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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity					R-1 Program Element (Number/Name)							
2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)					PE 0603462A / Next Generation Combat Vehicle Advanced Technology							
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	255.386	302.209	164.951	-	164.951	-	-	-	-	-	-
BF2: Autonomous Ground Resupply (AGR) Adv Tech	-	18.000	18.574	-	-	-	-	-	-	-	-	-
BF4: Combat Vehicle Robotics Adv Tech	-	9.884	8.504	26.777	-	26.777	-	-	-	-	-	-
BF5: Adv Lethality & Accuracy Sys for Med Cal Adv Tech	-	1.918	-	-	-	-	-	-	-	-	-	-
BF7: Crew Augmentation and Optimization Adv Tech	-	3.712	4.411	3.768	-	3.768	-	-	-	-	-	-
BG1: Sensors for Auto Oper and Survivability Adv Tech	-	11.030	13.954	10.733	-	10.733	-	-	-	-	-	-
BG3: Modeling and Simulation for MUMT Advanced Tech	-	3.499	3.241	5.188	-	5.188	-	-	-	-	-	-
BG4: Adv Mobility Experimental Prototype Adv Tech Demo	-	8.380	3.760	2.819	-	2.819	-	-	-	-	-	-
BG5: Extended Line of Sight (ELOS) Advanced Technology	-	10.419	1.396	-	-	-	-	-	-	-	-	-
BG7: Ground Systems Active Defense (GSAD) Advanced Tech	-	23.774	48.196	52.172	-	52.172	-	-	-	-	-	-
BG9: Obscuration Advanced Technology	-	2.958	9.774	2.608	-	2.608	-	-	-	-	-	-
BH1: Survivability Systems Controls Advanced Technology	-	12.487	13.680	-	-	-	-	-	-	-	-	-
BH3: C4ISR Modular Autonomy Advanced Technology	-	5.941	-	-	-	-	-	-	-	-	-	-
BH4: Ground Vehicle Holistic Defense Adv Tech	-	-	-	0.034	-	0.034	-	-	-	-	-	-
BH6: Platform Electrification and Mobility Adv Tech	-	4.775	24.006	24.891	-	24.891	-	-	-	-	-	-

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BH8: Enhanced VETRONICS Advanced Technology	-	12.398	12.009	14.989	-	14.989	-	-	-	-	-	-	
BI1: Protection for Autonomous Systems Adv Tech	-	3.931	-	-	-	-	-	-	-	-	-	-	
BI3: Sensor Protection Advanced Technology	-	1.438	1.752	1.645	-	1.645	-	-	-	-	-	-	
BI5: Materials Application and Integration Adv Tech	-	3.476	5.286	4.947	-	4.947	-	-	-	-	-	-	
BJ1: Vehicle System Security Advanced Technology	-	1.199	1.444	2.455	-	2.455	-	-	-	-	-	-	
BJ6: Hydrogen Based Combat System Advanced Technology	-	0.519	-	-	-	-	-	-	-	-	-	-	
BJ8: Detection of Explosive Hazards Advanced Technology	-	4.919	-	-	-	-	-	-	-	-	-	-	
BK1: Autonomous Mobility Adv Tech	-	9.308	8.470	6.244	-	6.244	-	-	-	-	-	-	
BK4: Next Gen Intelligent Fire Control(NG-IFC) Adv Tech	-	0.432	8.903	1.727	-	1.727	-	-	-	-	-	-	
BK6: Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech	-	0.489	3.026	-	-	-	-	-	-	-	-	-	
BP6: Ground Vehicle Advanced Technology(CA)	-	100.500	108.000	-	-	-	-	-	-	-	-	-	
BZ9: Smart Targeting Environment for Lower Level Assets	-	-	3.823	3.954	-	3.954	-	-	-	-	-	-	

**A. Mission Description and Budget Item Justification**

This PE executes development, and demonstration for the Army's modernization priority for the Next Generation of Combat Vehicles. This PE matures, integrates and demonstrates combat vehicle technologies that enable the Army to have a smarter, faster, more lethal, more precise, more protected, and more adaptable force. Technology development builds upon the foundational vehicle architectures to support the Next Generation of Combat Vehicles, to include autonomy architecture,

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power architecture, vehicle electronic architecture, physical architecture, lethality architecture and vehicle protection architecture. Technologies developed, matured, and demonstrated will enable leap ahead capabilities for manned, optionally manned and unmanned vehicles that deliver decisive lethality.

Work in this PE complements PE 0602141A (Lethality Technology), PE 0602144A (Ground Technology), PE 0602145A (Next Generation Combat Vehicle Technology), PE 0602146A (Network C3I Technology), PE 0602782A (Command, Control, Communications Technology), PE 0603116A (Lethality Advanced Technology), PE 0603119A (Ground Advanced Technology), PE 0603463A (Network C3I Advanced Technology), PE 0604115A (Technology Maturation Initiatives), and PE 0708045A (End Item Industrial Preparedness Activities). Work in this PE also transitions to PE 0603645A (Armored Systems Modernization Adv Dev) and PE 0604017A (Robotics Development).

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

All FY 2020 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work is performed by the U.S. Army Futures Command and the U.S. Army Engineer Research and Development Center.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>
Previous President's Budget	260.535	199.358	196.039	-	196.039
Current President's Budget	255.386	302.209	164.951	-	164.951
Total Adjustments	-5.149	102.851	-31.088	-	-31.088
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	100.500	108.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-99.179	-			
• SBIR/STTR Transfer	-6.470	-5.149			
• Adjustments to Budget Years	-	-	-31.088	-	-31.088

**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** BP6: *Ground Vehicle Advanced Technology(CA)*

Congressional Add: *Additive Manufacturing for Jointless Hull*

Congressional Add: *Carbon Fiber and Graphite Foam Technology*

Congressional Add: *Hydrogen Fuel Cells*

	<b>FY 2020</b>	<b>FY 2021</b>
	20.000	10.000
	10.000	10.000
	10.000	10.000

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<b>Appropriation/Budget Activity</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>
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<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>	<b>FY 2020</b>	<b>FY 2021</b>
Congressional Add: <i>ATE5.2 Engine Development</i>	5.000	10.000
Congressional Add: <i>Additive Manufacturing of Critical Components</i>	5.000	5.000
Congressional Add: <i>Advanced Water Harvesting Technology</i>	5.000	-
Congressional Add: <i>Advanced High Strength and Lightweight Steels</i>	3.000	-
Congressional Add: <i>Combat Vehicle Weight Reduction Initiative</i>	8.000	10.000
Congressional Add: <i>Virtual and Physical Prototyping</i>	8.000	10.000
Congressional Add: <i>HMMWV Augmented Reality System</i>	5.000	-
Congressional Add: <i>Health Usage Monitoring for HMMWV</i>	3.000	-
Congressional Add: <i>HMMWV Autonomy</i>	5.000	3.000
Congressional Add: <i>HMMWV Torque Monitoring</i>	2.000	-
Congressional Add: <i>HMMWV Automotive Enhancements</i>	7.500	5.000
Congressional Add: <i>Additive Manufacturing</i>	4.000	-
Congressional Add: <i>Program increase - combat vehicle blast testing</i>	-	6.000
Congressional Add: <i>Program increase - advanced adhesives</i>	-	5.000
Congressional Add: <i>Program increase - combat vehicle lithium 6T battery development</i>	-	5.000
Congressional Add: <i>Program increase - vehicle technology readiness levels</i>	-	2.000
Congressional Add: <i>Program increase - 10X technology demonstration</i>	-	8.000
Congressional Add: <i>Program increase - HMMWV augmented reality HUD</i>	-	5.000
Congressional Add: <i>Program increase - Operator?in?the?loop virtual and physical prototyping</i>	-	4.000
Congressional Add Subtotals for Project: BP6	100.500	108.000
Congressional Add Totals for all Projects	100.500	108.000

**Change Summary Explanation**

FY2022 funding change due to realignment of funds to higher priority modernization efforts in PE 0602181A All Domain Convergence Applied Research and PE 0603041A All Domain Convergence Advanced Technology.

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				<b>Project (Number/Name)</b> BF2 / <i>Autonomous Ground Resupply (AGR) Adv Tech</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BF2: <i>Autonomous Ground Resupply (AGR) Adv Tech</i>	-	18.000	18.574	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

Autonomous Ground Resupply (AGR) will mature and demonstrate an improved ground supply distribution system across multiple levels of strategic and tactical sustainment operations. The effort will equip existing military ground vehicles with scalable robotic technology through the integration of modular kits, common interfaces, and a common architecture to improve inter-node supply movement. Further, the system will modernize and optimize the operations within the supply nodes to improve accountability and throughput. The objective of AGR is to integrate new and emerging technologies into the Army's sustainment system to improve throughput, accountability, and safety and provide the Warfighter with the flexibility needed to meet future needs.

The work under this Project will transition to the Leader Follower Program of Record (PoR). The architecture and safety work under this Project also lays the groundwork for the Army Modernization Priority Next Generation Combat Vehicle (NGCV).

This Project matures and demonstrates simulation tools that predict autonomous vehicle performance. This Project matures and demonstrates a real-time simulator that provides the ability to design and assess ground vehicle autonomous behaviors in adverse environmental conditions, reducing the need for field testing. These simulation technologies can be integrated across Army vehicle platforms as required.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work in this Project is performed by the United States (US) Army Futures Command and the US Army Engineer Research and Development Center.

Work is also coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), and transitions to PE 0604017A (Robotics Development).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Architecture and Standards	7.177	7.236	-
<b>Description:</b> This effort matures and validates the government-owned autonomous architecture for an inclusive military library of behaviors that are non-proprietary and modular format to allow for design and development of payloads across the enterprise. This architecture allows the development and implementation of the same government owned software across multiple robotic systems. This will enable interoperability and modularity within systems and will lay the foundation for an affordable			

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
and sustainable lifecycle management model. This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).				
<p><b>FY 2021 Plans:</b> Mature and validate the government-owned autonomous architecture, the autonomous behaviors in the government-owned software library, and improvements to the government-managed interoperability profile standard. Validate the fail-safe architecture utilizing autonomous testing methodologies and procedures and demonstrate that standardized interfaces are enforced between unmanned platforms, payloads, controllers and wireless communication devices through field testing and Soldier experimentation events. Develop documentation for transition to Program Executive Office Combat Support and Combat Service Support in support of Leader Follower Program of Record and to the Next Generation Combat Vehicle.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Program ends in FY21.</p>				
<p><b>Title:</b> Hardware and Hardware-in-the-loop/Software-in-the-loop (HIL/SIL)</p> <p><b>Description:</b> The HIL/SIL is a test system that uses real-time, physics-based models of the vehicle (multi-body dynamics), sensor systems (optics/signal processing and positioning), platform mobility (vehicle-terrain interaction) and weather/environment to provide a "virtual proving ground" for the AGR system. This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).</p> <p><b>FY 2021 Plans:</b> Mature and demonstrate HIL and SIL configurations to optimize AGR sub-systems throughout the full range of environmental conditions that are controllable and repeatable within a validated simulation environment to optimize autonomous performance. Use HIL and SIL capability to rapidly integrate and simulate advanced software behaviors prior to conducting field testing. Improve and validate HIL and SIL system configurations in the laboratory before field testing and Soldier experimentation to reduce costs, save time and decrease risk for the Leader Follower Program of Record. Provide documentation for transition to Program Executive Office Combat Support and Combat Service Support in support of Leader Follower Program of Record and to the Next Generation Combat Vehicle.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Program ends in FY21.</p>		5.999	4.519	-
<p><b>Title:</b> Soldier Experimentation</p> <p><b>Description:</b> In conjunction with the Army Training and Doctrine Command (TRADOC) and Army Test and Evaluation Command (ATEC), this effort will employ unmanned systems in an operational evaluation to test the system in real word applications and environments. After the lab testing is complete and a safety test performed by ATC, then the soldier will provide the final test to</p>		4.537	6.338	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>determine if AGR is useful and rugged enough to enable the soldiers to increase through put on actual missions. This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).</p> <p><b>FY 2021 Plans:</b> Mature and validate safety documentation to demonstrate the employment of leader follower autonomous capability including advanced software behaviors in an operational evaluation to obtain Soldier feedback. Collaborate with TRADOC and ATEC to obtain a safety release to enable Soldiers and Marines to utilize AGR equipment in relevant operational environments.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Program ends in FY21.</p>				
<p><b>Title:</b> Simulation Tools for Autonomous Ground Resupply</p> <p><b>Description:</b> This effort matures and demonstrates a real-time and high-fidelity, hardware and software-in-the-loop simulation environment for evaluation of autonomous systems, and algorithm design and development for the same; demonstrates novel analysis methods for modeling and simulation to provide enhanced demonstrations of autonomous ground vehicles to include adverse environmental conditions.</p> <p><b>FY 2021 Plans:</b> Mature and demonstrate simulation environments for algorithm design and development to predict autonomous vehicle system performance in multiple adverse environmental conditions and provide improved analytical tools for optimizing sensor configurations for autonomous behavior for autonomous ground resupply.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Program ends in FY21.</p>		0.287	0.481	-
<b>Accomplishments/Planned Programs Subtotals</b>		18.000	18.574	-
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BF4 / Combat Vehicle Robotics Adv Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BF4: <i>Combat Vehicle Robotics Adv Tech</i>	-	9.884	8.504	26.777	-	26.777	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures and demonstrates innovative enabling technologies that enable scalable integration of multi-domain robotic and autonomous system capabilities teamed within Army formations supporting all combat warfighting functions (close combat, reconnaissance, targeting and acquisition, etc.). Project focus areas include Platform Electronic Control and Autonomy Safety Engineering.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy (AMS).

