (PM) Tactical Vehicles in vehicle evaluation for Re-Powered Light Tactical Vehicles (LTV). In FY06, conduct developmental/operational evaluation of Re-Powered LTV; conduct joint military operation and evaluation of SmarTruck tactical vehicle assessment of capabilities for Homeland Defense/Security automotive needs; and continue technology integration and evaluation of hybrid powertrain technologies focusing on the M113 Command Vehicle variant. In FY07, developmental/operational evaluations of the Re-power LTV; implementation of embedded diagnostics; wireless sensor capabilities to provide oil analysis, tire pressure, and battery analysis; increase survivability on Tactical Wheeled Vehicles to support GWOT; implementation of wireless ground vehicle location, cargo weight, and panic detection device; joint military operations/evaluations and an assessment of the SmarTruck Tactical Vehicles capability for Homeland Defense/Security automotive requirements; technological integration/evaluation of the Hybrid Powertrain for the M113 Command Vehicle variants. | 11645 | 14655 | 14083 |
| Future Tactical Truck System (FTTS) ACTD: In FY05, designed both the Maneuver Support Variant (MSV) and Utility Variant (UV) | 8688 | 1000 | 1000 |

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| vehicles incorporating advanced, integrated survivability technologies, advanced propulsion (i.e., hybrid electric) systems, logistic re-supply equipment, and C4ISR equipment; initiated build of MSV vehicles that will be used for the MSV Military Utility Assessment (MUA). In FY06, initiate build of UV vehicles that will be used for the UV MUA in FY07; continue to conduct the MSV MUA. In FY07, the MSV and UV vehicles will be supported during a residual phase during which further user evaluation will be conducted. | | | |
| Advanced Energy & Manufacturing Stored Energy Technology: This one-year Congressional add evaluated 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. | 2116 | 0 | 0 |
| SmarTruck: This one-year Congressional add provided various vehicle platforms to integrate and evaluate cutting-edge automotive technologies with military and homeland security/counter terrorism applications. No additional funds are required to complete this project. | 4135 | 0 | 0 |
| Military Wheeled Vehicle Electronic Architecture Integration: This one-year Congressional add investigated software interfaces for military vehicle situational awareness, maintenance, and logistics reporting. No additional funds are required to complete this project. | 2501 | 0 | 0 |
| Rapid Prototyping: This one-year Congressional add researched a soldier- friendly re-manufacturing software suite and a metal spray deposition system. No additional funds are required to complete this project. | 1443 | 0 | 0 |
| CALSTART Defense Advanced Transportation Technology Program: This one-year Congressional add facilitated development of commercial hybrid trucks, supported the Hybrid Truck Users Forum, and assisted in the accelerated development of hybrid electric vehicles. No additional funds are required to complete this project. | 962 | 0 | 0 |
| Army Trailer Technology Insertion (TTI): This one-year Congressional add investigated and evaluated suspension systems, propulsion alternatives, pintle alternatives, material options and power source methodologies for the Future Tactical Companion Trailer. No additional funds are required to complete this project. | 2452 | 0 | 0 |
| Center for Tribology and Coatings: This one-year Congressional add investigated new coating technologies to legacy and future vehicle systems. No additional funds are required to complete this project. | 1444 | 0 | 0 |
| Distributed Transportable Synthetic Fuel Manufacturing Modules: This one-year Congressional add developed conceptual microchannel process technology reactor design for the third step of synthetic fuel manufacturing (hrdrocracking). No additional funds are required to complete this project. | 1443 | 0 | 0 |
| Flexible JP-8 (Single Battlefield Fuel) Pilot Plant Program: This one-year Congressional add investigated use of synthetic fuels and 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. | 4327 | 0 | 0 |
| Future Hybrid Vehicle Systems: This one-year Congressional add developed and modeling and simulation tools and applications that support Future Hybrid Vehicle Systems. No additional funds are required to complete this project. | 1443 | 0 | 0 |
| Light Utility Vehicles: This one-year Congressional add investigated fuel cells for All Terrain Vehicles. No additional funds are required to complete this project. | 2163 | 0 | 0 |
| Multipurpose Utility Vehicle-Reconfigurable: This one-year Congressional add investigated 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. | 1346 | 0 | 0 |
