Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	62.339	69.062	64.589	-	64.589	72.309	71.803	68.573	72.473	Continuing	Continuing
C05: *Armor Applied Research*	-	25.276	28.440	27.037	-	27.037	28.407	28.547	27.114	29.804	Continuing	Continuing
H77: *National Automotive Center*	-	14.893	16.250	15.039	-	15.039	16.606	16.813	17.010	17.316	Continuing	Continuing
H91: *Ground Vehicle Technology*	-	22.170	24.372	22.513	-	22.513	27.296	26.443	24.449	25.353	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This program element (PE) researches, designs, and evaluates combat and tactical vehicle automotive technologies that enable the Army to have a lighter, more survivable, more mobile and more deployable force. Project C05 investigates, researches, and evaluates advanced ground vehicle design and occupant protection technologies in such areas as armor concepts, ballistic defeat mechanisms, blast mitigation, survivability modeling and simulation (M&S), hit avoidance, kill avoidance, safety, sensors, instrumentation and survivability packaging concepts to achieve superior survivability/protection for soldiers and military ground vehicles. Project H77 funds the National Automotive Center (NAC), which was chartered by the Secretary of the Army to conduct shared government and industry, or "dual use", technology programs to leverage commercial investments in automotive technology research and development for Army ground combat and tactical vehicle applications. Project H91 designs, matures, and evaluates a variety of innovative and enabling technologies in the areas of electrical power, thermal management, propulsion, mobility, power for advanced survivability, vehicle diagnostics, fuels, lubricants, water purification, intelligent systems, and other component technologies to enhance the mobility, power and energy and reduce the logistic chain of combat and tactical vehicles.

Work in this PE is related to, and fully coordinated with, PE 0602105A (Materials Technology), PE 0602618A (Ballistics Technology, Robotics Technology, PE 0602705A (Electronics and Electronic Devices), PE 0602716A (Human Factors Engineering Technology), PE 0603005A (Combat Vehicle and Automotive Advanced Technology), and PE 0708045A (Manufacturing Technology), PE 0603734 (Military Engineering Advanced Technology).

Work in this PE is coordinated with the U.S. Marine Corps, the Naval Surface Warfare Center, and other ground vehicle developers within the Defense Advanced Research Projects Agency (DARPA) and the Departments of Energy, Commerce, and Transportation.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this PE is performed by the Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army					DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*			R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	64.205	69.062	67.789	-	67.789
Current President's Budget	62.339	69.062	64.589	-	64.589
Total Adjustments	-1.866	0.000	-3.200	-	-3.200
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.049	-			
• Adjustments to Budget Years	-	-	-3.200	-	-3.200
• Other Adjustments 1	-0.817	-	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT C05: *Armor Applied Research*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
C05: *Armor Applied Research*	-	25.276	28.440	27.037	-	27.037	28.407	28.547	27.114	29.804	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project investigates, researches, and evaluates advanced ground vehicle design and occupant protection technologies in such areas as armor concepts, ballistic defeat mechanisms, blast mitigation, survivability modeling and simulation (M&S), hit avoidance, kill avoidance, safety, sensors for blast, crash and rollovers, instrumentation and survivability packaging concepts to achieve superior survivability/protection for soldiers and ground combat and tactical vehicles. Survivability/ protection technologies are being investigated to meet anticipated ground combat and tactical vehicle survivability objectives. Additionally, this project focuses on analysis, modeling, and characterization of potential survivability solutions that could protect against existing and emerging threats. This analysis is used to aid in the identification of technologies to enter maturation and development in PE 0603005A/project 221.

