Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
Total Program Element	-	256.916	60.005	66.707	-	66.707	80.755	84.493	90.308	90.477	0.000	729.661
BK7: *Robotics for Engineer Operations Technology*	-	1.802	6.459	5.436	-	5.436	3.505	2.093	6.574	5.238	0.000	31.107
BL1: *Materials and Manufacturing Research Technology*	-	4.249	4.321	7.779	-	7.779	10.245	10.581	10.762	10.874	0.000	58.811
BL2: *Explosives Forensics Technology*	-	1.612	1.707	1.025	-	1.025	1.026	1.729	1.747	1.765	0.000	10.611
BL5: *Expedient Passive Protection Technology*	-	4.303	2.957	2.726	-	2.726	4.194	4.168	3.464	3.264	0.000	25.076
BL7: *Power Projection in A2AD Environments Technology*	-	1.844	2.963	2.161	-	2.161	3.618	2.572	1.952	1.849	0.000	16.959
BL9: *Protection from Advanced Weapon Effects Technology*	-	5.037	5.211	5.033	-	5.033	4.818	5.523	7.205	6.798	0.000	39.625
BN8: *Ground Technology Materials(CA)*	-	204.900	-	-	-	-	-	-	-	-	0.000	204.900
CG6: *Ground Vehicle Power and Energy Concepts and Tech*	-	2.504	2.605	4.678	-	4.678	6.061	6.015	6.061	6.121	0.000	34.045
CG7: *Ground Protection Concepts and Technologies*	-	12.194	10.473	8.328	-	8.328	10.264	11.548	11.702	11.819	0.000	76.328
CG8: *Human Autonomy Teaming*	-	8.952	9.263	9.284	-	9.284	9.345	9.352	9.467	9.562	0.000	65.225
CI2: *Ground Enabling University Applied Research*	-	3.548	3.906	5.533	-	5.533	4.630	4.633	4.684	4.731	0.000	31.665
CV3: *Engineer Enablers Maneuver, LOG, & Sustainment Apl*	-	2.426	2.195	1.257	-	1.257	4.179	4.030	6.082	7.375	0.000	27.544
DA1: *SAFR Alternatives for Readiness Applied Research*	-	3.545	5.171	4.025	-	4.025	6.545	6.681	6.808	6.876	0.000	39.651

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Army												Date: March 2024
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602144A *I Ground Technology*							
DG1: *Development of Obscurants*	-	-	2.774	2.807	-	2.807	2.811	2.813	2.815	2.844	0.000	16.864
DI7: *Environmental Security Resilience Tech*	-	-	-	6.635	-	6.635	9.514	12.755	10.985	11.361	0.000	51.250

Note

In FY2025, project DI7 / Environmental Security Resilience Tech is a new effort realigned within PE0602144A /Ground Technology from project DA1 / SAFR Alternatives for Readiness Applied Research.

A. Mission Description and Budget Item Justification

This Program element (PE) executes research that support and enable the Army's modernization priority for the Next Generation of Combat Vehicles including systems for the deployment and sustainment of ground movement and maneuver. This PE designs and validates technologies that are necessary and foundational for enduring and future ground movement, maneuver and protection of Soldiers and systems.

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

Work is performed by the Army Research Laboratory (ARL); the Chemical Biological Center (CBC); the Data and Analysis Center (DAC); the University Technology Development Division; the Armaments Center (AC); the Aviation and Missile Center (AVMC); the Soldier Center (SC); the Ground Vehicle Systems Center (GVSC); the Environmental Laboratory; and the Cold Regions Research and Engineering Laboratory; the Construction Engineering Research Laboratory; the Information Technology Laboratory; the Geotechnical and Structures Laboratory.

Work in this PE complements PE 0602145A (Next Generation Combat Vehicle Technology), PE 0603119A (Ground Advanced Technology), PE 0603462A (Next Generation Combat Vehicle Advanced Technology), PE 0602143A (Soldier Lethality Technology) and PE 0603118A (Soldier Lethality Advanced Technology).

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Army					Date: March 2024
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*		R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*			
B. Program Change Summary ($ in Millions)	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**
Previous President's Budget	264.523	60.005	69.110	-	69.110
Current President's Budget	256.916	60.005	66.707	-	66.707
Total Adjustments	-7.607	0.000	-2.403	-	-2.403
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-6.998	-			
• SBIR/STTR Transfer	-0.609	-			
• Adjustments to Budget Years	-	-	-2.403	-	-2.403