| Unmanned Vehicles Surveillance & Sensor System: This one-year Congressional add researched intelligent software solutions that may | 962 | 0 | 0 |

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| facilitate adjustable autonomous robotic control. No additional funds are required to complete this project. | | | |
| Wireless Sensors for Vehicle Maintenance: This one-year Congressional add researched wireless sensors that apply to diagnostics/prognostics and logistics functions. No additional funds are required to complete this project. | 961 | 0 | 0 |
| Advanced Vehicle Life Consumption and Maintenance Prognostic System: This one-year Congressional add collected data and analyzed fatigue life of selected components/subsystems of the Stryker Infantry Combat Vehicle. No additional funds are required to complete this project. | 951 | 0 | 0 |
| Mobile Thermal Perimeter Surveillance System: This one-year Congressional add developed and tested a high-efficiency, swing rotary engine and advanced composite ballistic panels for integration into a HMMWV perimeter surveillance platform. No additional funds are required to complete this project. | 958 | 0 | 0 |
| Hydrogen PEM Fuel Cell Heavy Duty: This one-year Congressional add develops a fuel cell bus with exportable power for use in the Army Mobile Microgrid Demonstration. No additional funds are required to complete this project. | 0 | 1971 | 0 |
| Center for Tribology and Coating: This one-year Congressional add continues 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. | 0 | 1774 | 0 |
| Distributed Transportable Synthetic Fuel Manufacturing Modules: This one-year Congressional add continues development of an air-transportable synthetic fuel production system. No additional funds are required to complete this project. | 0 | 986 | 0 |
| Light Utility Vehicle (LUV): This one-year Congressional add supports FTTS efforts. No additional funds are required to complete this project. | 0 | 3449 | 0 |
| Defense Transportation Energy Research: This one-year Congressional add supports 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. | 0 | 2070 | 0 |
| Gaming Technology Software Initiative (GTSI): This one-year Congressional add integrates 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. | 0 | 986 | 0 |
| HAMMER (Hydraulic Hybrid, Advanced Materials & Multi-fuel Engine Research): This one-year Congressional add develops infinitely variable transmissions and series hydraulic drive systems for enhanced mobility and fuel economy. No additional funds are required to complete this project. | 0 | 1774 | 0 |
| Plasma JP-8 Fuel Reformer: This one-year Congressional add develop 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. | 0 | 1577 | 0 |
| Rapid Product Development and Deployment Portal: This one-year Congressional add focuses 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. | 0 | 1478 | 0 |
| Ultra Light Cargo Vehicle: This one-year Congressional add integrates and demonstrates the Light Utility Mobility Enhancement System (LUMES) with a fuel cell module. No additional funds are required to complete this project. | 0 | 3351 | 0 |
| Total | 49940 | 35071 | 15083 |

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|---|---|---|
| **2 - Applied Research** | **0602601A - Combat Vehicle and Automotive Technology** | **H91** |

| COST (In Thousands) | | 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 | 29745 | 38458 | 34708 | 32130 | 25537 | 26126 | 27481 |

**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 and tactical 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 System (FCS) and Future Force capabilities and for bringing critical platform enhancements to current platforms through upgrades. Future combat and tactical vehicles are being designed with hybrid electric architectures, providing power for propulsion, communications and control systems, survivability and lethality. 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 Systems Integration Laboratory (P&E SIL), funded in Program element (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. 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. 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 JP-8 reformation and desulphurization to provide hydrogen on which fuel cells can operate. The Warfighter-machine Interface and robotics technology efforts research, design, and evaluate optimal soldier-machine interfaces for maximum span of control of manned and unmanned ground and air vehicles with minimal soldier task loading. It performs applied research in tactical behaviors and intruder detection and reaction determination for Unmanned Ground Vehicles (UGVs) allowing them to act more intelligently during maneuvers such as tactical formations and stealthy movement as well as protecting themselves from human threats. The Real-time Vehicle Mobility and Motion Effects Modeling and Simulation (M&S) effort focuses on enhancing the interactions of the types of terrain and the vehicle mobility components, modeling of hybrid electric power trains, and methods for traversing complex obstacles and urban environments. 