Work in this Project supports the Army Modernization Priority, Next Generation Combat Vehicle (NGCV).

Work is performed by the U.S. Army Futures Command (AFC).

Work is also coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), and transitions to PE 0604017A (Robotics Development).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Platform Electronic Control	7.390	4.245	11.849
<b>Description:</b> This effort optimizes the electronic, closed loop control of by-wire vehicle systems to provide stable, reliable, and predictable control in the presence of potential malicious or unintended commands for both wheeled and tracked unmanned vehicles.			
<b>FY 2021 Plans:</b> Demonstrate the smart payload-agnostic interfaces and control mechanisms into the autonomous control systems to provide robust mobility characteristics and standard inputs. Develop a robust platform with system health intelligence for monitoring the critical component state and control data streams.			
<b>FY 2022 Plans:</b> Will develop an optimized solution to an expanded closed loop control of drive by-wire (DBW) systems for robotic ground vehicles to improve safe platform control. Will develop a stable interface, to control autonomous ground vehicle systems, for autonomy kits and/or user interfaces (UI) while maintaining safety critical aspects of the platform. Will demonstrate these enhancements through Engineering Evaluation Testing (EET) to ensure the autonomous technology has been fully evaluated for system safety, thereby			

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>	
<p>demonstrating technical maturity. Will mature and demonstrate Robotic and Autonomy Systems (RAS) safety standards for unmanned ground vehicle systems. Will validate Ground Vehicle Robotics Safety Board published guidelines to show they meet best practices for development of safety critical software for unmanned ground vehicle systems. Validation of Ground Vehicle Robotics Safety Board processes will result in a useable safety confirmation to enable testing and reduced developmental time for testing of autonomous ground combat systems.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding is increased in FY22 for planned progression of this effort to the research being performed and evaluated at the Engineering Evaluation Test (EET). The focus on the safety standard and optimization of DBW control for the robotic and autonomous systems will ensure readiness and validation for testing at the EET.</p>					
<p><b>Title:</b> Autonomous Safety Engineering</p> <p><b>Description:</b> This effort demonstrates a holistic approach to the development of Robotic and Autonomy System (RAS) Safety Standards, development of RAS Virtual Testing Procedures, and maturation of a Safety Based Design Methodology for Robotic Systems.</p>		2.494	-	-	
<p><b>Title:</b> Unmanned Maneuver</p> <p><b>Description:</b> This effort matures and demonstrates the advanced mobility performance of autonomous systems within complex, combat scenarios to allow for the completion of mission goals in separate and teaming configurations at various levels of autonomy.</p> <p><b>FY 2021 Plans:</b> Integrate advanced autonomous behaviors for the robotic combat vehicle in a manned/unmanned team mission demonstrating the off-road capability and commanded formation. Optimize the ability to operate in extreme weather conditions and on unimproved terrain while challenging the robotic assets within the complexity of a combat scenario.</p> <p><b>FY 2022 Plans:</b> Will improve and demonstrate autonomous vehicle maneuvering in rough terrain. Will demonstrate the ability to detect and avoid negative obstacles, such as large holes, bodies of water, and cliffs. Will mature and demonstrate the ability to detect the characteristics of the terrain the vehicle is driving over, and optimize the combat vehicle's driving behaviors in response. Will demonstrate these enhancements through Engineering Evaluation Testing (EET) to ensure the autonomous technology has been fully evaluated for system safety, thereby demonstrating technical maturity.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b></p>		-	2.931	9.448	

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
Funding is increased in FY22 for planned progression of this effort to the research being performed and evaluated at the Engineering Evaluation Test (EET). The focus on autonomous vehicle maneuvering in rough terrain and negotiating negative obstacles will ensure readiness and validation for testing at the EET.				
<p><b>Title:</b> Soldier-Robotic Interface Integration</p> <p><b>Description:</b> This effort is a focused approach to optimize control of the unmanned systems with improved performance incorporating Manned-Unmanned Teaming enabled formations and is measured against multiple phases of the combat scenario for improved operational effectiveness and overall system performance.</p> <p><b>FY 2021 Plans:</b> Develop enhanced multi-vehicle, assisted autonomous control to include dynamically reconfigurable interfaces for the mission systems to increase standoff and enable force multiplication. Develop the capability to utilize and orient configurations of the control interface per the preferred operational mission, allowing the warfighter to choose the screen layout and interface assistance.</p> <p><b>FY 2022 Plans:</b> Will develop an expanded operator span of control for robotic vehicles in defined mission to improve Manned /Unmanned Teaming to increase operator standoff and enable control of multiple platforms. Will demonstrate these enhancements through Engineering Evaluation Testing (EET) to ensure the autonomous technology has been fully evaluated for system safety, demonstrating technical maturity.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding is increased in FY22 for planned progression of this effort to the research being performed and evaluated at the Engineering Evaluation Test (EET). The focus on optimization of unmanned systems controls for the Soldier's ability to operate robotic vehicles will ensure readiness and validation for testing at the EET.</p>		-	1.328	5.480
<b>Accomplishments/Planned Programs Subtotals</b>		9.884	8.504	26.777
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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**Exhibit R-2A, RDT&E Project Justification:** PB 2022 Army **Date:** May 2021

<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology	<b>Project (Number/Name)</b> BF5 / Adv Lethality & Accuracy Sys for Med Cal Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BF5: Adv Lethality & Accuracy Sys for Med Cal Adv Tech	-	1.918	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

**A. Mission Description and Budget Item Justification**

This Project matures and demonstrates advanced medium caliber ammunition, weapon, fire control, and Ammunition Handling Systems (AHS) optimized for remote operation. This effort demonstrates cannon super high elevation engagement, high performance stabilization, remote ammunition loading, weapon safety and reliability, improved lethality, accuracy, ability to fire a suite of ammunition from non-lethal to lethal, and escalation of force capability in one system.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this Project is related to and fully integrated with the efforts funded in Program Element PE0604115A (Technology Maturation Initiative).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2020	FY 2021	FY 2022
<b>Title:</b> Advanced Lethality and Accuracy System for Medium Caliber Advanced Technology	1.918	-	-
<b>Description:</b> This effort matures and demonstrates advanced medium caliber ammunition, weapon, fire control, and AHS optimized for remote operation. This effort demonstrates cannon-super high elevation engagement, high performance stabilization, remote ammunition loading, weapon safety and reliability, improved lethality, accuracy, ability to fire a suite of ammunition from non-lethal to lethal, and escalation of force capability in one system.			
<b>Accomplishments/Planned Programs Subtotals</b>	1.918	-	-

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BF7 / Crew Augmentation and Optimization Adv Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BF7: Crew Augmentation and Optimization Adv Tech	-	3.712	4.411	3.768	-	3.768	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures and demonstrates advanced technologies to enable crew augmentation and optimization for closed hatch operations of ground vehicle platforms in a complex multi-domain operations environment. This includes integration of intelligent technologies to improve dynamic tasking and full crew interactions, machine learning to improve decision aids, early warnings, reduce response times and shorten task durations, and machine learning to optimize tasking and function. Mature technologies are incorporated onto existing or prototype Army-owned technology demonstrators so that performance of the enabling technologies can be evaluated.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle. Work in this Project is conducted by the United States (US) Army Futures Command.

Work in this PE/Project is also coordinated with work in PE 0602145A (Next Generation Combat Vehicle Technology) and PE 0602143 (Soldier Lethality Technology)

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Crew Augmentation & Optimization Advanced Technology	3.712	4.411	3.768
<b>Description:</b> This effort focuses on optimizing crew station technologies while reducing crew sizes that will provide the same overall performance by exploiting human-machine interaction technologies, automation, machine intelligence and customization to permit soldiers to achieve performance beyond today's constrained ground vehicle environment			
<b>FY 2021 Plans:</b> Mature and demonstrate vehicle and crew task management and re-tasking to enhance team performance. Demonstrate effectiveness of individual vehicle operators without increasing levels of manpower for specific mission sub-sets. Demonstrate baseline teaming of crew and robotic operator configurations to permit reconfiguration of roles, improve ease of use and increase overall productivity. Validate effectiveness in an operationally-relevant, motion-based simulation environment with Soldiers.			
<b>FY 2022 Plans:</b> Will mature and demonstrate vehicle and crew task management at the section level to enable sharing of critical tasks between crew and robotic operators during times of high workload. Will integrate and demonstrate interface advancements in novel display technologies (i.e. helmet mounted displays) to improve situational awareness. Will demonstrate section-level teaming of crew and			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BF7 / <i>Crew Augmentation and Optimization Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
robotic operator configuration to permit reconfiguration of mission roles. Will validate effectiveness in an operationally-relevant, field experiment.				
<b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort for slightly reduced demonstration efforts in FY22.				
<b>Accomplishments/Planned Programs Subtotals</b>		3.712	4.411	3.768
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b> N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				<b>Project (Number/Name)</b> BG1 / <i>Sensors for Auto Oper and Survivability Adv Tech</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BG1: <i>Sensors for Auto Oper and Survivability Adv Tech</i>	-	11.030	13.954	10.733	-	10.733	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures, optimizes, and demonstrates automated, advanced multi-function sensors and integrates threat cueing capabilities for operations in full spectrum, complex environments, for next generation manned, optionally manned, and robotic platform applications. This Project will deliver sensor payloads which provide greatly increased situational awareness (e.g. pre-shot and hostile fire detection, threat classification) in all environments for manned and unmanned ground vehicle systems.

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

Work in this Project supports the Army Science and Technology Next Generation Combat Vehicle, Soldier Lethality, and Future Vertical Lift modernization priorities.