This project supports Army science and technology efforts in the Ground portfolio.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Tank Automotive Research, Development, and Engineering Center (TARDEC) Warren, MI and is fully coordinated with work at the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Vehicle Armor Protection for Lightweight Combat Systems:	9.261	0.000	0.000
Description: This effort designs, fabricates, and investigates add-on lightweight armor packages to protect combat systems against projectiles, warheads, penetrators and blast fragments.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT C05: *Armor Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Completed armor design and fabrication; performed shaker and ballistic assessment to validate and improve armor design, armor attachment durability, and ballistic performance for combat vehicles. This work was done in conjunction with program elements 0602105A, 0602618A, and 0603005A.			
Title: Advanced Armor Development: ***Description:*** The objective of this effort is to design, integrate and validate performance of advanced armor systems to defeat single and multiple chemical and kinetic energy (CE and KE) emerging threats for combat and tactical vehicles. These systems include base armor (small arms / medium caliber opaque B-kits and transparent), applique armor (passive / reactive / active multi-threat C-kits) and multifunctional armor (embedded antennas & health monitoring devices). ***FY 2012 Accomplishments:*** Developed advanced armor designs at the panel level that will reduce areal density from the threshold level while still defeating threshold threat. Examined integrated armor designs for vulnerability reduction and material cost savings for the threshold armors. Investigated integration of communication antennas and health monitoring equipment into armor recipe and design. This work was done in conjunction with program elements 0602105A, 0602618A and 0603005A. ***FY 2013 Plans:*** Mature high-performance lightweight armor recipes by conducting risk mitigation and system level multi-hit ballistic validation evaluation; examine novel integration methods for transparent armor; mature and evaluate the integration of communication antennas and health monitoring into armor recipe and design; create techniques and procedures for integration of advanced armors. ***FY 2014 Plans:*** This effort will provide initial characterization of next generation advanced light weight combat vehicle armors for identification of future maturation risk; will perform initial performance and cost trade analysis on the integration of advanced armor technologies; and will perform environmental and ballistic testing on vehicle size armor coupons for system level integration.	7.160	10.950	11.453
Title: Blast Mitigation: ***Description:*** This effort designs, fabricates and evaluates advanced survivability and protection capabilities, tools and technologies to improve protection against vehicle mines, improvised explosive devices (IEDs) and other underbody threats, and crash events. This effort also designs and evaluates technologies purposed for protecting the occupant such as seats and restraints. This effort creates the laboratory capability needed to enable expeditious research and development of blast-mitigating technologies. Blast and crash mitigation technologies are further investigated and matured in such areas as active and passive exterior/hull/cab/kits, interior energy absorbing capabilities for seats, floors, restraints, sensors for active technologies	8.855	12.490	11.144

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT C05: *Armor Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
and performance evaluation, modeling and simulation (M&S), experimentation and instrumentation. In FY13 and FY14, this effort supports Technology Enabled Capability Demonstration 1.c: Force Protection - Occupant Centric Platform. ***FY 2012 Accomplishments:*** Increased fidelity in end-to-end modeling and simulation (M&S) tools for occupant protection and vehicle underbody and Soldier blast protection. Validated live fire test and evaluation events with M&S to reduce program risk and expense, and used high fidelity models to identify quick reaction solutions to the Warfighter. Matured techniques to reduce flammability of vehicle tires, track, and composite materials and protect lithium-ion batteries against fire events. ***FY 2013 Plans:*** Leverage defense, automotive and medical communities to research innovative occupant protection technologies such as restraints, hull structure designs, seats, and crash event simulation tools; refine finite-element M&S tools for quicker assessment of occupant protection technologies; develop a Multi-Axis Blast Simulator (MABS) for rapid component-level testing; mature and evaluate occupant protection technologies in such areas as exterior protection technologies, interior protection technologies, sensor technologies and instrumentation technologies; Create 3D CAD models of the Occupant Centric System Demonstrator to further refine and validate the design through M&S; create standards for occupant protection against underbody blasts and crashes to capture and document the best practices of occupant protection. ***FY 2014 Plans:*** This effort will research innovative approaches and improve occupant protection capabilities in mitigating underbody blast, crash and rollover injuries in areas such as seats, restraints, protective trim, hull structures, and energy absorbing materials and approaches; will refine and employ modeling and simulation (M&S) tools for assessing occupant protection technologies; will acquire laboratory tools to better assess integrated components, sub-system and system level responses for protection of soldiers in underbody blast, crash and rollover events; will leverage and expand on defense, automotive and medical community efforts for improving vehicle exterior, interior and sensor capabilities; will continue incorporating lessons learned into occupant protection standards and guidelines; and will advance instrumentation capabilities such as anthropometric test devices and blast data collection for research.			
Title: Synergistic Vehicle Protection Technologies: ***Description:*** This effort investigates and integrates advanced synergistic survivability technologies and simulation tools to provide enhanced protection for ground vehicles while minimizing overall system burdens. Synergistic survivability technologies such as, armor and active protection, offer the potential of non-linear survivability improvements. The modular approach facilitates trade-offs between protection, payload, performance, cost drivers and performance of vulnerability assessments throughout the life cycle of a system. Provides quantifiable metrics for development of requirements and evaluation of concept feasibility	0.000	5.000	4.440

