Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Army											Date: February 2015	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602601A *I Combat Vehicle and Automotive Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**Cost To Complete**	**Total Cost**
Total Program Element	-	63.476	72.861	68.839	-	68.839	69.739	68.527	62.971	64.293	-	-
C05: *Armor Applied Research*	-	26.220	31.399	29.251	-	29.251	28.414	26.121	20.850	21.354	-	-
H77: *National Automotive Center*	-	14.815	15.636	15.738	-	15.738	15.936	16.219	16.322	16.642	-	-
H91: *Ground Vehicle Technology*	-	22.441	25.826	23.850	-	23.850	25.389	26.187	25.799	26.297	-	-

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, autonomy-enabled systems, and other component technologies to enhance the mobility, power and energy and reduce the logistic chain of combat and tactical vehicles. This PE executes the Army's Combat Vehicle Prototyping (CVP) program to mature, integrate and demonstrate ground vehicle leap ahead technologies in support of future combat vehicles.

Work in this PE is related to, and fully coordinated with, 0602105A (Materials Technology), 0602618A (Ballistics Technology, Robotics Technology), 0602705A (Electronics and Electronic Devices), 0602716A (Human Factors Engineering Technology), 0603005A (Combat Vehicle and Automotive Advanced Technology), 0603125A (Combating Terrorism – Technology Development), 0603734 (Military Engineering Advanced Technology), and 0708045A (Manufacturing 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 2016 Army					Date: February 2015
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*			R-1 Program Element (Number/Name) PE 0602601A / *Combat Vehicle and Automotive Technology*		
B. Program Change Summary ($ in Millions)	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**
Previous President's Budget	64.555	72.883	69.342	-	69.342
Current President's Budget	63.476	72.861	68.839	-	68.839
Total Adjustments	-1.079	-0.022	-0.503	-	-0.503
• Congressional General Reductions	-	-0.022			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.006	-			
• SBIR/STTR Transfer	-1.073	-			
• Adjustments to Budget Years	-	-	-0.503	-	-0.503

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army			Date: February 2015
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602601A / *Combat Vehicle and Automotive Technology*	Project (Number/Name) C05 / *Armor Applied Research*	

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
C05: *Armor Applied Research*	-	26.220	31.399	29.251	-	29.251	28.414	26.121	20.850	21.354	-	-

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), improved situational awareness, 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 Maneuver 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 and at Communications-Electronics Research, Development and Engineering Center (CERDEC), Aberdeen Proving Ground, MD and Fort Belvoir, VA.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Advanced Armor Development:	10.915	15.855	12.744
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.			
FY 2014 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** C05 / *Armor Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Provided initial characterization of next generation advanced lightweight combat vehicle armors for identification of future armor maturation risk; conducted initial performance and cost trade analysis on the integration of advanced armor technologies; and performed environmental and ballistic testing on vehicle size armor coupons for system level integration. ***FY 2015 Plans:*** Continue characterization of next generation advanced lightweight combat and tactical vehicle armors; perform environmental and ballistic testing, along with modeling and simulation integration analysis for combat and tactical objective threat-based laminate and encapsulated kinetic energy armor systems (B-Kits); perform risk mitigation and integration analysis for combat vehicle threat-based passive, reactive and electromagnetic chemical energy armor systems (C-Kits); explore adaptive armor applicability and related platform integration techniques to reduce armor weights while increasing protection levels. ***FY 2016 Plans:*** Develop new armor materials and mechanisms to achieve an overall ground vehicle armor subsystem weight reduction of 10-15%. Will mature advanced passive and explosive reactive armor component technologies using new and novel material selections and design approaches for defeat of kinetic energy threats, chemical energy threats, and improvised explosive devices. Will conduct advanced passive kinetic energy armor and explosive reactive armor integration experiments for component integration, and system seams and attachments. Will begin validation of advanced passive kinetic energy armor systems (B-Kits), and advanced reactive armor systems for chemical energy threats (C-Kits) by conducting ballistic experiments. Will mature lightweight materials for structural application and structural designs to provide the protection capability required when integrated with B-Kit and C-Kit armor.			
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 blast mitigating technologies and performance evaluation, modeling and simulation (M&S), experimentation and instrumentation. ***FY 2014 Accomplishments:*** Researched innovative approaches and improved 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; refined and employed modeling and simulation (M&S) tools for assessing occupant protection technologies; developed laboratory tools to better assess integrated components, sub-system and system level responses for protection of Soldiers in underbody	11.003	9.284	6.541