Work in this Project is performed by the US Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Sensors for Autonomous Operations and Survivability Advanced Technology	9.668	-	-
<b>Description:</b> This effort will demonstrate aided target detection (AiTD) and aided target recognition (AiTR) for rapid search, and an automated, multi-spectral sensing capability to detect concealed threats and identify/apply countermeasures to enable decisive action and maneuver, for manned and unmanned platforms. This effort is coordinated with PE 0602145A (NGCV Technology), 0602143A (Soldier Lethality Technology), and 0603118A (Soldier Lethality Advanced Technology).			
<b>Title:</b> Advanced Sensors with Embedded Processing	-	8.493	5.786
<b>Description:</b> Matures and demonstrates advanced, multi-spectral and multi-function sensors, and image processing capabilities with improved performance in all environments and against all threats to include low-contrast targets in camouflage or in degraded conditions. Matures and demonstrates rapid detection of concealed enemy optical threat systems (visible, midwave infrared, longwave infrared) and real-time hostile fire detection (HFD) for anti-armor threats while on the move, exploiting multi-functional imaging components and embedded processing. Enables enhanced situational awareness and targeting capabilities in complex environments via manned, optionally manned, and robotic platform applications.			
<b>FY 2021 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG1 / <i>Sensors for Auto Oper and Survivability Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>Mature sensor payloads with embedded Aided Target Detection and Recognition (AiTD and AiTR) algorithms for situational awareness and targeting sensors. Demonstrate sensors with multi-spectral response and embedded processing to provide real-time performance on space-constrained platforms. Continue to mature threat optics detection with targeting sensors by combining pre-shot and thirdgeneration forward looking infrared capability.</p> <p><b>FY 2022 Plans:</b> Will mature low-power processing approaches for high definition (HD) sensor data to exploit imagery in degraded environments and detect threats. Will validate performance of novel uncooled infrared sensors to assess the impact of increased dynamic range, sensitivity, and higher data rates for passive hostile fire detection (HFD) of anti-armor threats. Will exploit infrared digital read out integrated circuit (DROIC) technologies for 3rd Gen Forward Looking Infrared to improve multi-spectral, multifunction targeting and threat detection for greatly enhanced range performance and increased ability to detect targets and threats in degraded environments. Will mature advanced pulsed mid-wave infrared laser technology to enable maturation of on-the-move threat optics detection capabilities.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort with reduced algorithm development.</p>				
<p><b>Title:</b> Multi-Mission Payload</p> <p><b>Description:</b> Matures and demonstrates sensor payloads for ground vehicle based unmanned aerial systems to detect line of sight, and beyond line of sight threats and complex obstacles such as personnel and vehicles in all environments.</p> <p><b>FY 2021 Plans:</b> Mature multi-mission sensor payloads for small unmanned aerial system platforms using polarized and broad band electro-optic / infrared technology to provide improved cueing performance against threats that inhibit maneuver. Demonstrate sensor payloads on-the-move at low altitudes for rotary and fixed wing platforms in close combat open terrain scenarios. Mature threat cueing algorithms based on the integrated sensor payload architecture and multi-look flight paths.</p> <p><b>FY 2022 Plans:</b> Will improve performance of rotary and fixed wing unmanned aerial system (UAS) payloads to enable advanced detection of threats and targets in complex environments, day or night. Will exploit feature extraction and target detection techniques to enable advanced sensing capabilities inherent in the multi-modal sensor technologies to increase detection of near-peer threats and suppress clutter. Will demonstrate advanced sensor payloads in realistic open terrain environments to establish a baseline capability to augment maneuver and protection of small unit level formations.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b></p>		-	5.461	4.947

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG1 / <i>Sensors for Auto Oper and Survivability Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
Funding change reflects planned lifecycle of this effort.				
<b>Title:</b> Sensors for Automated Target Recognition Advanced Research		1.362	-	-
<b>Description:</b> This effort demonstrates and matures the pairing of ground borne, airborne, and soldier worn sensors with artificial agents to rapidly detect and identify adversary targets.				
<b>Accomplishments/Planned Programs Subtotals</b>		11.030	13.954	10.733
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BG3 / Modeling and Simulation for MUMT Advanced Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BG3: Modeling and Simulation for MUMT Advanced Tech	-	3.499	3.241	5.188	-	5.188	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures and demonstrates modeling and simulation (M&S) tools/technologies to assess and improve freedom of movement for ground forces and supports vehicle developers by addressing challenges for robotic and ground vehicles. This Project matures and demonstrates obstacle detection capabilities for autonomous systems operating in complex environments. This Project also matures and demonstrates real-time mobility decision support tools, vehicle-terrain interaction models for autonomous convoy operations, simulation tools for vehicle mobility in highly altered terrain, and M&S tools for predicting the performance of autonomous vehicles. These M&S technologies can be integrated across Army vehicle platforms as required.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work in this Project is conducted by the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology) / Project BG2 (Modeling and Simulation for MUMT Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Mobility in Complex Urban Environments Demonstrations	3.499	-	-
<b>Description:</b> This effort matures and demonstrates a real-time, hardware-in-the-loop simulator capable of rapid design and assessment of ground vehicle autonomous behaviors and integrates autonomy solutions into this tool.			
<b>Title:</b> Simulation Tools for CoVeR Demonstrations	-	3.241	5.188
<b>Description:</b> This effort matures and demonstrates M&S tools to support the development of autonomous ground vehicle platforms and components for successful maneuver in unstructured and mission relevant environments. This effort demonstrates M&S capabilities to evaluate hardware and software technologies enabling battlefield autonomy in complex and challenging environments.			
<b>FY 2021 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG3 / <i>Modeling and Simulation for MUMT Advanced Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>Mature and demonstrate desktop and high performance computing-based software-in-the-loop and hardware-in-the-loop M&amp;S tools for operational assessments of autonomy algorithms and hardware; optimize and improve M&amp;S tools to support autonomous vehicle platforms and component development; and optimize adaptive learning models and analytical tools for predicting impacts to maneuver in unstructured environments.</p> <p><b>FY 2022 Plans:</b> Will mature and demonstrate analytical tools and adaptive learning models for predicting autonomous maneuver performance and determining alternative routes in unstructured environments; and will mature advanced algorithms to detect obstacles that affect maneuver corridors in unstructured environments.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding partially realigned from PE 0602145A (NGCV Technology) Project BG2 (Modeling and Simulation for MUMT Technology) in FY2022 to mature and demonstrate simulation tools to predict autonomous vehicle performance, and algorithms to detect obstacles in unstructured environments.</p>				
<b>Accomplishments/Planned Programs Subtotals</b>		3.499	3.241	5.188
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BG4 / Adv Mobility Experimental Prototype Adv Tech Demo			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BG4: Adv Mobility Experimental Prototype Adv Tech Demo	-	8.380	3.760	2.819	-	2.819	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures and fabricates advanced powertrain, power generation and running gear technologies into a combat vehicle that will reduce the percentage of no-go terrain for ground vehicles, increase the maneuver speeds across all traversable terrain, reduce fuel demands thus extending operation time between resupply, and provide onboard power generation to enable the integration of energy based capabilities such as directed energy weapons and electromagnetic armor.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work in this Project is conducted by the United States (US) Army Futures Command.

This Project is coordinated with PE 0604115A (Technology Maturation Initiatives).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Advanced Mobility Experimental Prototype (AMEP) Advanced Technology	8.380	3.760	2.819
<b>Description:</b> This effort develops the advanced powertrain, track and running gear, and unmanned robotic technologies for integration into a ground combat vehicle to demonstrate increased mobility, increased maneuver speeds, and optionally manned capabilities in order to validate performance and capability enhancements at increased vehicle weights to inform ground combat vehicle design.			
<b>FY 2021 Plans:</b> Will develop field-installable suspension system to enable increased mobility performance for a specific class of combat vehicles. Will mature powertrain drive-by-wire control software to enable autonomous maneuverability.			
<b>FY 2022 Plans:</b> Will improve running gear performance for ground combat vehicles with gross vehicle weights up to 50 tons.			
<b>FY 2021 to FY 2022 Increase/Decrease Statement:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG4 / <i>Adv Mobility Experimental Prototype Adv Tech Demo</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
Funding change reflects planned lifecycle to conclusion of this effort in FY2022 with reduced research into powertrain drive-by-wire control software.				
<b>Accomplishments/Planned Programs Subtotals</b>		8.380	3.760	2.819
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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**Exhibit R-2A, RDT&E Project Justification:** PB 2022 Army **Date:** May 2021

<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BG5 / Extended Line of Sight (ELOS) Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BG5: <i>Extended Line of Sight (ELOS) Advanced Technology</i>	-	10.419	1.396	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project develops a precision guided tank fire and forget 120-mm munition to engage high-value targets including heavy armor, the growing Anti-Tank Guided Munition (ATGM) threat (dismounted and mounted), and light armor at extended ranges (2 to 8 km (T), 2 to 12 km (O)).

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work in this Project is performed by the United States (US) Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2020	FY 2021	FY 2022
<b>Title:</b> Extended Line Of Sight (ELOS) Advanced Technology	10.419	1.396	-
<b>Description:</b> This effort demonstrates a 120-mm Tank-fired ELOS Munition that counters the growing Anti-Tank Guided Missile (ATGM) threat at extended line of sight ranges beyond current capability.			
<b>FY 2021 Plans:</b> Demonstrate a 120-mm tank-fired munition with the capability to seek, detect, guide, maneuver, and defeat an ATGM threat at extended range. The munition demonstrates advanced technologies including: fin stabilization; next generation seeker components; electronic guidance, navigation and control (GNC) software; and other advanced component technology.			
<b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> This project ends in FY21.			
<b>Accomplishments/Planned Programs Subtotals</b>	10.419	1.396	-

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG5 / <i>Extended Line of Sight (ELOS) Advanced Technology</i>

**D. Acquisition Strategy**  
N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				<b>Project (Number/Name)</b> BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BG7: <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>	-	23.774	48.196	52.172	-	52.172	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures and demonstrates protection and survivability technologies to increase the survivability of ground vehicles and the protection of the Soldiers who depend on them. The tasks will focus on component maturation and demonstration and transfer products for demonstration as holistic (vehicle level) solutions. The Project will mature technologies to defeat threats throughout the timeline of a threat engagement; from obscuring a target, to actively defeat a threat and through mitigating its effects after engagement. These include the active employment of smoke, physical and electronic active protection, advanced and adaptive armors, advanced and active blast mitigation systems and adaptive interior protection.

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

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

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this project will be coordinated with PE 0602145A (Next Generation Combat Vehicle Technology) and transitions to PE 0604852A (Suite of Vehicle Protection Systems - EMD).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Ground Systems Active Defense Development	10.438	-	-
<b>Description:</b> This effort matures and demonstrates active and adaptive component sensors and effectors which, in combination with modular Survivability Subsystem Controls (SSC) architecture, provide the ability to sense, track, respond and neutralize pacing threats prior to catastrophic terminal effects. The components/subsystems will work in tandem in an efficient manner to provide threat defeat redundancy and layered survivability to optimize protection with reduced weights. This effort matures and demonstrates modern armors that directly complement active protection technologies in order to implement sophisticated mass efficient protection mechanisms and materials investments to act as a system in order to defeat advanced threats. This effort also matures and demonstrates active blast technologies to counter underbody attacks.			
<b>Title:</b> Obscuration Technologies for Active Protection Systems	0.584	2.298	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology	<b>Project (Number/Name)</b> BG7 / Ground Systems Active Defense (GSAD) Advanced Tech		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p><b>Description:</b> Research, develop, test, evaluate, and demonstrate obscurant soft-kill vehicle protection technologies to defeat the observer/gunner, anti-tank guided missiles (ATGMs), and other guided threats. Design and evaluate systems that are Modular Active Protection System (MAPS) and Survivability Subsystem Controls (SSC) compliant.</p> <p><b>FY 2021 Plans:</b> Optimize payloads and demonstrate dissemination of obscurant materials for the Extended Range Obscuration System (EROS).</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding was realigned in FY22 to higher priority modernization efforts in PE 0603041A All Domain Convergence Advanced Technology. Funding decrease results in transition of mature competent technologies at TRL 5 level.</p>				
<p><b>Title:</b> Active Protection Technologies</p> <p><b>Description:</b> This effort demonstrates protection for light armored combat vehicles from anti-armor threat weapons such as rocket-propelled grenades (RPG), anti-tank guided missiles (ATGM), and recoilless rifle projectiles (RR).</p> <p><b>FY 2021 Plans:</b> Conduct component experiments with radar, propulsion/thruster and warhead mechanisms hardware and software to verify performance meets design intent and is repeatable; begin design and development of integrated testbed for demonstration and evaluation of integrated protection system.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> This work was consolidated in FY22 with other Hard Kill efforts and is now funded as part of the effort in this Project titled ?Hard Kill Active Protection System (HK APS) Development, Integration, and Demonstration?.</p>		3.304	7.098	-
<p><b>Title:</b> Advanced Radar and Soft-Kill (A-RASK) Suite</p> <p><b>Description:</b> This effort matures next generation vehicle radar technologies and holistic electronic warning and soft-kill countermeasure techniques to support a layered modular active protection suite and ensure the survivability of ground combat platforms in all-weather day or night conditions with 360 degree situational awareness and threat defeat.</p> <p><b>FY 2021 Plans:</b> For Combat Operations Battlefield Radar: Conclude capability/tradeoff analysis based on techniques for active protection systems with 360-degree situational awareness radar technology; conclude baseline improvement of resource management and processing algorithms to support multiple combat vehicle protection capabilities and radar simulation models for hardware-in-the-loop evaluation of emerging threats and future sensor improvements and technologies; and provide analysis to ensure operation in cluttered radio frequency environments.</p>		9.448	9.778	0.974