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. Work in this project is performed in collaboration with the U.S. Army Engineer Research, Development, and Engineering Center located at Vicksburg, Mississippi. The Vehicle Survivability effort provides component technologies that contribute to layered vehicle survivability approach. 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 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 designs 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 through three approaches: 1) innovative purification of traditional water sources, 2) water recovery from exhaust, and 3) advanced water recovery technologies. 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 2005 | FY 2006 | FY 2007 |
|---|---|---|---|
| Hybrid Electric/Electric Vehicles: In FY05, evaluated the high temperature performance of silicon carbide (SiC) solid state components | 13945 | 13555 | 14744 |

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|---|---|---|---|
| used in high voltage rectifiers, converters, and motor drives in order to produce a more compact hybrid power management system for FCS vehicles; evaluated and validated advanced power/energy density in Lithium Ion (Li-ion) batteries; matured critical technologies to enable system level integration and demonstrations of P&E components; continued to characterize performance and condition of additional state-of-the-art components for transition to and incorporation into the P&E SIL (a technology development effort in PE 63005) and assessed Li-Ion batteries to confirm improved performance after incorporating fire retarding material, power/thermal management, and higher power density into the design. In FY06, enhance SiC switch design and fabricate high voltage rectifiers, converters, and motor drives; increase Li-ion battery power and energy densities; continue to assess battery performance and potential and begin integration into the P&E SIL with multiple configurations to determine the optimal solution. In FY07, will validate significant performance and capability enhancements to SiC components (60% increase for inverters and a 250% increase for DC-DC converts in power density), and special high-power/high-energy Li-ion batteries (20% increase in power density), allowing for integration into a complete, compact hybrid power management system; and conduct experiments determining whether components, sub-systems and systems can operate successfully at 110oC without degradation in vehicle performance - nearly double the 65oC baseline. This is a collaborative TARDEC and ARL effort. | | | |
| Pulse Power - In FY05, investigated and evaluated SiC solid state device concepts for improved output switches and for reduced size pulse charger inverter/rectifier circuits; matured high-performance dielectric materials to further increase the energy density of fast-discharge, high-voltage capacitors; developed novel, modular silicon solid-state output switch concepts; investigated and evaluated advanced thermal management approaches for high temperature operation. In FY06, significantly enhance the capabilities of modular SiC solid state switches by refining current sharing techniques; reduce the size of pulse charger inverter/rectifier circuits with transformer cores improvements; enhance energy density of fast-discharge, high-voltage capacitors with the use of diamond-like carbon (DLC) and fill improvements via new chemistries and antioxidants; and design and evaluate advanced ceramic high temperature thermal management techniques. In FY07, will 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. This is a collaborative effort between TARDEC and ARL. | 5621 | 5613 | 7175 |
| Real-time Vehicle Mobility and Motion Effects Modeling and Simulation (M&S): In FY05, enhanced understanding of adverse effects and passive and active mitigation strategies of moving vehicle operations; validated motion simulation capability for moving vehicles; incorporated hybrid electric power train models into real-time mobility models; and started power system integration for war fighter experiment to determine duty cycle and validate with associated field test plan to establish accuracy of newly developed vehicle-terrain interface. In FY06, continue to evolve mobility models, terrain models, and motion effects mitigation techniques, perform experiments validating motion mitigation techniques concepts, model complex obstacles and urban terrain, and execute power duty cycle experiment. | 1973 | 2695 | 0 |