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT C05: *Armor Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
in the development of survivable combat systems. In FY13 and FY14, this effort supports Technology Enabled Capability Demonstration 1.c: Force Protection - Occupant Centric Platform. ***FY 2013 Plans:*** Synergize vehicle survivability technologies to optimize protection during multi-threat, multi-aspect engagements; design and evaluate assessment methodologies for quantifying and mitigating post-engagement damage and crew casualties from effects such as fire and blast; provide enhanced capabilities to support combat modeling such as COMBAT XXI by providing rapid vehicle/weapon interaction modeling. ***FY 2014 Plans:*** The effort will provide rapid organization and assessment of threat/countermeasure interaction reducing the overall burden on systems; will design and develop modeling and simulation capability to optimize vehicle protection; design modeling capabilities to represent blast technologies for tradeoff analysis; will provide quick reaction capability to quantify platform baseline survivability and prioritize enhancements.			
Accomplishments/Planned Programs Subtotals	25.276	28.440	27.037

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT H77: *National Automotive Center*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H77: *National Automotive Center*	-	14.893	16.250	15.039	-	15.039	16.606	16.813	17.010	17.316	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project funds the National Automotive Center (NAC), which was chartered by the Secretary of the Army to conduct shared government and industry (dual use) technology programs to leverage commercial investments in automotive technology research and development for Army ground combat and tactical vehicle applications. Primary thrusts for this activity include advanced power and energy technologies for tactical and non-tactical ground vehicles, electric infrastructure and alternative energy for installations and bases, vehicle networking and connectivity to maximize overlap between commercial and military requirements. Active outreach to industry, academia and other government agencies develops new thrust areas for this project to maximize shared commercial and government investment.

This project supports Army science and technology efforts in the Ground portfolio.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, Michigan and is coordinated with PE 0602705A (Electronics and Electronic Devices).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Alternative Energy:	8.835	0.000	0.000
Description: This effort leverages opportunities from industry to develop alternative energy technologies for Army applications.			
FY 2012 Accomplishments: Concluded development of dual-use M&S tools for advanced high-density hybrid engine powered non-tactical vehicle business case analysis; began planning for large scale investigation of vehicle-to-grid and grid-to-vehicle capabilities integrated into a power grid with a high proportion of renewable generation; continued to pursue qualification of alternative fuels for use in ground			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT H77: *National Automotive Center*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
vehicle systems; conducted system level assessments of synthetic and renewable fuel blends supporting their implementation into military fleets. This work was done in conjunction with program element 0602705A.			
Title: Conditioned Based Maintenance (CBM) and Intelligent Systems: ***Description:*** This effort advances condition based maintenance and intelligent systems technologies for dual use applications, including the investigation of commercial hybrid electric non-tactical vehicles on military bases to gather performance, reliability and maintainability data. ***FY 2012 Accomplishments:*** Pursued fleet level evaluation of dual-use CBM tools for battery prognostics and diagnostics and began development and investigation of dual-use CBM tools for additional vehicle subsystem prognostics and diagnostics.	2.272	0.000	0.000
Title: Power, Energy and Mobility: ***Description:*** This effort investigates dual use power, energy, and mobility technologies leveraging commercial and academic investment to military application focusing on technologies such as light weight composite materials, electrification of engine accessories, alternative fuels, hybrid vehicle architectures, and compact electrical power generation in order to maximize common investment to meet Army ground vehicle requirements. This work is done in conjunction with program element 0603005A. ***FY 2012 Accomplishments:*** Continued the pursuit of dual-use power and energy component development and integrated initial products into non-tactical vehicles for assessment on military installations. Continued to support transition of distributed generation hardware to PM Mobile Electric Power or other materiel developers. ***FY 2013 Plans:*** Continue the development and integration of dual use power, energy and weight reducing components such as lightweight composites, electrification of engine accessories and compact electrical power generation into non-tactical vehicles for fuel consumption and mobility improvement; conduct operational assessments of advanced propulsion vehicles on military installations; pursue dual use automotive technology collaborations with other government agencies, industry and university partners. ***FY 2014 Plans:*** This effort will continue to partner with other government agencies such as the Department of Energy (DoE) through cooperative alliances such as the Advanced Vehicle Power Technology Alliance (AVPTA); will continue to support the transition of technology to/from industry and government; leverage both industry and government facilities for evaluation, integration and testing; will mature new manufacturing processes and material technologies to reduce platform weight through lightweight composite	3.786	5.933	4.083