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>For Advanced Soft Kill Countermeasures (ASKCM): Integrate laser hardware into existing soft-kill countermeasure system to defeat additional threats and to demonstrate defeat of anti-tank guided missiles as part of a layered protection system in cooperation with the Soft-Kill System Development effort in this Project.</p> <p>For Soft Kill Techniques and Effects: Execute 2nd &amp; 3rd iterations of validation of threat hardware successfully integrated in the lab without countermeasure in the loop (dry shot demonstration). Perform laboratory validation and demonstration of two iterations of soft-kill countermeasure techniques to evaluate performance and transition techniques to the most promising soft-kill countermeasure design from the layered protection system demonstration conducted in the Soft-Kill System Development effort in this Project.</p> <p><b>FY 2022 Plans:</b> Will continue to develop soft-kill countermeasure techniques and effects for additional anti-tank guided missile (ATGM) threats. Will conduct demonstrations of system capabilities with integrated techniques to assess system performance against multiple ATGM threat classes, launch profiles and distances.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> FY 22 funding was realigned to a higher priority modernization program.</p>				
<p><b>Title:</b> Long Range Hard Kill Countermeasure (LRHK-CM)</p> <p><b>Description:</b> This effort matures and demonstrates a MAPS-compliant hard-kill countermeasure system able to defeat current threats such as RPG, ATGM and future threat munitions such as kinetic energy and artillery delivered sub-munitions. This effort will optimize a complete hard-kill active protection system including munitions, launcher, sensors, and fire-control, and demonstrate capabilities through modeling and simulation and live-fire demonstrations.</p> <p><b>FY 2021 Plans:</b> Conduct system trade studies by incorporating additional system, experimental, and threat data. Will mature the hard-kill countermeasure munition and incorporate effectiveness against multiple threat categories. Mature a hard-kill countermeasure launcher and integrate using the MAPS Framework and Controller on a combat vehicle, integrate existing sensor technologies and perform simulation and live-fire demonstrations.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> This work was consolidated with other Hard Kill efforts in FY22 and is now funded as part of the effort in this Project titled ?Hard Kill Active Protection System (HK APS) Development, Integration, and Demonstration?.</p>		-	6.896	-
<p><b>Title:</b> Soft-Kill System Development</p>		-	9.140	10.199

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p><b>Description:</b> This effort focuses on maturing and demonstrating soft-kill system technologies to protect combat vehicles from current and emerging ATGM threats at stand-off distances with an unlimited magazine and low collateral hazard. This capability will also enhance situational awareness to vehicle occupants by detecting and alerting when threats have been fired. Technologies will be optimized and integrated on combat vehicles using the MAPS Framework and Controller, and demonstrated in a relevant environment.</p> <p><b>FY 2021 Plans:</b> Integrate the soft-kill system developed in the Advanced Radar and Soft-Kill Suite effort in this Project utilizing the MAPS Framework and Controller for system demonstration. Conduct virtual / laboratory demonstrations; assess system performance and robustness through and verify system performance in physical live-fire demonstration with the goal to alert the crew of threats being fired and providing the defeat of multiple ATGMs.</p> <p><b>FY 2022 Plans:</b> Will develop and mature soft-kill subsystems such as those developed in the Advanced Radar and Soft-Kill Suite effort in this Project by delivering soft-kill capabilities, environmentally hardening, upgrading to the latest revision of the MAPS Framework (MAF), and optimizing space, weight, and power (SWAP) of the subsystems. Will begin virtual / lab demonstrations to assess subsystem performance and robustness in preparation for system integration.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> The funding increase reflects the start of next capability increment which increases scope of associated deliverables and increased virtual/lab demonstrations.</p>				
<p><b>Title:</b> Advanced Threat Protection</p> <p><b>Description:</b> This effort matures and integrates armor and occupant protection technology to protect against emerging both top and bottom attacks threats increasing vehicle survivability and Soldier protection.</p> <p><b>FY 2021 Plans:</b> Mature test methods to evaluate Soldier protection technologies from both top and bottom attack emerging threats. Leverage modelling and simulation to evaluate protection technologies from current and future top and bottom attack threats. Demonstrate underbody technologies that provide full-spectrum protection against bottom attack threats at a reduced weight from current technology. Demonstrate top attack armor solutions and evaluate whether they interfere with vehicle operation. Validate compliance with combat vehicle architectures, perform environmental and durability testing, and demonstrate capabilities against pacing threats in a representative environment.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b></p>		-	6.294	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
This effort ends in FY21 with planned completion of research.				
<p><b>Title:</b> Survivability Capability Characterization and Demonstration</p> <p><b>Description:</b> This effort evaluates emerging protection technologies to characterize and assess their performance and maturity and potential for transition to Product Manager (PdM) Vehicle Protection System (VPS).</p> <p><b>FY 2021 Plans:</b> Assess vehicle protection capability gaps, conduct a targeted market survey of emerging survivability technologies which address those gaps, request vendor proposals, and provide an experimentation venue to demonstrate performance of selected technologies in FY21 to characterize enhanced vehicle protection. Characterization data will be used to inform technology development and transition to PdM VPS.</p> <p><b>FY 2022 Plans:</b> Canvas industry, academia, and government for unverified high potential / high impact survivability technologies that have applicability to current ground vehicle platform requirements. Down-select promising technologies and work with industry, academia, or government partners to begin planning for the demonstration and assessment of the technologies. Identify the technology and any other necessary resources for future demonstration.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding was partially realigned in FY22 to higher priority modernization efforts in PE 0603041A All Domain Convergence Advanced Technology.</p>		-	2.944	2.503
<p><b>Title:</b> Sensors for Adaptive Armor</p> <p><b>Description:</b> This effort demonstrates mature sensor technology to enable an adaptive armor system using the MAPS Framework and Controller on a combat vehicle platform. This effort matures real-time processing software, continuously refines the threat trajectory prediction algorithm and integrates sensors with an adaptive countermeasure for threat defeat to the MAPS Framework and Controller to ensure the activation of adaptive armor to protect against incoming threats.</p> <p><b>FY 2021 Plans:</b> Mature the real-time processing software of sensor data, improve detect and track algorithms of the adaptive armor system and analyze/assess MAPS architecture-compliant integration on a combat vehicle platform. Perform analysis and maturation of adaptive armor countermeasure concepts.</p> <p><b>FY 2022 Plans:</b></p>		-	2.714	1.691

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
Will optimize real-time processing software and improve trajectory prediction algorithm of the sensor technology to enable adaptive armor systems. Will mature sensor subsystem and will perform environmental and hardening testing. <b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> In FY 2022, funding decrease reflects planned reduction in research assessment of MAPS architecture-compliant integration.				
<b>Title:</b> Active Blast Mitigation Environmental and Durability Validation <b>Description:</b> This effort demonstrates mature sensor technology for an Active Blast Mitigation System (ABMS) into the MAPS Framework on a combat vehicle platform with improved countermeasure design for protection from blast events. ABMS will support a reduction of injuries caused from underbody blast events by providing a counterforce to the blast acceleration of the vehicle hull. <b>FY 2021 Plans:</b> Optimize MAPS-compliant ABMS technology using improved countermeasure design for safety and manufacturing. Develop a more effective countermeasure and improve upon the performance of prior ABMS designs. <b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> This effort ends in FY21 with planned completion of research		-	1.034	-
<b>Title:</b> APS Residuals Protection Maturation and Complex Threat Attack Protection (CTAP) <b>Description:</b> This effort contributes to the Army's ground vehicle survivability by maturing, integrating, and demonstrating advanced technologies which physically defeat incoming threats. These technologies involve passive and reactive mechanisms that work seamlessly with active protection systems in order to increase the overall efficiency of the system. This effort will mature and demonstrate armor components that defeat residual blast and fragmentation from hard-kill active protection systems engagements with kinetic threats in order to protect vehicle occupants and critical subsystems. This effort also matures and demonstrates armor and occupant protection components that provide threat defeat for advanced and emerging threats with complex defeat mechanisms. <b>FY 2022 Plans:</b> Will mature and demonstrate component technologies developed under PE 0602145A (Next Generation Combat Vehicle Technology) Project BG6 (Advanced Concepts for Active Defense Technology) for protection against degraded threats, ballistic shields for sensors, advanced mechanisms for moving armor to protect optics, and multi-functional modular seats to protect occupants from injury. Will mature and package these component designs for durability. Will demonstrate hardened component		-	-	10.082

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>threat defeat performance through exposure to environmental conditions. Will validate that packaged component physical parameters, such as size and weight, are able to meet vehicle system-level design constraints.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> This is a planned new effort in FY22 which transitions from PE 0602145A (Next Generation Combat Vehicle Technology) Project BG6 (Advanced Concepts for Active Defense Technology).</p>				
<p><b>Title:</b> Controls and Architecture</p> <p><b>Description:</b> This effort provides the basis for holistic (vehicle level) active defense by ensuring compatibility of active defense subsystems and systems. This effort advances the effectiveness and efficiency of the controls and architecture for active defense systems. The focus will be to enable the integration of multiple emerging survivability technologies into safe and secure configurations. This effort will conduct Size, Weight, and Power-Cooling (SWaP-C) optimization for the system components.</p> <p><b>FY 2022 Plans:</b> Will build upon previous controls and architecture for Active Protection Systems (APS) efforts by advancing the intelligent decision management subsystem, cross domain management solution, active survivability safety measures, and vehicle user-interface subsystem for emerging survivability technologies. Will ensure that enhancements do not interfere with current compliant technology performance.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding for this effort has been realigned from Project BH1 Survivability Systems Controls Advanced Technology in this PE to focus on controls and architecture for APS.</p>		-	-	5.452
<p><b>Title:</b> Hard Kill Active Protection System (HK APS) Development, Integration, and Demonstration</p> <p><b>Description:</b> This effort matures, integrates, and demonstrates a Hard Kill Active Protection System (HK APS) capable of defeating Rocket Propelled Grenades, Anti-Tank Guided Missiles, and Recoilless Rifles ensuring the platform's ability to shoot, move and communicate after an engagement. The system will be compliant to the Modular APS Framework (MAF). This effort will optimize an HK APS that includes the following sub-systems; counter-measure, launcher, and sensors (active/passive). The HK APS capabilities will be demonstrated in a virtual and live fire demonstration in a relevant operational environment.</p> <p>Counter-measure (CM): Develops and matures CM designs that includes the following aspects: blast size, time of flight, velocity, engagement distance, accuracy, and SWaP-C. Analysis will be conducted for each counter-measure component as well as at the sub-system level. Demonstrations will be performed in the following environments: virtual, hardware in the loop, and live fire.</p>		-	-	21.271

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>Launcher: Develops and matures launcher designs that considers the following aspects: SWaP-C, engagement speed and accuracy, number of launchers, material composition and reliability. The most mature and suitable launcher for the project will be demonstrated in the following environments: virtual, hardware in the loop, and live fire.</p> <p>Sensors: Matures the overall sensor suite design (active/passive) that considers the following aspects; radar frequency, power, weight, volume, algorithms, accuracy, search range, tracking and identification time, and passive cueing integration and optimization. The most mature and suitable sensor suite (active/passive) for the project will be demonstrated in the following environments: virtual, hardware in the loop, and live fire.</p> <p>Integration: Demonstrate the matured HK APS sub-systems on a platform in the following environments: virtual, hardware in the loop, and live fire. This will also analyze subsystem and system performance characteristics against Integrated Product Team (IPT) stakeholder requirements. Develop a performance baseline for future hard kill system evaluations.</p> <p><b>FY 2022 Plans:</b> Will conduct individual Initial Design Reviews for the CM, Launcher and Sensor sub-systems, using previous efforts as a baseline, with industry and government experts. Will integrate CM, Launcher and sensor suite sub-systems based on the Initial Design Reviews including long lead components for future sub-system demonstration and validation. Will begin planning and develop sub-system models to demonstrate the sub-systems in a virtual environment. Will conduct planning for the integration of the CM, Launcher, and Sensor sub-systems into a unified HK APS onto the demonstration platform. Will execute a system level Initial Design Review including the CM, Launcher and Sensor sub-system baselines established in the sub-system Initial Design Reviews. Will begin planning and integrate an HK APS simulation to represent the system in a relevant environment using previous efforts to demonstrate the HK APS in a virtual environment.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> This new effort reflects a consolidation of Active Protection Technologies and Long Range Hard Kill Countermeasure (LRHK-CM) efforts in this Project into a single collaborative effort.</p>				
<b>Accomplishments/Planned Programs Subtotals</b>		23.774	48.196	52.172
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				<b>Project (Number/Name)</b> BG9 / <i>Obscuration Advanced Technology</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BG9: <i>Obscuration Advanced Technology</i>	-	2.958	9.774	2.608	-	2.608	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

The Project matures and demonstrates obscurant technologies with potential to enhance personnel and platform survivability by degrading threat force surveillance sensors and defeating the enemy's target acquisition devices, missile guidance, and directed energy weapons. Dissemination systems for new and improved obscurants are developed with the goal of providing efficient and safe screening of deployed forces. Synthetic Biology Manufacturing technologies in this project will provide Department of Defense (DoD) with the ability to manufacture products such as explosive alternatives and defense-only critical chemicals & materials.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work is performed by the U.S. Army Futures Command.