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** C05 / *Armor Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
blast, crash and rollover events; leveraged and expanded on defense, automotive and medical community efforts for improving vehicle exterior, interior and sensor capabilities; continued incorporating lessons learned into occupant protection standards and guidelines; and advanced instrumentation capabilities such as anthropometric test devices and blast data collection for research. ***FY 2015 Plans:*** Research and conduct experiments to evaluate the use of advanced passive and active approaches to mitigate the effects of underbody blast threats in areas such as seats, restraints, energy absorbing materials and active blast countermeasures; conduct tests to evaluate the integration of exterior and interior blast mitigation solutions onto the Occupant-Centric Protection (OCP) demonstrators, vehicle systems, test assets and/or sub-systems; verify and validate occupant-centric design guidelines/standards, M&S tools, test procedures, laboratory processes, experimentation capabilities; research means to allow mechanical countermine tactics or products to be more effective; support testing of new instrumentation capabilities being developed by other programs such as the Warrior Injury Assessment Manikin (WIAMan) Generation 1 blast dummy. ***FY 2016 Plans:*** Will develop blast mitigation technologies to include seats, restraints, flooring and structures at the component and sub-system level to verify sub-system interactions. Will evaluate passive and active technology solutions using Finite Element Modeling and Simulation tools along with sub-system laboratory tools to develop a variety of concepts. Will verify component and sub-system design guidelines and evaluation techniques. Will mature the Warrior Injury Assessment Manikin (WIAMan) in the laboratory environment through durability, repeatability and sensitivity tests of the WIAMan device components and system. Will begin development of WIAMan test device certification procedures through calibration testing.			
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 in the development of survivable combat systems. ***FY 2014 Accomplishments:*** Provided rapid organization and assessment of threat/countermeasure interaction reducing the overall burden on systems; designed and developed modeling and simulation capability to optimize vehicle protection; designed modeling capabilities to represent blast technologies for tradeoff analysis; provided quick reaction capability to quantify platform baseline survivability and prioritize enhancements. ***FY 2015 Plans:***	4.302	3.253	1.000

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** C05 / *Armor Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Provide enhanced capabilities for protected mobility and survivability optimization to support combat modeling, and assessment of technologies that provide enhanced protection with minimum increase in system burdens; provide enhanced assessment methodologies for quantifying and mitigating post-engagement damage and crew casualties from effects such as blast and fire; and provide enhanced assessment methodologies for mobility and survivability on protected mobility. ***FY 2016 Plans:*** Will leverage the enhanced protected mobility optimization and assessment tools and methodologies developed previously to design future vehicle concepts, optimize protection and mobility technologies to minimize system burdens, and identify future technology metrics and requirements.			
Title: Improved Situational Awareness for Ground Platforms ***Description:*** This effort investigates situational awareness (SA) technologies and architectures to improve occupant and vehicle survivability in all conditions and environments to include degraded visual environments (DVE) for ground vehicles. This effort also investigates and analyzes electronic architectures to enable the efficient integration of DVE systems such as intra-vehicle data and video networks, SA input/output devices, and associated software architectures and interfaces. This effort coordinates with PEs 0603005A, 0602709A, and 0603710A. ***FY 2015 Plans:*** Conduct initial investigation of video and data architectures that enable the efficient integration of degraded visual environment (DVE) situational awareness (SA) technologies; Conduct feasibility analysis, trade studies and interface definitions of DVE SA technologies from aviation and commercial applications onto ground combat and tactical vehicles utilizing advanced vehicle digital architectures. ***FY 2016 Plans:*** Will integrate aviation-based degraded visual environment (DVE) sensors onto an Indirect Vision Driving vehicle through the Integrated Digital Video System (IDVS); Develop algorithms that determine how to take World Model information from various sources and overlay that information in real time on the Indirect Vision Driving screens to aid the vehicle operator in visually occluded environments. Conduct human-in-the-loop experiments of the Indirect Vision Driving system augmented with DVE sensors.	-	3.007	7.040
Title: Vision Protection ***Description:*** This effort investigates and develops protection materials, concepts, and devices to protect vehicle occupants' eyes, vehicle cameras and electro-optical fire control systems against emerging laser threats. This effort also evaluates methods to apply the advanced protection materials, concepts, and devices onto vehicle cameras and electro-optical systems to prevent	-	-	1.926