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT H77: *National Automotive Center*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
materials and novel material joining; will continue to pursue collaborations with industry and university partners to develop dual use, energy efficient, automotive technologies.			
Title: Dual Use Technologies: ***Description:*** This effort investigates, researches and evaluates ground vehicle technologies with both military and commercial applications such as renewable energy technologies, electrical power management between vehicles and the grid, alternative fuels, and advanced vehicle networking and communication (telematics). This effort maximizes commercial technology investment for military applications in line with the National Automotive Center's Charter. Collaborations with industry, universities and other government agencies on standards writing for joint applications will facilitate this activity. This work is done in conjunction with program element 0603005A. ***FY 2013 Plans:*** Pursue, identify and leverage dual use technology opportunities to benefit both commercial industry and military application through active partnering and outreach; mature vehicle-to-grid and grid-to-vehicle technology and standards; emphasize the use of renewable energy sources to solve military energy problems for base applications; continue to support the transition of distributed power generation hardware to PM Mobile Electric Power or other materiel developers; pursue vehicle based telematics (vehicle networking and communication) solutions in support of Homeland Defense. ***FY 2014 Plans:*** This effort will continue to identify, pursue, and leverage dual use technical opportunities with both military and industry application through active partnering with industry/academia/other government agencies as well as other consortiums/forums/alliances and associations such as the Hybrid, Electric and Advanced Truck Users Forum; continue to focus on technologies that will help solve vehicle and installation energy problems; continue University applied research in areas including off-road vehicle dynamics and controls, soldier/vehicle interaction modeling, high-performance/lightweight structures and materials, alternative propulsion systems, advanced thermal management, and vehicle system design optimization for reliability and robustness.	0.000	10.317	10.956
Accomplishments/Planned Programs Subtotals	14.893	16.250	15.039

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT H77: *National Automotive Center*

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT H91: *Ground Vehicle Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H91: *Ground Vehicle Technology*	-	22.170	24.372	22.513	-	22.513	27.296	26.443	24.449	25.353	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project designs, develops, and evaluates a variety of innovative enabling technologies in the areas of vehicle concepts, virtual prototyping, electrical power, thermal management, propulsion, mobility, survivability, vehicle diagnostics, fuels, lubricants, water purification, intelligent systems, and other component technologies for application to combat and tactical vehicles.