Work in this Project is related to, and fully coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Advanced Obscuration	2.958	1.774	2.608
<b>Description:</b> This effort investigates, designs and demonstrates the dissemination of new and advanced obscurants. This effort will support PE 0603462 Project (Ground Systems Active Defense Advanced Technology).			
<b>FY 2021 Plans:</b> Validate and demonstrate dissemination materials compatible with the screening obscuration module. Demonstrate dissemination materials for the Improved Rapid Obscuration System (IROS). Optimize multi-spectral payloads to perform as obscurant countermeasures for effective vehicle protection.			
<b>FY 2022 Plans:</b> Will examine packing and dissemination methods of advanced obscuration materials. Will ensure that materials can be safely and efficiently disseminated, and material packing methods geared towards use in obscuration programs .			
<b>FY 2021 to FY 2022 Increase/Decrease Statement:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BG9 / <i>Obscuration Advanced Technology</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
Funding increase reflects planned lifecycle of effort to demonstrate on two systems in FY22.			
<p><b>Title:</b> Synthetic Biology Bioprocessing Facility</p> <p><b>Description:</b> This effort supports the modernization of the Army's Synthetic Biology Bioprocessing Technology to manufacture pilot scale products such as explosives, obscurants and defense-only critical chemicals &amp; materials. This effort will expedite transitioning products from the new Synthetic Biology Manufacturing Innovation Institute into technology development efforts to support the Department of Defense.</p> <p><b>FY 2021 Plans:</b> Modernize bio-manufacturing facility's fermentation and downstream purification capabilities.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> This effort competes in FY21 with pilot-scale facility improved to support biotechnology research activities.</p>	-	8.000	-
<b>Accomplishments/Planned Programs Subtotals</b>	2.958	9.774	2.608

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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**Exhibit R-2A, RDT&E Project Justification:** PB 2022 Army **Date:** May 2021

<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BH1 / <i>Survivability Systems Controls Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BH1: <i>Survivability Systems Controls Advanced Technology</i>	-	12.487	13.680	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

**Note**

Funding for this project in Fiscal Year (FY) 2022 was realigned to Program Element (PE) 0603462A / Project BG7 Ground Systems Active Defense (GSAD) Advanced Tech, and to higher priority modernization efforts in PE 0603041A All Domain Convergence Advanced Technology.

This Project terminates in FY2021.

**A. Mission Description and Budget Item Justification**

This Project advances the design and capability of the Modular Active Protection System (MAPS) framework and controller to enable integrating emerging survivability technologies into safe and secure configurations and demonstrating them in a representative operational environment. The effort will verify compliance of component sensors and effectors with the modular active protection architecture. This effort ultimately feeds demonstrations of active defense subsystems for demonstration as holistic (vehicle level) solutions. This Project is a key enabler for insertion of current and future active survivability technologies onto ground platforms in order to combat current and emerging threats.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

This work is performed by the United States (US) Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2020	FY 2021	FY 2022
<b>Title:</b> Survivability System Control	12.487	13.680	-
<b>Description:</b> This effort focuses on maturing and demonstrating a common and open survivability architecture and core implementation to ensure its operational effectiveness. Specifically, this effort includes extending the MAPS architecture across a broader set of active survivability capabilities and increasing the portfolio of Modular APS Framework (MAF) compliant technologies. In addition, this project will enhance the government-developed controller subsystem for performance and integration effectiveness with high speed digital signal processing and embedded systems/firmware/software which will be required due to the expanded active defense suite of sensors (e.g., electro-optic, infrared, radio frequency, magnetic, acoustic), sensor fusion, and explore synthesizing sensor data beyond situational awareness to situational understanding with context that			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BH1 / <i>Survivability Systems Controls Advanced Technology</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>can greatly enhance operational effectiveness and vehicle survivability. The activities under this effort provide incremental growth for broader threat spectrum defeat relevant to vehicle protection systems and will be aligned to capability gaps for transition to the acquisition community.</p> <p><b>FY 2021 Plans:</b> Continue to build upon the foundation of the MAPS controller and artifacts to include an update to the framework and extend beyond active protection capability to a layered protection capability. Implement and demonstrate an expanded MAPS base kit derived from studies conducted in FY20. Demonstrate a reduced size-weight-and-power MAPS base kit design enabling integration for tactical wheeled vehicles and providing alternative integration solutions for combat vehicles. Expand the layering capability of multiple, future MAPS Framework compliant vehicle protection technologies developed in PE 0603462A Next Generation Combat Vehicle Advanced Technology, Project BG7 Ground System Active Defense (GSAD).</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding for this project in FY22 was realigned to PE 0603462A / Project BG7 Ground Systems Active Defense (GSAD) Advanced Tech and to higher priority modernization efforts in PE 0603041A All Domain Convergence Advanced Technology.</p>				
<b>Accomplishments/Planned Programs Subtotals</b>		12.487	13.680	-
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b> N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BH3 / C4ISR Modular Autonomy Advanced Technology			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BH3: C4ISR Modular Autonomy Advanced Technology	-	5.941	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**Note**

In Fiscal Year (FY) 2021 this Project is realigned to:  
 Program Element (PE) 0603462A Next Generation Combat Vehicle Advanced Technology  
 \* Project BZ9 Smart Targeting Environment for Lower Level Assets

**A. Mission Description and Budget Item Justification**

This Project matures and develops software and algorithms to integrate ground and aerial Robotics and Autonomous Systems (RAS) with mission command information systems enabling commanders to more effectively plan, monitor and incorporate RAS into unit formations and missions, and assist the development of doctrine.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy (AMS).

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work in this Project is performed by the United States (US) Army Futures Command (AFC).

Work in this PE complements PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Command of Autonomous Teams (COAT)	3.747	-	-
<b>Description:</b> This effort designs, fabricates, evaluates, and integrates RAS and Manned Unmanned Teaming (MUM-T) concepts with mission command information systems and doctrine allowing commanders' the ability to plan, monitor and incorporate RAS into formations while reducing Soldier burden. This work will provide an integrated mission planning and execution capability for Next Generation Combat Vehicle, and allow RAS platforms to be quickly incorporated into mission formations and complete complex tactical tasks.			
<b>Title:</b> Command and Control of Robotic and Autonomous Systems in a MDO Environment	2.194	-	-
<b>Description:</b> This effort matures and virtually demonstrates the ability for commanders to synchronize robotic, autonomous, manned, and unmanned systems in support of building an agile, cross-service kill chain.			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BH3 / <i>C4ISR Modular Autonomy Advanced Technology</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Accomplishments/Planned Programs Subtotals</b>	5.941	-	-

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BH4 / Ground Vehicle Holistic Defense Advanced Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BH4: Ground Vehicle Holistic Defense Adv Tech	-	-	-	0.034	-	0.034	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**Note**

This was a planned Presidential Budget (PB) 2021 New Project starting in FY22

Funding for this project in Fiscal Year (FY) 2022 was partially realigned to higher priority modernization efforts in PE 0603041A All Domain Convergence Advanced Technology.

**A. Mission Description and Budget Item Justification**

Ground Vehicle Holistic Defense (GVHD) will be the basis for a holistic survivability design framework utilizing virtual design models in a Modeling and Simulation (M&S) environment as well as conducting hardware in the loop and live fire demonstration. This Project will inform multiple system level demonstrations to validate that layered survivability technologies are optimized to defeat emerging near-peer threats. Data collected will be used to further validate and verify M&S tools. This Project provides a design approach available to analyze and adjust the family of protection technologies for combat vehicles in relevant operational theaters.

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

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

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this Project is coordinated with PE 0603462A (Next Generation Combat Vehicle Advanced Technology) Project BG7 (Ground Systems Active Defense) and transitions to PE 0604852A (Suite of Vehicle Protection Systems - EMD).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Layered Survivability Demonstration	-	-	0.034
<b>Description:</b> This effort will utilize virtual models in a Modeling and Simulation (M&S) environment to analyze layered survivability technologies for integration to a demonstration platform. Selected technologies will be demonstrated in a relevant environment to include, virtual, hardware/software in the loop, and live fire environments. This effort will validate that layered Survivability technologies are optimized to defeat threats consistent with the threat defeat capabilities of the selected technologies.			
<b>FY 2022 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BH4 / <i>Ground Vehicle Holistic Defense Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
Will conduct very limited holistic vehicle defense analysis in support of larger vehicle systems security activities found in Project BJ1 (Vehicle System Security Advanced Technology).				
<b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> This is a new planned effort under PE 0603462A in FY22. The funding increase is to start an M&S demonstration.				
<b>Accomplishments/Planned Programs Subtotals</b>		-	-	0.034
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b> N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BH6 / Platform Electrification and Mobility Adv Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BH6: Platform Electrification and Mobility Adv Tech	-	4.775	24.006	24.891	-	24.891	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures, integrates and demonstrates technologies to electrify both manned and unmanned Next Generation Combat Vehicle platforms. Electrification of these platforms will enable advanced onboard electrified payloads such as directed energy weapons, reduce battlefield fuel consumption, and provide new capabilities such as burst acceleration, extended silent mobility and silent watch. The effort will mature, integrate and demonstrate technologies to increase electric power such as a high voltage/temperature generator and high power/ temperature power electronics as well as technologies to reduce power demands including composite rubber band track and adaptive hydro-strut suspension.

This Project also continues the Advanced Vehicle Power Technology Alliance between the Department of Energy and the Department of the Army with a focus on electrification technology that enables military ground vehicles to become significantly more energy efficient. The Alliance is chartered to accelerate the conceptualization and transition into deployment of inventive and creative energy-saving concepts that the Nation needs to achieve energy security.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work is performed by the U.S. Army Futures Command.