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** C05 / *Armor Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
lasers from destroying sighting systems, disabling cameras that provide situational awareness, and damaging or disorienting Warfighter vision. Coordinated work is also being performed in PEs 0602120A, 0602705A, 0602712A and 0603005A. ***FY 2016 Plans:*** Will conduct damage threshold and damage mechanism studies on current day cameras and optical systems from short-pulsed laser threats. Will also improve capability to conduct experiments and validation of protection concepts against emerging laser threats.			
Accomplishments/Planned Programs Subtotals	26.220	31.399	29.251

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army			Date: February 2015
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602601A / *Combat Vehicle and Automotive Technology*	Project (Number/Name) H77 / *National Automotive Center*	

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
H77: *National Automotive Center*	-	14.815	15.636	15.738	-	15.738	15.936	16.219	16.322	16.642	-	-

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 Maneuver 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Power, Energy and Mobility:	4.024	4.234	4.236
Description: This effort investigates dual use power, energy, and mobility technologies leveraging commercial and academic investment to military application. This effort focuses on technologies such as lightweight 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 PEs 0603005A and 0603125A.			
FY 2014 Accomplishments: Continued 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); continued to support the transition of technology to/from industry and government; leveraged both industry and government facilities for evaluation, integration and testing; developed new manufacturing processes and material technologies to reduce platform weight through lightweight composite materials and novel			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H77 / *National Automotive Center*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
material joining; continued to pursue collaborations with industry and university partners to develop dual use, energy efficient, automotive technologies. ***FY 2015 Plans:*** Collaborate with the Department of Transportation, to leverage activities in the active safety and autonomy areas to exploit efficient fuel vehicle operation over military platforms and duty cycles. Perform next generation of joint activities under the AVPTA vehicle efficiency alliance with the Department of Energy. Develop modeling and simulation of advanced vehicle technologies with DOE AVPTA activities. Investigate energy efficient lubrication potential to produce a significant savings in overall fuel efficiency for our fleets. This work is being coordinated with PE 0603125A. ***FY 2016 Plans:*** Will continue joint activities with Department of Energy and Department of Transportation to exploit fuel efficient vehicle operation for military platforms and duty cycles. Will continue to support the transition of technology to/from industry and government. Will develop and mature fuel cell systems for initial integration experiments of fuel cells onto vehicles. Will investigate fuel reduction and water generation technologies to determine logistical impacts, leveraging commercial and academic investments.			
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 PE 0603005A. ***FY 2014 Accomplishments:*** Continued 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; continued to focus on technologies that will help solve vehicle and installation energy problems; continued 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. ***FY 2015 Plans:*** Continue to partner with the Department of Transportation to leverage both traditional crash worthiness as well as active safety and autonomous driving. Other areas of collaborative research include component safety, human interface and distracted driving	10.791	11.402	11.502