This project supports Army science and technology efforts in the Ground portfolio.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, Michigan. Efforts in this project are closely coordinated with 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Pulse Power:	3.784	1.002	0.962
Description: This effort focuses on growing compact, high frequency/high energy/high power density components and devices for several advanced electric-based survivability and lethality weapon systems. Technologies include direct current (DC) to DC chargers, high energy batteries, pulse chargers, high density capacitors, and solid state switches. This effort is coordinated with PEs 0603005A (Combat Vehicle and Automotive Advanced Technology) and 0602705A (Electronics and Electronic Devices).			
FY 2012 Accomplishments: Investigated silicon carbide (SiC) based super gate turn off (SGTO) switches for electro-mechanical armor applications; investigated SiC components in high power electrical conversion components, and pulse chargers; investigated improvements			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT H91: *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
in fast high energy density capacitors with improved clearing agents using newly developed films for directed energy weapons (DEW). ***FY 2013 Plans:*** Investigate silicon carbide (SiC) and fast discharge high energy density capacitors based components for electro-mechanical armor to protect ground vehicles from the next generation threats at reduced platform weight. ***FY 2014 Plans:*** This effort will perform component development and maturation of advanced electrified armor components, and directed energy systems components related to survivability and lethality including high voltage solid state devices and high energy density capacitors and will continue component development and maturation to decrease space, volume, and thermal requirements while increasing performance.			
Title: Propulsion and Thermal Systems: ***Description:*** This effort researches, designs and evaluates high power density engines and transmission systems needed to offset increasing combat vehicle weights (armor), increased electrical power generation needs (onboard communications, surveillance and exportable power), improved fuel economy (fuel cost & range), enhanced mobility (survivability), and reduced cooling system burden (size, heat rejection). Currently, less than 1/3 of the total available energy from the fuel is converted into usable mechanical work (propulsion). This effort also researches and matures thermal management technologies and systems including heat energy recovery, propulsion and cabin thermal management sub-systems to utilize waste heat energy and meet objective power and mobility requirements on all ground vehicles. Lastly, this effort maximizes efficiencies within propulsion and thermal systems to reduce burden on the vehicle while providing the same or greater performance capability. This effort is coordinated with PE 063005A (Combat Vehicle and Automotive Advanced Technology). ***FY 2012 Accomplishments:*** Investigated the durability and reliability of advanced fuel systems operating on JP-8 fuel at high temperatures; examined engine performance when using military grade fuels; completed powertrain analysis for efficiency and thermal heat rejection; examined designs to improve the mechanical efficiency of advanced transmissions while increasing ratio spread and electronic controls; investigated and developed components to reduce engine cooling burden. ***FY 2013 Plans:*** Conduct combat and tactical powertrain simulation and component designs; investigate novel high power density low heat rejection, fuel efficient engine technologies to address increasing combat vehicle weights and thermal burden issues; assess	5.201	4.334	3.058

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT H91: *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
waste heat recovery feasibility from the engine compartment and innovative thermoelectric generator designs to achieve greater conversion to onboard electricity. ***FY 2014 Plans:*** This effort will investigate and create concepts for a high power density low heat rejection, fuel efficient engine technology that is scalable and modular for combat and tactical vehicles to address increasing vehicle weights, commonality and thermal burden issues and will prototype an advance fan design that will provide for a more efficient cooling capability for the engine to increase the overall system capability.			
Title: Power Management Technologies: ***Description:*** This effort investigates power management technologies, software, and implementation approaches. Technologies include A/C-DC inverters, DC-DC converters, solid state circuit protection, power distribution, and automated control of complete power systems. Special emphasis has been placed on developing high temperature capable power electronics, leading to the use of Silicon Carbide (SiC) in the above technologies. This effort coordinates with 0603005A, Project 497 for electrical power architectural needs and interface design standards. This effort also coordinates with 0603005A, Project 441 for interoperability with power generation and non-primary power sources. ***FY 2012 Accomplishments:*** Enhanced advanced intelligent (learning and adaptive) control architecture to control multiple vehicular power sources and loads. ***FY 2013 Plans:*** Mature a common vehicle power management control architecture as well as write and evaluate power control software, design high voltage power electronics with high operating temperatures to be further matured in 0603005A, project 497. These technologies optimize power distribution and minimize thermal burdens on the vehicle as demands for greater electrical power continue to increase. ***FY 2014 Plans:*** This effort will design and procure prototype Silicon Carbide-based power electronics for power conversion, distribution, and control in order to implement the next generation, open, non-proprietary electrical power architecture for military ground vehicles and will merge power management efforts from FY12 with architectural developments in FY12 and FY13 in order to be ready to demonstrate in FY15 the fuel savings (at least 10% on a 72-hour combat mission) power management brings when combined with an advanced electrical power architecture.	1.016	3.916	1.903
Title: Power Electronics, Hybrid Electric and On-Board Vehicle Power (OBVP) Components: ***Description:*** Advanced computing, sensors, survivability and communications systems have driven electrical power demands on ground vehicle platforms beyond current generation capability, requiring some platforms in theater to turn off critical mission	5.329	1.968	2.419