This work complements PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> NGCV Platform Electrification & Mobility Advanced Technology	4.775	-	-
<b>Description:</b> This effort develops and demonstrates scalable electrification architecture, electronics and mobility components required to electrify both manned and unmanned Next Generation Combat Vehicle platforms.			
<b>Title:</b> Platform Electrification Technologies	-	14.377	11.015
<b>Description:</b> This effort matures and integrates components and sub-systems in order to demonstrate a modular electrification architecture that scales across light to heavy weight classes of combat vehicles.			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BH6 / <i>Platform Electrification and Mobility Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p><b><i>FY 2021 Plans:</i></b> Develop scaleable, modular combat vehicle electrification architecture. Develop electric sprocket drive motors, diesel-electric power system and thermal management system for electrification architecture. Develop combat vehicle electrification software architecture. Develop electric fan and demonstrate cooling architecture. Demonstrate combat vehicle electrification software architecture. Demonstrate architecture and components for a modular high voltage, high energy storage system. Demonstrate architecture for a tactical battlefield recharge capability.</p> <p><b><i>FY 2022 Plans:</i></b> Will mature the electric sprocket drive system and develop integration software. Will mature thermal management system for a modular high voltage energy storage system. Will mature the diesel-electric power system and thermal management system and develop integration software. Will develop high power electrical components to enable the tactical battlefield recharging capability.</p> <p><b><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i></b> Funding decrease is a result of funding realignments to two new efforts in this Project, namely "Scalable Electrification &amp; Control Architecture Technology" for electrification architecture and "Robotic Combat Vehicle (RCV) Silent Watch and Mobility Range Extension Advanced Technology" for silent watch/range extension; also slightly reduced work required to mature components developed in FY21.</p>				
<p><b><i>Title:</i></b> Advanced Mobility Technologies</p> <p><b><i>Description:</i></b> This effort matures and demonstrates a reduced weight composite running gear system for medium combat vehicle applications which increases operational effectiveness and reduces fuel consumption.</p> <p><b><i>FY 2021 Plans:</i></b> Demonstrate and validate performance of solid composite track and external suspension systems.</p> <p><b><i>FY 2022 Plans:</i></b> Will exploit composite materials and component designs to significantly reduce running gear system weights. Will reduce integration and supportability concerns with external suspension systems.</p> <p><b><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i></b> Funding increase reflects planned lifecycle of this effort attributable to the cost of lightweight materials in the suspension component and track designs.</p>		-	3.744	5.819
<p><b><i>Title:</i></b> Advanced Vehicle Power Technology Alliance (AVPTA) - Electrification Technology</p> <p><b><i>Description:</i></b> This effort develops and matures advanced energy storage technologies to improve power and energy performance and safety for vehicles. Higher energy stored with less space and weight increases vehicle efficiency and range. Ensures</p>		-	2.841	2.068

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BH6 / <i>Platform Electrification and Mobility Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>electrified ground vehicles have enough power for mobility, silent watch, and enables capabilities such as advanced protection, lethality and network capabilities. This effort is a partnership with the Department of Energy.</p> <p><b>FY 2021 Plans:</b> Demonstrate commercial battery chemistry and packaging technologies applicable to military hybrid and all-electric drive combat and tactical platforms.</p> <p><b>FY 2022 Plans:</b> Will mature and optimize commercial based energy storage systems to meet military environmental conditions at a module level.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort with redirected focus on military hardening of commercial energy storage systems</p>				
<p><b>Title:</b> System/Vehicle Integration and Test</p> <p><b>Description:</b> This effort integrates advanced mobility, platform electrification components and electrification architecture technologies into surrogate platforms to demonstrate the performance, scalability and modularity of the system approach which will provide the capabilities of silent mobility, improved mobility performance, improved operational duration without re-supply, and provides power to enable integration of advanced protection, lethality and network capabilities.</p> <p><b>FY 2021 Plans:</b> Integrate the sub-system models of the modular electrification architecture and components into surrogate hull models to maximize available volume.</p> <p><b>FY 2022 Plans:</b> Will demonstrate sub-system packaging into the surrogate hulls for significantly improved under-armor power density while maximizing system integration for ease of assembly, maintenance, and supportability.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding decrease reflects slightly lower level of effort required to realize and demonstrate the packaging approaches modeled in FY21.</p>		-	3.044	2.597
<p><b>Title:</b> Scalable Electrification &amp; Control Architecture Technology</p> <p><b>Description:</b> This effort validates component-level performance and integrates the power distribution and control components to implement a common, scalable, electrified vehicle power architecture to enable analyze layered survivability technologies, high voltage batteries, fast vehicle charging from the grid, and silent mobility on combat platforms from 15 to 50 tons.</p>		-	-	1.930

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BH6 / <i>Platform Electrification and Mobility Adv Tech</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p><b><i>FY 2022 Plans:</i></b> Will demonstrate component-level performance of the high voltage power converter and import/export power converter. Will integrate those components into the power subsystem to validate subsystem-level performance.</p> <p><b><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i></b> Funding for this effort was realigned from "Platform Electrification Technologies" effort in this Project to perform component demonstration and subsystem integration of required high voltage power conversion devices.</p>			
<p><b><i>Title:</i></b> RCV Silent Watch and Mobility Range Extension Advanced Technology</p> <p><b><i>Description:</i></b> This effort matures and integrates JP8 reformer components and sub-systems in order to demonstrate extended silent watch and mobility as part of a modular electrification architecture supporting robotic combat vehicles. The Army's robotic combat vehicles are expected to have increased silent watch and silent mobility requirements that are not met by current technologies.</p> <p><b><i>FY 2022 Plans:</i></b> Will optimize the lightweight anode supported solid oxide fuel cell integration with JP8 reformer and mature from test stand to stand alone operation on a light robotic combat vehicle to increase silent watch and mobility.</p> <p><b><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i></b> Funding for this effort was realigned from "Platform Electrification Technologies" effort in this Project to mature fuel cell for vehicle integration.</p>	-	-	1.462
<b>Accomplishments/Planned Programs Subtotals</b>	4.775	24.006	24.891

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				<b>Project (Number/Name)</b> BH8 / <i>Enhanced VETRONICS Advanced Technology</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BH8: <i>Enhanced VETRONICS Advanced Technology</i>	-	12.398	12.009	14.989	-	14.989	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures, integrates, and demonstrates vehicle electronics hardware such as computers, sensors, communications systems, displays, and vehicle command/control/driving mechanisms as well as vehicle software to enhance crew performance, increase vehicle fuel efficiency, reduced Size, Weight, and Power (SWaP) burdens and reduce vehicle maintenance costs. This Project also advances open system architectures (power and data) for military ground vehicles to enable common interfaces, standards and hardware implementations. The overall vehicle system architecture approach provides an open architecture such as the Vehicle Integration for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance / Electronic Warfare (C4ISR/EW) Interoperability (VICTORY), to allow platforms to accept future technologies without the need for significant re-design as new technologies are developed and integrated. Additionally this Project matures infrastructure that enables the ease of integration of autonomous subsystem technologies into future and existing tactical and combat vehicle architectures. Technical challenges include: software and algorithm development for increased levels of automation for both manned and unmanned systems, secure vehicle data networks, interoperability of intra-vehicle and inter-vehicle systems, and implementation of advanced user interfaces. Overcoming these technical challenges enables improved and increased span of collaborative vehicle operations, efficient workload management, commander's decision aids, embedded simulation for battlefield visualization and fully integrated virtual test/evaluation.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work in this Project is performed by the U.S. United States (US) Army Futures Command.

Work is also coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Enhanced - Vehicle Electronics (E-Vetronics)	12.398	12.009	14.989
<b>Description:</b> This effort addresses technical and integration challenges in the areas of vehicle architecture and systems integration. Specifically, this effort focuses on maturing and demonstrating a common ground vehicle open architecture with distributed display processing architecture, computing hardware capable of being re-configured to adapt to changes in Input / Output (I/O) needs, advanced network video distribution, advancements in slip ring technology, tactical situational awareness (SA), cooperative engagement and mission package integration through open architecture components and software. These			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BH8 / <i>Enhanced VETRONICS Advanced Technology</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>efforts will enable future vehicle capabilities, reduce dependencies on proprietary solutions, and support increased market competition through open architecture components and software. This project will create the electronics architecture for future ground combat vehicles to enable software and hardware commonality and reduce system integration timing and cost.</p> <p><b>FY 2021 Plans:</b> Begin development of a shared processor to support addition of new functionality without requiring additional processing hardware to the vehicle. Conduct first bench level demonstration of advanced slip ring technology, flexible computing I/O, and advancements in open systems architecture and tactical SA.</p> <p><b>FY 2022 Plans:</b> Will continue development of architecture, tactical situational awareness, digital containerization, flexible computing I/O and advanced slip ring. Will conduct final demonstration of advanced slip ring and flexible computing I/O technologies, as well as a second bench level demonstration of all available components in an open system architecture. Will develop scalable, modular hybrid electric system architecture for tactical vehicles as well as interfaces to high voltage energy storage modules, power management systems to improve fuel efficiency for military vehicles.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Adjustment to economic assumptions because all long lead hardware procured as well as increase investment in Climate change initiative to reduce vehicle platform carbon emissions and increase fuel efficiency.</p>				
<b>Accomplishments/Planned Programs Subtotals</b>		12.398	12.009	14.989
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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**Exhibit R-2A, RDT&E Project Justification:** PB 2022 Army **Date:** May 2021

<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> B11 / Protection for Autonomous Systems Adv Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BI1: Protection for Autonomous Systems Adv Tech	-	3.931	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures, integrates, and demonstrates protection and survivability components such as novel ballistic and sensor protection to address both current and emerging advanced threats to autonomous ground vehicles. This Project integrates complimentary survivability technologies to enable advanced protection suites, providing greater survivability and protection against emerging threats. This Project develops a holistic set of protection technologies that specifically target the autonomous subsystems integrated on a robotic platform.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. All FY 2020 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

In FY 2020 this Project will develop efforts that were successfully funded in PE 0602601A (Combat Vehicle and Automotive Technology) / Project C05 (Armor Applied Research) during FY 2019.

Work in this Project supports the Army Science and Technology Next Generation Combat Vehicle Portfolio.

Work is performed by the U.S. Army Futures Command.

Work in this Project complements PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Protection for Autonomous Systems	2.724	-	-
<b>Description:</b> This effort focuses on maturing and demonstrating novel ballistic protection and sensor protection concepts to ensure autonomous ground vehicles can continue their mission in contested environments.			
<b>Title:</b> Vehicle Anti-Personnel Protection Armament System	1.207	-	-
<b>Description:</b> This effort matures and demonstrates capabilities to provide protection of manned and unmanned platforms against threats, non-combatants, civilian belligerents, and other potentially hostile actors.			
<b>Accomplishments/Planned Programs Subtotals</b>	3.931	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> B11 / <i>Protection for Autonomous Systems Adv Tech</i>

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BI3 / Sensor Protection Advanced Technology			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BI3: Sensor Protection Advanced Technology	-	1.438	1.752	1.645	-	1.645	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures and demonstrates novel sensor protection capabilities which dramatically reduce the susceptibility of our thermal electro-optic/infrared (EO/IR) sensors to ever increasing threats on the battlefield. This effort enables continuation of the mission despite potential threat laser engagements. Low cost modular solutions will be demonstrated that can be applied across current and planned EO/IR targeting, surveillance, and situational awareness sensor systems against existing and emerging threats in support of combined arms maneuver.

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

Work in this Project supports the Army Modernization Priorities Next Generation Combat Vehicle, Soldier Lethality, and Future Vertical Lift.

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), 0602143A (Soldier Lethality Technology), 0603465A (Future Vertical Lift Advanced Technology) and 0603118A (Soldier Lethality Advanced Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Sensor Protection Advanced Technology	1.438	1.752	1.645
<b>Description:</b> This effort will mature and demonstrate sensor protection and signature reduction capabilities which better ensure sensors are difficult to detect, dazzle, and damage by current and future laser threats.			
<b>FY 2021 Plans:</b> Mature and demonstrate technologies to protect emerging high sensitivity uncooled longwave infrared sensors.			
<b>FY 2022 Plans:</b> Will mature super window optical coating or material solution with environmental hardening. Will validate protected uncooled microbolometer camera in a relevant environment.			
<b>FY 2021 to FY 2022 Increase/Decrease Statement:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BI3 / <i>Sensor Protection Advanced Technology</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
Funding change reflects planned lifecycle of this effort.			
<b>Accomplishments/Planned Programs Subtotals</b>	1.438	1.752	1.645

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> B15 / Materials Application and Integration Adv Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
B15: <i>Materials Application and Integration Adv Tech</i>	-	3.476	5.286	4.947	-	4.947	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures, integrates, and demonstrates lightweight novel materials, and new manufacturing processes and methodologies. These materials and technologies will enable the Army to address critical areas within survivability, mobility, and transportability.

This Project also continues the Advanced Vehicle Power Technology Alliance between the Department of Energy and the Department of the Army with a focus on materials, providing an emphasis on developing advanced technologies that enable military ground vehicles to become significantly more energy efficient. The Alliance is chartered to accelerate the conceptualization and transition into deployment of inventive and creative energy-saving concepts that the Nation needs to achieve energy security. This Project matures and integrates lightweight materials and joining technologies in support of lighter military vehicles which are more fuel-efficient and expeditionary with superior mobility and protection of both vehicles and occupants.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work is performed by the United States (US) Army Futures Command .