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H77 / *National Automotive Center*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
technologies. Proceed to leverage the commercial automotive and trucking research and development centers at the OEM and tier suppliers to bring reliable, affordable technology solutions to our military ground vehicle fleet. ***FY 2016 Plans:*** Will continue to leverage commercial automotive and trucking research and development centers to transition reliable, affordable technology solutions to our military ground vehicle fleet. Will continue to leverage industry's state of the art vehicle electrification and open vehicle architecture standards and facilitate transition into military ground vehicles. Will continue to research and develop autonomous vehicle standards with industry and other government organizations. Will mature intelligent ground vehicle systems and develop mission payloads for dual use applications to increase efficiences. Will investigate solutions to transition commercial fuel cell technologies to military ground systems.			
Accomplishments/Planned Programs Subtotals	14.815	15.636	15.738

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army			Date: February 2015
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602601A / *Combat Vehicle and Automotive Technology*	Project (Number/Name) H91 / *Ground Vehicle Technology*	

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
H91: *Ground Vehicle Technology*	-	22.441	25.826	23.850	-	23.850	25.389	26.187	25.799	26.297	-	-

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, autonomy-enabled systems, and other component technologies for application to combat and tactical vehicles.

This project supports Army science and technology efforts in the Ground Maneuver 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 and DevelopmentCenter, Edgewood Chemical Biological Center (ECBC), and the Army Medical Department.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Pulse Power:	0.958	3.369	3.423
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 and 0602705A.			
FY 2014 Accomplishments: Performed component development 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. Continued component development to decrease space, volume and thermal requirements while increasing performance.			
FY 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Fabricate electrified armor and pulse power components for validation at the subsystem level against MIL-STD-810G test procedures, thermal, rain and salt testing, shock/vibration and performance testing. Conduct road testing and soldier-in-the-loop testing with electrified armors for safety and performance validation. ***FY 2016 Plans:*** Will complete the design and integration of energy storage and high-voltage power electronic components into a system that enables high mass-efficiency electro-magnetic threat defeat mechanisms. Will begin pulse power system laboratory testing to validate the power system performance needed for electromagnetic armor threat defeat. Will complete design of an electromagnetic armor module.			
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). 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. ***FY 2014 Accomplishments:*** Investigated and created 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. Developed an advanced fan design to provide for a more efficient cooling capability for the engine to increase the overall system capability. ***FY 2015 Plans:*** Investigate waste heat recovery applications for military vehicles to increase system efficiencies. Investigate grill designs for greater cooling capability. Design and fabricate 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 that are not available in commercial-off-the-shelf engines specific to military applications. ***FY 2016 Plans:***	3.046	4.465	5.122

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Will design and develop an advanced heat exchanger and efficient fan subsystem to increase cooling capabilities and fuel efficiency. Will design waste heat recovery system for military vehicle applications to provide additional onboard electrical power. Will mature engine component concept designs through thermal, structural and reliability modeling and simulation.			
Title: Power Management Technologies: ***Description:*** This effort investigates power management technologies, software, and implementation approaches. Technologies include Alternating Current (AC) to Direct Current (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 PE 0603005A. ***FY 2014 Accomplishments:*** Designed and developed 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 merge previous power management developments with architectural developments to support demonstration of fuel savings (at least 10% on a 72-hour combat mission) power management brings when combined with an advanced electrical power architecture. ***FY 2015 Plans:*** Test Silicon Carbide-based power electronics for power conversion, distribution, and control to implement the next generation, open, non-proprietary electrical power architecture for military ground vehicles. Continue development of the power management algorithms and software for the next generation power architecture. Demonstrate power management and advanced electrical power architecture fuel savings gains of at least 10% on a 72-hour combat mission. Begin integration of the components for the next generation power architecture into a Systems Integration Lab (SIL) to demonstrate SiC and automated power management. ***FY 2016 Plans:*** Will complete development of the next generation power architecture and corresponding system design using SiC power electronics and low cost computers. Will integrate high and low voltage power components into a system integration laboratory (SIL) and will conduct validation of the power architecture and power electronics in the SIL, demonstrating SiC and automated power management.	1.898	2.823	2.583
Title: Power Electronics, Hybrid Electric and Onboard Vehicle Power (OBVP) Components: ***Description:*** This effort researches, develops and evaluates technologies to increase onboard vehicle electric power to enable vehicle systems such as advanced survivability systems, situational awareness systems, advanced computing, and the Army network. This effort researches, designs and evaluates high temperature and efficient power generation components to provide increased electrical power and reduced thermal loads using high operating temperature switching devices and advanced electrical	2.409	1.328	1.218