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
systems in order to power other components. Advancing technologies for greater platform capabilities will further exacerbate the problem. To provide the electrical power required by the Warfighter, new efficient power generation systems for platforms must be created. As power increases, waste heat increases and must be removed from the platform. With increased efficiency of the power generation system, less energy will be expended on cooling and can be redistributed to other needs. This effort will design and evaluate high temperature and efficient power generation components using high operating temperature switching devices and advanced electrical generation components such as integrated starter generators and integrated starter alternators as well as advanced control techniques to make these systems more efficient. ***FY 2012 Accomplishments:*** Investigated the feasibility of increasing the operating temperature of the power electronics components to reduce the thermal management burden of the total vehicle system that incorporates power generation for internal and external use; investigate Integrated Starter Generator controls to provide on-board and export power; investigate and evaluate thermal systems to increase Heating Ventilation Air Conditioning (HVAC) efficiency; evaluate electronics cooling technologies to reduce the system cooling burden. ***FY 2013 Plans:*** Mature OBVP generation components; model and validate electric machines and power electronics hardware that will meet performance requirements for military ground vehicle electrical power needs. ***FY 2014 Plans:*** This effort will investigate vehicle efficiency, space and weight impacts of OBVP generation in an system laboratory that includes the vehicle power pack and supporting auxiliary systems; compare OBVP system performance versus the performance of the conventional system; and investigate the potential controls strategy enhancements of system operation where speed/power of auxiliary systems are easily manipulated. Additionally, this effort will investigate vehicle level benefits (efficiency, space, weight, ambient temperature operating range) of high temperature power electronics compared to traditional power electronics for power generation.			
Title: Advanced Non-Primary Power Systems: ***Description:*** A significant portion of operating time for stationary military ground vehicles is spent with their main engines idling to generate electrical power which consumes considerable fuel and creates greater vulnerability for signature detection. Auxiliary power units (APUs) can produce the required power more efficiently than the main engines at reduced acoustic and thermal signatures. This effort will research, investigate, conduct experiments and validate APU technologies such as modular/scalable engine based APUs, fuel cell reformer systems to convert JP8 to hydrogen, sulfur tolerant JP8 fuel cell APUs and novel engine based APUs for military ground vehicle and unmanned ground systems. This effort will also determine inputs for APU interface control documents, as well as investigate solutions for reducing APU acoustic signature for silent operation during mounted	2.119	2.998	3.115

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602601A: *Combat Vehicle and Automotive Technology*	PROJECT H91: *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
surveillance missions. Finally, this effort investigates the use of small engines and JP8 fuel cell systems for use as prime power solutions for unmanned ground systems. ***FY 2012 Accomplishments:*** Investigated JP-8 reformer/fuel cell system models and component level evaluation data; finalized JP-8 reformer/fuel cell system design; investigated small engine technologies for use on small unmanned ground vehicles. ***FY 2013 Plans:*** In order to reduce fuel consumption and meet the increasing power demands of military vehicles, this effort investigates modular/ scalable small engine technologies, mature fuel injection strategies and validates their application for use as auxiliary power units for military ground vehicles and unmanned ground systems. ***FY 2014 Plans:*** This effort will investigate engine based 10 kW Auxiliary Power Unit (APU) oil consumption reduction technologies in order to decrease maintenance intervals and increase reliability; will conduct experiments and takes measurements on acoustic treatments for engine based APUs; will conduct sulfur tolerant JP8 reformer experiments; and will conduct initial assessment of fuel cell based APU solutions.			
Title: Elastomer Improvement Program: ***Description:*** Track systems are one of the highest Operations & Sustainment (O&S) cost drivers for combat vehicle platforms. The typical failure mechanism for these systems is associated with the elastomeric (rubber) components. As vehicle platforms operate across a variety of terrain conditions, energy and heat from the environment causes premature fatiguing that can limit the overall life of these track systems. The Elastomer Improvement Program (EIP) uses a state-of-the-art laboratory to research, formulate and laboratory test new elastomer compounds to increase track system durability and reduce O&S costs. ***FY 2013 Plans:*** Integrate advanced nano-composites into elastomer designs and formulations to increase durability and reduce flammability of materials. In addition, novel running gear elastomers designs are being fabricated and tested in order to reduce maintenance and increase system durability. Finally, this effort is performing laboratory testing of new compounds to validate the new materials/ properties are exceeding the properties of existing materials. ***FY 2014 Plans:*** This effort will expand integration of short fibers into elastomer compounds to augment durability and increase abrasion resistance; will fabricate American Society for Testing and Materials (ASTM) samples and perform laboratory evaluation of short	0.000	1.000	0.990