Work in this Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> System Design Optimization for Lightweighting	3.476	4.588	4.252
<b>Description:</b> This effort matures technologies, tools, and advanced manufacturing techniques in support of the Army's mission to increase mobility, protection, and transportability while reducing weight. This effort focuses on maturing and demonstrating technologies to decrease ground vehicle weight while optimizing performances and enabling the Army trade space for enhanced capabilities. The technologies being demonstrated are in the fields of material maturation, design optimization, operational metrics, joining technologies, and additive manufacturing. This effort is coordinated with PE 0602145A (NGCV Technology).			
<b>FY 2021 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> B15 / <i>Materials Application and Integration Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>Mature and demonstrate advanced/lightweight material technologies for design/weight optimization and advanced manufacturing, to include additive manufacturing. Validate and demonstrate integration of solid-state joining and hybrid joint design of dissimilar materials to improve performance while reducing weight and increasing system robustness. Validate material and component manufacturability, blast/ballistic performance, machinability, weldability, corrosion resistance, and stiffness characteristics.</p> <p><b>FY 2022 Plans:</b> Will mature and demonstrate advanced/lightweight materials technologies including materials for armor applications, and novel materials for high temperature and high wear surfaces. Will apply integrated computational materials engineering (ICME) tools for improved Modeling &amp; Simulation for virtual prototyping. Will mature and demonstrate advanced manufacturing technologies such as additive manufacturing for design optimization to improve component and sub-system performance, reduce part complexity, and reduce weight. Will validate and demonstrate integration of solid-state materials joining to include joint designs for advanced armor materials.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort for reduced research on solid state joining and hybrid joint design of dissimilar materials.</p>				
<p><b>Title:</b> Advanced Vehicle Power Technology Alliance ? Materials</p> <p><b>Description:</b> This effort develops and matures lightweight materials and joining technologies in support of lighter military vehicles which are more fuel-efficient and expeditionary with superior mobility and protection of both vehicles and occupants. Lighter materials/constructions and advances in joining technologies such as multi-material and dissimilar material joining will lead to lightweight military vehicle structures.</p> <p><b>FY 2021 Plans:</b> Mature and demonstrate advanced/lightweight materials for ground vehicle weight optimization, energy storage/transfer, and protection such as FeMnAl (Iron, Manganese and Aluminum alloy), CuTa (Copper Tantalum), Magnesium, and/or other high strength aluminum alloys through optimization and validation of advanced manufacturing, machining, blast/ballistic performance, dissimilar material joining/weldability, and corrosion.</p> <p><b>FY 2022 Plans:</b> Will mature and demonstrate advanced/lightweight materials for weight optimization, energy storage/transfer, and protection such as FeMnAl (Iron, Manganese and Aluminum alloy) for high hard armor applications, high strength alloy for structural applications, and conductive materials for energy transfer; validate manufacturing, machining, blast/ballistic, dissimilar materials joining/</p>		-	0.698	0.695

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> B15 / <i>Materials Application and Integration Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
weldability and corrosion performance for these materials. Will mature and demonstrate wire arc additive manufacturing for design optimization of large ground system components.  <b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> NA.				
<b>Accomplishments/Planned Programs Subtotals</b>		3.476	5.286	4.947
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b> N/A				

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**Exhibit R-2A, RDT&E Project Justification:** PB 2022 Army **Date:** May 2021

<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BJ1 / Vehicle System Security Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BJ1: Vehicle System Security Advanced Technology	-	1.199	1.444	2.455	-	2.455	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures and demonstrates ground vehicle cyber protection and resilience technologies to increase the cybersecurity of ground vehicles and ensure their continued operation in near-peer cyber contested environments. This Project will mature cybersecurity technologies at the platform level to defeat cybersecurity threats and maintain assured vehicle functionality and freedom of maneuver in the cyber warfighting domain.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work is performed by the United States (US) Army Futures Command.

This Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2020	FY 2021	FY 2022
<b>Title:</b> Vehicle System Security Advanced Technology	1.199	1.444	2.455
<b>Description:</b> This effort matures and demonstrates technologies required to maintain operating tempo and overmatch capability during offensive digital attacks to military ground vehicle systems. Additionally, the effort will maintain critical vehicle functionality in peer and near-peer cyber-contested environments. The effort will also mature and demonstrate technologies to mitigate risk of future and emerging cyber vulnerabilities by designing highly assured systems with cybersecurity designed from the beginning.			
<b>FY 2021 Plans:</b> Develop a secure systems integration and assessment capability integrating hardware-in-the-loop and vehicular cybersecurity vulnerability models and exploits to assess cyber resiliency approaches. Mature and demonstrate vehicle data bus protection using embedded advanced sensing and analytics to provide real-time protection against malicious near-peer cyber attacks for both present and future tactical and combat military vehicles.			
<b>FY 2022 Plans:</b> Mature and demonstrate vehicle cybersecurity technologies which verify and validate the functionality of the hardware, software or firmware operation of vehicular microelectronics by identification, logging and notification of any instances of compromised			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BJ1 / <i>Vehicle System Security Advanced Technology</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
hardware, software or firmware and the corresponding threat mitigation strategies without degrading the vehicle's designed functionality.  <b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> Funding increase reflects planned lifecycle of this effort to focus on demonstration of cybersecurity hardware in relevant environments.				
<b>Accomplishments/Planned Programs Subtotals</b>		1.199	1.444	2.455
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b> N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BJ6 / Hydrogen Based Combat System Advanced Technology			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BJ6: Hydrogen Based Combat System Advanced Technology	-	0.519	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures, integrates and demonstrates the technologies required to enable combat systems to be powered by fuel cells to enable increased operational endurance, silent operations and improved mobility. This effort demonstrates the integration of multiple fuel cell stacks to achieve necessary power levels for tracked combat systems. The efforts in this Project analyze hydrogen generation and distribution approaches to validate operational relevance of hydrogen on the battlefield. This effort also develops and demonstrates in a relevant environment the required hydrogen generation technologies in order to quantify reliability, durability and efficiency.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work is performed by the U.S. Army Futures Command (AFC).

This Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Hydrogen Based Combat System Advanced Technology	0.519	-	-
<b>Description:</b> This effort matures, integrates and demonstrates the technologies required to enable combat systems to be powered by fuel cells.			
<b>Accomplishments/Planned Programs Subtotals</b>	0.519	-	-

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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**Exhibit R-2A, RDT&E Project Justification:** PB 2022 Army **Date:** May 2021

<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				<b>Project (Number/Name)</b> BJ8 / <i>Detection of Explosive Hazards Advanced Technology</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
<i>BJ8: Detection of Explosive Hazards Advanced Technology</i>	-	4.919	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures, optimizes and demonstrates leap ahead capabilities for manned and unmanned detection and neutralization of peer, near peer and other threat mines, minefields and improvised explosive devices in all environments.

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

Work in this Project supports Army Modernization Priorities Next Generation Combat Vehicle, and Soldier Lethality modernization priorities.

Work in this Project is performed by the United States (US) Army Futures Command.

This Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2020	FY 2021	FY 2022
<b>Title:</b> Detection of Explosive Hazards Advanced Technology	4.919	-	-
<b>Description:</b> This effort matures and demonstrates an integrated, standoff, modular sensor processing capability that will enable remote, rapid autonomous detection of mines, other Explosive Hazards (EH) and indicators of emplacement from manned and unmanned ground vehicles and Unmanned Aerial Systems (UAS). This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), 0602143A (Soldier Lethality Technology), and 0603118A (Soldier Lethality Advanced Technology).			
<b>Accomplishments/Planned Programs Subtotals</b>	4.919	-	-

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				<b>Project (Number/Name)</b> BK1 / <i>Autonomous Mobility Adv Tech</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BK1: <i>Autonomous Mobility Adv Tech</i>	-	9.308	8.470	6.244	-	6.244	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures and demonstrates Artificial Intelligence and Machine Learning (AI/ML) technologies to increase autonomy and mobility to perform teamed operations with manned and unmanned air and ground vehicles in a military relevant environment through data collection on relevant platforms. Data collection will involve both simulation and live collection. Simulation will provide a baseline to correctly collect, clean, and analyze data that meets the need for improving algorithms for both formation control and unmanned aerial vehicle map input for unmanned ground vehicle mobility. Live data will start with Surrogate platforms in local areas. This will allow proper collection techniques, tools, and data to maximize embedded autonomy using Machine Learning and other Artificial Intelligent methods before utilizing live data collection. The Project will use AI/ML techniques to mature and demonstrate intelligent formation control to be used on maintained roads and in complex terrain without the need for GPS. Data will be collected from mounted platforms utilizing special internal and external sensors to improve algorithms for exact positioning, undistributed formation control, and increased speeds of unmanned platforms. Also, the Project will use AI/ML techniques to optimize intelligent autonomous ground platform planning through the use of Unmanned Aerial Systems (UAS) mapped areas. Data collected from air vehicle will be converted to maneuverable information for unmanned ground platform with the identification of enemy positions, go/no-go areas, terrain classification, and optimal suggested paths.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work is performed by the United States (US) Army Futures Command.

This Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Machine Learning Data Collection	2.777	5.195	3.475
<b>Description:</b> This effort matures and demonstrates techniques and technologies for mass data collection to be used towards Army research in mobility with AI/ML efforts.			
<b>FY 2021 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BK1 / <i>Autonomous Mobility Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>Optimize data collection system created in FY20. Design the data pipeline and infrastructure to support a large number of sensor platforms, petabytes (quadrillion bytes) of data, and many concurrent users. Mature and demonstrate overall data collection approach with surrogate and actual vehicles using training and simulated operational events.</p> <p><b>FY 2022 Plans:</b> Will optimize the data infrastructure for storage of large amounts of robotic ground vehicle data (petabytes) and access by many concurrent users. Will demonstrate the ground robotic data collection process with sensor kits installed on Army ground vehicles. Will mature and expand the AI/ML data for robotic ground data vehicles to include new environments and new types of robotic ground vehicle data</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> FY22 funding decrease reflects planned reduction to align to the data infrastructure maturation (optimizing from the previous years? work) and the data collection demonstration.</p>				
<p><b>Title:</b> Formation Control</p> <p><b>Description:</b> This effort uses AI/ML techniques to develop intelligent formation control to be used on maintained roads and in complex terrain without the need for GPS. Data will be collected from mounted platforms utilizing special internal and external sensors to develop algorithms for exact positioning, undistributed formation control, and increased speeds of unmanned platforms.</p>		4.038	-	-
<p><b>Title:</b> UAS Mapping</p> <p><b>Description:</b> This effort uses AI/ML techniques to develop intelligent autonomous ground platform planning through the use of UAS mapped areas. Data collected from air vehicle will be converted to maneuverable information for unmanned ground platform with the identification of enemy positions, go/no-go areas, terrain classification, and optimal suggested paths.</p> <p><b>FY 2021 Plans:</b> Improve the ability to use data collected from UAS to inform Unmanned Ground Vehicles (UGV) maneuver including in Global Positioning System (GPS)-denied and other degraded environments. Optimize the UAS's ability to identify enemies and terrain to be used for future UAS/UGV coordination.</p> <p><b>FY 2022 Plans:</b> Will mature the ability to map the terrain, identify obstacles, and characterize the soil from a UAS and share that information with an unmanned ground vehicle (UGV) to better inform its planned maneuver(s). Will demonstrate these capabilities with Army platforms at a relevant Army test site.</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b></p>		-	3.275	2.769