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
generation components such as integrated starter generators and integrated starter alternators. This effort also researches, designs and evaluates advanced control techniques for power generation components to make these systems more efficient, increase electrical power output and reduce thermal loads. ***FY 2014 Accomplishments:*** Investigated vehicle efficiency, space and weight impacts of OBVP generation in a system laboratory that includes the vehicle power pack and supporting auxiliary systems; compared OBVP system performance versus the performance of a conventional system; investigated the potential controls strategy enhancements of system operation where speed/power of auxiliary systems are easily manipulated; investigated vehicle level benefits (efficiency, space, weight, ambient temperature operating range) of high temperature power electronics versus traditional power electronics for power generation. ***FY 2015 Plans:*** Investigate approaches to further electrify and control parasitic vehicle automotive loads and increase efficiency; model and simulate tracked vehicle performance with OBVP technologies integrated; investigate approaches to implement mild hybrid (system that integrates electric machines to assist internal combustion engines for propulsion) capabilities on OBVP equipped vehicles. Investigate intelligent engine start/stop strategy, architecture and controls to dramatically reduce engine idling. ***FY 2016 Plans:*** Will design and develop a high power generator, high temperature inverter and electronic controls strategy to electrify and control parasitic vehicle automotive loads to increase onboard vehicle power availability and fuel efficiency with no negative impact to vehicle mobility.			
Title: Advanced Non-Primary Power Systems: ***Description:*** This effort researches, investigates, conducts experiments and validates Auxiliary Power Units (APUs) technologies such as modular/scalable engine based APUs, fuel cell reformer systems to convert JP-8 to hydrogen, sulfur tolerant JP-8 fuel cell APUs and novel engine based APUs for military ground vehicle and unmanned ground systems. This effort also determines inputs for APU interface control documents, as well as investigates solutions for reducing APU acoustic signature for silent operation during mounted surveillance missions. This effort investigates the use of small engines and JP-8 fuel cell systems for use as prime power solutions for unmanned ground systems. ***FY 2014 Accomplishments:*** Investigated engine based 10 kilowatt (kW) Auxiliary Power Unit (APU) oil consumption reduction technologies in order to decrease maintenance intervals and increase reliability; conducted experiments on acoustic treatments for engine based APUs; conducted sulfur tolerant JP-8 reformer experiments; and conducted initial assessment of fuel cell-based APU solutions. ***FY 2015 Plans:***	3.103	3.052	1.909

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Investigate technologies that would enable a 20kW fuel cell APU; beginning initial experiments on increasing fuel cell components resistance to sulfur; beginning initial experiments of high power rotary engine APU designs; beginning to investigate noise mitigation solutions for high power rotary engine APUs. ***FY 2016 Plans:*** Will design and develop high power rotary engine technologies to increase the power density up to two times current power densities of other heavy fueled internal combustion engines. Will investigate and design active noise control, muffler and insulation technologies to reduce the acoustic signature of engine-based auxiliary power units (APU) to decrease detection during mounted surveillance missions.			
Title: Elastomer Improvement Program: ***Description:*** This effort researches, formulates and tests new elastomer (rubber) compounds for vehicle track systems to increase track system durability, reduce track system failures and reduce Operations & Sustainment (O&S) costs related to premature track system failures. ***FY 2014 Accomplishments:*** Expanded integration of short fibers into elastomer compounds to augment durability and increase abrasion resistance; fabricated American Society for Testing and Materials (ASTM) samples and performed laboratory evaluation of short fiber infused elastomer coupons to determine material property improvements; and fabricated vehicle test articles and performed on-vehicle testing to validate laboratory based improvements to material compound changes. ***FY 2015 Plans:*** Perform analysis of previously tested short fiber materials; optimize fiber orientation and validate through laboratory testing; analyze the potential of combining short fiber material with novel other fillers to further reduce black carbon in the elastomer material; perform laboratory testing of optimized compounds. ***FY 2016 Plans:*** Will fabricate elastomer samples with optimized compounds for durability evaluation. Will validate durability evaluation data with predictive fatigue models. Will perform design iterations of track system elastomer components based on field test results and fatigue modeling and simulation.	0.986	0.662	0.662
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,	6.522	7.592	6.614