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
fiber infused elastomer coupons to determine material property improvements; and will fabricate vehicle test articles and perform on vehicle testing to validate laboratory based improvements to material compound changes.			
Title: Intelligent Systems Technology Research: ***Description:*** This effort investigates improved operations of manned platforms through the application of sensing and autonomy technologies developed for unmanned systems such as maneuver and tactical behavior algorithms, driver assist techniques, autonomy kits, advanced navigation and planning, vehicle self-protection, local situational awareness, advanced perception, vehicle and pedestrian safety, active safety, and robotic command and control. In FY13 and FY14, this effort supports Technology Enabled Capability Demonstration 1.c: Force Protection - Occupant Centric Platform. ***FY 2012 Accomplishments:*** Conducted initial trade studies in the areas of intelligence, perception, communications, robotic control and payload integration for a weaponized robotic system; advanced technologies for manned/unmanned collaboration and teaming, unmanned tactical behaviors, command and control of the unmanned systems from a common Warfighter machine interfaces, intelligence agents, and developed intelligent architectures for systems level weaponized robotic control. ***FY 2013 Plans:*** Expand development of tactical behaviors utilizing common frameworks and control interfaces to provide drive-by-wire capability to the tactical wheeled fleet; extend this capability to the tracked and wheeled combat fleet, emphasizing combat-unique mission sets and payloads; investigate advanced sensors and control software; continue to advance autonomy and cognition to enable manned/unmanned collaboration and teaming; mature command and control software to enable single-operator control of multiple unmanned vehicles. ***FY 2014 Plans:*** This effort will advance active safety systems to include controls, algorithms and associated hardware onto manned/unmanned wheeled and tracked vehicles; will increase performance of perceptive sensors and planning algorithms and apply to robotic platforms for safe operations in dynamic environments; and will refine tactical behaviors for mission execution on robotic platforms.	4.721	7.909	6.538
Title: Energy Storage: ***Description:*** This effort investigates novel advanced ground vehicle energy storage devices such as advanced chemistry batteries and ultra capacitors for starting, lighting, and ignition and silent watch requirements for powering vehicle electronics and communications systems with main engine off. These energy storage devices must meet harsh military requirements that far exceed commercial requirements such as extreme temperature operation (-46 to +71C), ballistic shock and vibration, and electromagnetic interference (in accordance with MIL-SPEC 810G). Mature advanced batteries are required to reduce	0.000	0.000	2.387

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
battery volume and weight while improving their energy and power densities within the same footprint and must be designed in a standardized form factor (6T) to enhance logistics. ***FY 2014 Plans:*** This effort will conduct initial experiments to validate performance of novel materials (anode, cathode, electrolyte, and separators) for cell and battery module (series of cells in series or parallel) with improved energy density and power density in the same form factor as the existing batteries for extended silent watch durations.			
Title: Petroleum, Oil, and Lubricant (POL) Products: ***Description:*** This project focuses on creating and evaluating innovative petroleum, oil and lubricant (POL) products that reduce logistic burdens, maintenance requirements, and fuel consumption. Products will be developed in areas such as alternative fuels, fuel additives, lubricants, power train fluids, coolants, and petroleum, oil, and lubricant products to support new military technology requirements (i.e. anti-lock brakes, semi-active suspension, etc.). In FY13 and FY14, this effort supports Technology Enabled Capability Demonstration 4a: Sustainability/Logistics - Basing. ***FY 2013 Plans:*** Initiate design and evaluation of POL products to meet new military technology requirements (i.e. anti-lock brakes, semi-active suspension, etc.) while exceeding future and legacy equipment performance and technical requirements; begin research and design of lubricants and fluids which promote improved energy efficiencies, improved performance and are longer lasting; characterize alternative fuels and fuel additives that improve performance and diversify energy sources; initiate research and evaluation of nanofluid technology that suspends nanoparticles in coolants and lubricants to improve thermal, friction, and wear properties. ***FY 2014 Plans:*** This effort will identify candidate fuel efficient gear lubricants and hydraulic fluids to improve ground system performance and reduce logistics burden; will evaluate new alternative fuels and fuel additives that may improve performance and diversify energy sources; and will identify candidate POL products with high potential to meet new military technology requirements while ensuring legacy equipment performance and technical requirements are maintained.	0.000	1.245	1.141
Accomplishments/Planned Programs Subtotals	22.170	24.372	22.513

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.