| Propulsion/Prime Power: In FY05, analyzed results of performance and durability tests conducted on FCS candidate engines to establish whether they achieved the full 6 hp/cu.ft. system power density in a 4-cylinder configuration and began investigation of alternate engine concepts to determine the feasibility of increasing power density to 8 hp/cu.ft. In FY06, complete both Opposed-Piston/Opposed Cylinder (OPOC) and high speed combustion analysis and design. In FY07, will initiate surrogate engine fabrications for both high speed combustion and OPOC engine evaluations. | 1500 | 2070 | 2425 |
| Vehicle Survivability (Active Protection/Minefield Clearance/Laser Protection/Hit Avoidance): In FY05, evaluated lightweight materials and blast dissipation techniques for scalable design configurations that were capable of withstanding the blast effect of mines; used modeling and simulation to assess feasability; finalized designs that meet the targeting requirements and integration plans for frequency agile laser vision protection; modeled and simulated signature management components. In FY06, complete design and fabricate prototype countermine mission modules, add Global Positioning System to the sensor fusion situational awareness system, add templates for threat detection to alert users to threats, and evaluate low cost signature management techniques. In FY07, will select subsystem | 1692 | 2389 | 4685 |
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| concepts and develop interface/platform baseline requirements for simulation and modeling of advanced survivability technologies for tactical vehicles. | | | |
| Mobility for Manned and Unmanned Vehicles - In FY05, investigated and evaluated lightweight, remote controlled automated modular gap defeat technologies, evaluated automated emplacement techniques and gap sensor technology; and matured a concept through scaled physical models and computer simulations. Began preliminary designs for an unmanned ground vehicle tactical behavior architecture and methodology. In FY06, perform scaling studies, identify and estimate preliminary performance characteristics select best concept and fabricate a breadboard prototype to evaluate a gap defeat technology. Complete unmanned ground vehicle tactical behavior architecture designs. In FY07, will continue improvements of breadboard design, and will initiate evaluation of operational safety, improved autonomous navigation, mobility concepts, tactical behaviors for unmanned systems, and improved diagnostics/prognostics in unmanned systems. | 1750 | 2969 | 845 |
| Water generation, recovery, and purification: In FY05, developed, fabricated, and evaluated performance of two water from exhaust units mounted on High Mobility Multi-Purpose Wheeled Vehicles (HMMWVs) at Aberdeen Proving Grounds to validate maturity, adequacy with respect to amount of water produced, and water quality; evaluated performance of laboratory breadboard system to establish proof of concept for advanced water recovery technologies. In FY06, complete water-from-exhaust HMMWV field experiment, design, fabricate, and demonstrate 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, will develop fabricate, and conduct analysis of a matured water from air device. | 1974 | 3159 | 1762 |
| Fuel Cell Power Initiative: In FY05, conducted laboratory assessment of the state of the art in JP-8/diesel reformation to quantify capabilities and limitations for auxiliary combat vehicle power, developed models that can be used to evaluate reformer designs. In FY06, initiate development of key components of the reformation system (JP-8 desulfurizer, reformer, thermal management and control) that meet reformate gas purity requirement for both proton exchange membrane (PEM) and solid oxide fuel cell (SOFC) power generation applications. In FY07, will 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. | 1290 | 5102 | 1680 |
| Single Engine and Transmission Lubricants products for reduced logistics footprint: In FY06, conduct a study to determine the feasibility of developing a single engine-transmission lubricant that could reduce logistics footprint by reducing the number of grades from eight (8) to one (1). In FY07, will evaluate various lubricants and lubricant additives to determine their ability to meet both engine and transmission requirements using only one grade. | 0 | 906 | 1392 |
| Total | 29745 | 38458 | 34708 |