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
vehicle and pedestrian safety, active safety, and robotic command and control. This effort is coordinated with efforts in PEs 0602120A and 0603005A ***FY 2014 Accomplishments:*** Developed advance active safety systems to include controls, algorithms and associated hardware onto manned/unmanned wheeled vehicles; increased performance of perceptive sensors and planning algorithms and integrated on to robotic platforms for safe operations in dynamic environments; and refined tactical behaviors for mission execution on robotic platforms. ***FY 2015 Plans:*** Extend the capabilities of active safety systems for military vehicles to reduce soldier injury due to vehicle accidents and rollovers; advance capabilities for manned/unmanned teaming; enhance command and control software to enable single-operator control of multiple unmanned systems; refine algorithms, sensor fusion, dismounted behaviors, and soldier-robot interaction capabilities to enable mission planning and execution in dynamic environments; further development of interoperability profiles and mission package integration; develop capabilities for longer-duration/higher-tempo operations. ***FY 2016 Plans:*** Will develop autonomous behaviors for mounted and dismounted ground vehicle systems that are adaptable to different missions and environments. Will develop advanced cognitive control through feedback coupling of Soldier-Unmanned Ground Vehicle system capabilities and behavior at neural, neurocognitive, and sociocognitive levels. Will mature reliable and consistent autonomous capabilities for mounted and dismounted ground vehicle systems to increase autonomous vehicle control and reduce required level of human interaction.			
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. Develop and test energy storage devices to 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-STD-810G). Designs and develops advanced batteries to reduce battery volume and weight while improving battery energy and power densities within the same footprint and standardized form factor of current batteries (6T) to enhance logistics. ***FY 2014 Accomplishments:***	2.378	2.535	2.319

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Conducted 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. ***FY 2015 Plans:*** Integrate novel battery materials (anode, cathode, electrolyte, and separators) into battery cells designed to fit into existing military battery form-factors (ex: 6T); improve existing advanced 6T battery pack prototypes and designs by incorporating new cell technologies and refining their battery management systems, control algorithms, and physical construction for shock & vibration and Electro-Magnetic Interference (EMI); improve 6T battery designs for manufacturability, commonality and cost reduction; validate improved 6T designs against latest battery & vehicle safety and performance requirements. ***FY 2016 Plans:*** Will design and develop advanced cell level materials to fit into standardized military battery form factors such as 6T. Will design improved advanced standardized battery prototypes by incorporating advanced cell materials. Will develop and mature electrochemical cell designs to improve energy density, starting, lighting, propulsion system ignition, silent watch and reliability of military specific battery.			
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 such as anti-lock brakes and semi-active suspension. ***FY 2014 Accomplishments:*** Identified candidate fuel efficient gear lubricants and hydraulic fluids to improve ground system performance and reduce logistics burden; evaluated new alternative fuels and fuel additives that may improve performance and diversify energy sources; and identified candidate POL products with high potential to meet new military technology requirements while ensuring legacy equipment performance and technical requirements are maintained.	1.141	-	-
Accomplishments/Planned Programs Subtotals	22.441	25.826	23.850

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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D. Acquisition Strategy

N/A

E. Performance Metrics

N/A