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BK1 / <i>Autonomous Mobility Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
In FY 2022, funding decrease reflects planned lifecycle progression of effort to focus on the UAS/UGV information-sharing demonstration at an Engineering Evaluation Test (EET).				
<b>Title:</b> Data Collection for Automated Target Recognition Advanced Research		2.493	-	-
<b>Description:</b> This effort synchronizes and fuses disparate data elements (images, videos, visual compilations, and figures) for machine learning algorithm training to inform automated target recognition.				
<b>Accomplishments/Planned Programs Subtotals</b>		9.308	8.470	6.244
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BK4 / Next Gen Intelligent Fire Control(NG-IFC) Adv Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BK4: Next Gen Intelligent Fire Control(NG-IFC) Adv Tech	-	0.432	8.903	1.727	-	1.727	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project will mature and deliver armament specific hardware, algorithms and architectures to support the Next Generation Combat Vehicle with the necessary fire control on future manned and unmanned platforms.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this Project is related to and fully integrated with the efforts funded in PE 0602145A (Next Generation Combat Vehicle Technology).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Next Generation Intelligent Fire Control	0.432	8.903	1.727
<b>Description:</b> This effort will deliver armament specific hardware, algorithms and architectures to support the Next Generation Combat Vehicle with the necessary fire control on future manned and unmanned platforms.			
<b>FY 2021 Plans:</b> Demonstrate sensor interoperability in a fire control System Integration Lab (SIL) environment. Optimize and integrate hardware and software for beyond line of sight targeting with a forward sensor platform/system. Integrate fire control system, decision-aided algorithms, and targeting hardware in a relevant environment to demonstrate decreased sensor to shooter engagement time for combat vehicle platforms.			
<b>FY 2022 Plans:</b> Will demonstrate reduction of engagement timeline by leveraging advances of fire control technologies for extended range engagements through an improved user interface. Will mature hardware to demonstrate a tailored modular architecture framework.			
<b>FY 2021 to FY 2022 Increase/Decrease Statement:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BK4 / <i>Next Gen Intelligent Fire Control(NG-IFC) Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
Funding decrease in accordance with project lifecycle plans for reduced demonstrations of next generation fire control integrated technologies.				
<b>Accomplishments/Planned Programs Subtotals</b>		0.432	8.903	1.727
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b> N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BK6 / Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BK6: Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech	-	0.489	3.026	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures and demonstrates technologies for large caliber direct fire light-weight armament systems that will exceed the current capability of 120 millimeter (mm) direct fire cannons and be optimized for future operational environment with cross-domain engagement capability. Specifically this effort integrates and demonstrates technologies for rapid fire on-the-move at all elevations (direct & indirect), compact ammunition design with advanced ignition, advanced recoil mitigation to reduce impulse and allow integration onto lighter platforms, automated ammunition handling and reloading. This Project supports open architecture to enable supervised autonomy and remote operation and integrates intelligent fire control to address multi-domain targets from manned and unmanned platforms.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this Project is related to and fully integrated with the efforts funded in Program Element (PE) 0602145A (Next Generation Combat Vehicle Technology) and PE 0604115A (Technology Maturation Initiative).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Advanced Direct In-Direct Armament System (ADIDAS)	0.489	-	-
<b>Description:</b> This effort matures and demonstrates technologies for large caliber direct fire light-weight armament systems that will exceed the current capability of 120mm direct fire cannons and be optimized for future operational environment with cross-domain engagement capability.			
<b>Title:</b> Large Caliber Armament System (LCAS)	-	3.026	-
<b>Description:</b> This effort develops a next generation, automated, lightweight 120-mm armament system design for Next Generation Combat Vehicle, providing tank-like lethality for light medium-weight optionally manned platforms.			
<b>FY 2021 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BK6 / <i>Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
Optimize the weapon mount for increased gun elevations, an automated ammunition handling system, and integration on lighter weight, optionally manned combat vehicles; and mature and demonstrate an improved 120-mm reduced recoil weapon mount with increased lethality for future combat vehicles.  <b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> FY22 funding was realigned to PE 0602181 All Domain Convergence Applied Research / Project CM7 Collaborative Convergence Applied Research. The "Large Caliber Armament System" effort completed in FY 2021; the "Advanced Lethality Armament System - Large Caliber" effort planned to start in FY 2022 is delayed to FY 2023 to allow technology to mature in PE 0602145A (Next Generation Combat Vehicle Technology), Project BK5 (Advanced Direct InDirect Armament System technology).				
<b>Accomplishments/Planned Programs Subtotals</b>		0.489	3.026	-
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b> N/A				

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**Exhibit R-2A, RDT&E Project Justification:** PB 2022 Army **Date:** May 2021

<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology	<b>Project (Number/Name)</b> BP6 / Ground Vehicle Advanced Technology(CA)
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BP6: Ground Vehicle Advanced Technology(CA)	-	100.500	108.000	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**Note**  
Congressional Interest Item funding provided for Ground Vehicle Advanced Technology.

**A. Mission Description and Budget Item Justification**

Congressional Interest Item funding provided for Ground Vehicle Advanced Technology.

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

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2020	FY 2021
<p><b>Congressional Add:</b> Additive Manufacturing for Jointless Hull</p> <p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on Additive Manufacturing for Jointless Hull.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p><b>FY 2021 Plans:</b> Conduct advanced research in Additive Manufacturing for Jointless Hull.</p> <p>Work executed by Army Futures Command.</p>	20.000	10.000
<p><b>Congressional Add:</b> Carbon Fiber and Graphite Foam Technology</p> <p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on Carbon Fiber and Graphite Foam Technology.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p><b>FY 2021 Plans:</b> Conduct advanced research in Carbon Fiber and Graphite Foam Technology.</p> <p>Work executed by Army Futures Command.</p>	10.000	10.000
<p><b>Congressional Add:</b> Hydrogen Fuel Cells</p>	10.000	10.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BP6 / <i>Ground Vehicle Advanced Technology(CA)</i>
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>
<p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on Hydrogen Fuel Cells.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p><b>FY 2021 Plans:</b> Conduct advanced research in Hydrogen Fuel Cells.</p> <p>Work executed by Army Futures Command.</p>		
<p><b>Congressional Add:</b> ATE5.2 Engine Development</p> <p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on ATE5.2 Engine Development.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p><b>FY 2021 Plans:</b> Conduct advanced research in ATE5.2 Engine Development.</p> <p>Work executed by Army Futures Command.</p>	5.000	10.000
<p><b>Congressional Add:</b> Additive Manufacturing of Critical Components</p> <p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on Additive Manufacturing of Critical Components.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p><b>FY 2021 Plans:</b> Conduct advanced research in Additive Manufacturing of Critical Components.</p> <p>Work executed by Army Futures Command.</p>	5.000	5.000
<p><b>Congressional Add:</b> Advanced Water Harvesting Technology</p> <p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on Advanced Water Harvesting Technology.</p> <p>Work executed under the direction of the Army Futures Command.</p>	5.000	-
<p><b>Congressional Add:</b> Advanced High Strength and Lightweight Steels</p> <p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on Advanced High Strength and Lightweight Steels.</p>	3.000	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021	
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BP6 / <i>Ground Vehicle Advanced Technology(CA)</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>	
Work executed under the direction of the Army Futures Command.			
<b>Congressional Add:</b> Combat Vehicle Weight Reduction Initiative <b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on Combat Vehicle Weight Reduction Initiative.	8.000	10.000	
Work executed under the direction of the Army Futures Command. <b>FY 2021 Plans:</b> Conduct advanced research in Combat Vehicle Weight Reduction Initiative.			
Work executed by Army Futures Command.			
<b>Congressional Add:</b> Virtual and Physical Prototyping <b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on Virtual and Physical Prototyping.	8.000	10.000	
Work executed under the direction of the Army Futures Command. <b>FY 2021 Plans:</b> Conduct advanced research in Virtual and Physical Prototyping.			
Work executed by Army Futures Command.			
<b>Congressional Add:</b> HMMWV Augmented Reality System <b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on HMMWV Augmented Reality System.	5.000	-	
Work executed under the direction of the Army Futures Command.			
<b>Congressional Add:</b> Health Usage Monitoring for HMMWV <b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on Health Usage Monitoring for HMMWV.	3.000	-	
Work executed under the direction of the Army Futures Command.			
<b>Congressional Add:</b> HMMWV Autonomy	5.000	3.000	

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BP6 / <i>Ground Vehicle Advanced Technology(CA)</i>
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>
<p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on HMMWV Autonomy.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p><b>FY 2021 Plans:</b> Conduct advanced research in HMMWV Autonomy.</p> <p>Work executed by Army Futures Command.</p>		
<p><b>Congressional Add:</b> HMMWV Torque Monitoring</p> <p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on HMMWV Torque Monitoring.</p> <p>Work executed under the direction of the Army Futures Command.</p>	2.000	-
<p><b>Congressional Add:</b> HMMWV Automotive Enhancements</p> <p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on HMMWV Automotive Enhancements.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p><b>FY 2021 Plans:</b> Conduct advanced research in HMMWV Automotive Enhancements.</p> <p>Work executed by Army Futures Command.</p>	7.500	5.000
<p><b>Congressional Add:</b> Additive Manufacturing</p> <p><b>FY 2020 Accomplishments:</b> Program Increase to support advanced research on Additive Manufacturing.</p> <p>Work executed under the direction of the Army Futures Command.</p>	4.000	-
<p><b>Congressional Add:</b> Program increase - combat vehicle blast testing</p> <p><b>FY 2021 Plans:</b> Conduct advanced research in Combat Vehicle Blast Testing.</p> <p>Work executed by Army Futures Command.</p>	-	6.000
<p><b>Congressional Add:</b> Program increase - advanced adhesives</p> <p><b>FY 2021 Plans:</b> Conduct advanced research in Advanced Adhesives.</p>	-	5.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BP6 / <i>Ground Vehicle Advanced Technology(CA)</i>
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>
Work executed by Army Futures Command.		
<b>Congressional Add:</b> Program increase - combat vehicle lithium 6T battery development <b>FY 2021 Plans:</b> Conduct advanced research in Combat Vehicle Lithium 6T Battery Development.	-	5.000
Work executed by Army Futures Command.		
<b>Congressional Add:</b> Program increase - vehicle technology readiness levels <b>FY 2021 Plans:</b> Conduct advanced research in Vehicle Technology Readiness Levels.	-	2.000
Work executed by Army Futures Command.		
<b>Congressional Add:</b> Program increase - 10X technology demonstration <b>FY 2021 Plans:</b> Conduct advanced research in 10x Technology Demonstration.	-	8.000
Work executed by Army Futures Command.		
<b>Congressional Add:</b> Program increase - HMMWV augmented reality HUD <b>FY 2021 Plans:</b> Conduct advanced research in HMMWV Augmented Reality HUD.	-	5.000
Work executed by Army Futures Command.		
<b>Congressional Add:</b> Program increase - Operator-in-the-loop virtual and physical prototyping <b>FY 2021 Plans:</b> Conduct advanced research in Operator-in-the-Loop Virtual and Physical Prototyping.	-	4.000
Work executed by Army Futures Command.		
<b>Congressional Adds Subtotals</b>	100.500	108.000
<b>C. Other Program Funding Summary (\$ in Millions)</b>		
N/A		
<b>Remarks</b>		
<b>D. Acquisition Strategy</b>		
N/A		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603462A / Next Generation Combat Vehicle Advanced Technology				<b>Project (Number/Name)</b> BZ9 / Smart Targeting Environment for Lower Level Assets			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
BZ9: Smart Targeting Environment for Lower Level Assets	-	-	3.823	3.954	-	3.954	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This Project matures and demonstrates mission targeting support software and algorithms leveraged from the Defense Advanced Research Project Agency (DARPA) System-of-System Enhanced Small Unit (SESU) concepts and technology to enable small units to continuously build and share targeting data and access strike assets in multi-domain operations.

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

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle.

Work in this Project is performed by the United States (US) Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Small Targeting Environment for Lower Level Assets (STELLA )	-	3.823	3.954
<p><b>Description:</b> This effort integrates search, fusion, data dissemination and interoperability algorithms to speed the overall targeting process by: utilizing automated target search algorithms based on mission parameters for processing time, detecting concealed targets and target priority; fusing local data processing of navigation and payload data to increase accuracy for engagement of targets; optimizing data dissemination algorithms based on local network conditions; streamlining interfaces for small units to access joint strike assets.</p> <p><b>FY 2021 Plans:</b> Analyze reports and laboratory models to improve performance of technologies that will be integrated into small unit common operating picture (COP) to identify enemy location and access strike assets; mature tactical automated search algorithms with attribute trade-offs such as speed or detection thresholds.</p> <p><b>FY 2022 Plans:</b> Will incorporate development of improved alignment of non-kinetic strike assets and plan for integration into the COP. Will implement tactical procedure software into Mounted Computing Environment/Mounted Mission Command software baselines. Will continue maturing small unit common operating picture procedural software for strike asset planning and tasking alignment</p>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Army		<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	<b>Project (Number/Name)</b> BZ9 / <i>Smart Targeting Environment for Lower Level Assets</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
both prior to and during missions. Will conduct Soldier touch points and lab/field based demonstrations to assure project is meeting threshold metrics.  <b><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i></b> Increase reflects planned lifecycle of this effort.				
<b>Accomplishments/Planned Programs Subtotals</b>		-	3.823	3.954
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b> N/A				