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2023	FY 2024
Project: BN8: *Ground Technology Materials(CA)*		
Congressional Add: *Program increase - INTEGRITY OF TRANSPARENT ARMOR*	4.400	-
Congressional Add: *Program increase - ENVIRONMENTAL QUALITY ENHANCED COATINGS*	5.000	-
Congressional Add: *Program increase - MATERIALS RECOVERY TECHNOLOGIES FOR DEFENSE SUPPLY RESILIENCY*	10.000	-
Congressional Add: *Program increase - RAPID ADVANCED DEPOSITION*	10.000	-
Congressional Add: *Program Increase - RARE EARTH INITIATIVE*	10.000	-
Congressional Add: *Program Increase - VERIFIED INHERENT CONTROL*	10.000	-
Congressional Add: *Program Increase - ADVANCED CERAMIC TECHNOLOGIES*	2.000	-
Congressional Add: *Program Increase - ALTERNATIVE ENERGY RESEARCH*	20.000	-
Congressional Add: *Program Increase - AUTONOMOUS DIGITAL DESIGN*	5.000	-
Congressional Add: *Program Increase - CARBON NANOMATERIALS AS FUNCTIONAL ADDITIVES*	6.500	-
Congressional Add: *Program Increase - COLD REGION RESEARCH*	5.000	-
Congressional Add: *Program Increase - DEFENSE RESILIENCY AGAINST EXTREME COLD WEATHER*	11.000	-
Congressional Add: *Program Increase - DEFENSE RESILIENCY PLATFORM ADDRESSING EXTREME COLD WEATHER*	10.000	-
Congressional Add: *Program Increase - DETECTION AND DEFEAT OF BURIED MUNITIONS*	4.000	-
Congressional Add: *Program Increase - EARTHEN STRUCTURES SOIL ENHANCEMENT*	4.000	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Army	Date: March 2024
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602144A *I Ground Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2023	FY 2024
Congressional Add: *Program Increase - ELECTROLYZER*	7.000	-
Congressional Add: *Program Increase - EXTREME BATTERY TECHNOLOGIES*	10.000	-
Congressional Add: *Program Increase - FLEXIBLE HYBRID ELECTRONICS*	15.000	-
Congressional Add: *Program Increase - FUNCTIONAL POLYMERIC MATERIALS AND COMPOSITES FOR EXTREME TEMPERATURE ENVIRONMENTS*	5.000	-
Congressional Add: *Program Increase - GROUND TECHNOLOGY FOR CHEMICAL AND BIOLOGICAL DEFENSE*	1.000	-
Congressional Add: *Program Increase - HIGH PERFORMANCE POLYMER COMPOSITES AND COATINGS*	10.000	-
Congressional Add: *Program Increase - LIGHTWEIGHT HIGH ENTROPY METALLIC ALLOY DISCOVERY COLLABORATION*	5.000	-
Congressional Add: *Program Increase - LOGISTICS OVER-THE-SHORE CAPABILITIES*	10.000	-
Congressional Add: *Program Increase - POLAR PROVING GROUND*	5.000	-
Congressional Add: *Program Increase - PROTECTIVE COATINGS*	10.000	-
Congressional Add: *Program Increase - ULTRA-HIGH DENSITY STORAGE*	10.000	-
Congressional Add Subtotals for Project: BN8	204.900	-
Congressional Add Totals for all Projects	204.900	-

Change Summary Explanation

FY 2025 changes are due to reprioritization of resources across the Science and Technology portfolio.

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) BK7 / *Robotics for Engineer Operations Technology*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
BK7: *Robotics for Engineer Operations Technology*	-	1.802	6.459	5.436	-	5.436	3.505	2.093	6.574	5.238	0.000	31.107

A. Mission Description and Budget Item Justification

This research investigates and develops standoff robotic capabilities to reduce Soldier/Combat Engineer risks and fatalities while conducting activities essential to shaping the environment. It will close the gaps between commercial construction equipment and the requirements of the future Engineer Force to support maneuver, movement, and sustainment. This research will develop the capability to generate a near real-time site model with appropriate engineering details to allow unmanned system shaping of the environment through physical interaction (e.g., push, pull, lift, or dig). This effort will also develop the requisite mission planner and task execution controller that accepts input from the user and provides suggestions and feedback based on updates to the site model, reporting from hardware agents, and resource allocation logic. The end state goal is the development of beyond line of sight teleoperation and semiautonomous capabilities allowing Engineer robotic support to match pace in future combat environments. This effort will support the development, testing, and evaluation of prototypical robotic Combat Engineer equipment. This Project develops modeling and simulation tools that represent realistic states for Engineer robotic operations and develops and assesses semi-autonomous and autonomous construction equipment technologies needed for remote control Engineer operations.

Work in this Project complements Program Element (PE) 0603119A (Ground Advanced Technology) / Project BK8 (Robotics for Engineer Operations Advanced Technology).

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

Work in this Project is coordinated with Program Element (PE) 0603462A (Next Generation Combat Vehicle Advanced Technology).

Work in this Project is performed by the United States Army Engineer Research and Development Center Construction Engineering Research Laboratory, Information Technology Laboratory, and Geotechnical and Structures Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Semi-Autonomous Engineer Operations	1.802	6.459	5.436
Description: This effort investigates and develops robotic machine tools and behaviors to perform semi-autonomous shaping of the terrain through physical interaction with the environment (push, pull, lift, and dig). The effort develops the necessary decision-making, data fusion, localization, and inter-platform communication to allow semi-autonomy on commercial off the shelf (COTS) equipment.			
FY 2024 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BK7 / *Robotics for Engineer Operations Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will adapt and validate autonomous path planning and movement control algorithms, developed during previous efforts, to apply to heavy Engineer equipment. Will enhance simulation environment with the design and development of machine-learning based terrain shaping algorithms to enable autonomous execution of a simple repetitive Combat Engineer task using single type of heavy Engineer equipment. ***FY 2025 Plans:*** Will develop expanded autonomy algorithms for heavy Engineer equipment manipulation of terrain (e.g., blade and bucket). Will validate negative obstacle detection and characterization implemented on heavy Engineer equipment. Will conduct experiments on automated terrain shaping operations to remove negative obstacles. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects the planned reduction of workflows as technologies are transitioned for maturation and demonstration.			
Accomplishments/Planned Programs Subtotals	1.802	6.459	5.436

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) BL1 / *Materials and Manufacturing Research Technology*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
BL1: *Materials and Manufacturing Research Technology*	-	4.249	4.321	7.779	-	7.779	10.245	10.581	10.762	10.874	0.000	58.811

A. Mission Description and Budget Item Justification

This Project links materials research, manufacturing processes, and design to enable high quality additive manufacturing products for Army applications through the development of high-performance feedstock materials (polymers, metals, and ceramics), physics-based process models, and in-situ process monitoring. Integration of these tools with process models enables real-time control and manipulation of material structure and properties to produce three-dimensional hybrid electronics packaging, power and energy sources and converters and new materials/structures for protection. The goal of this work is to develop robust physics-based models to optimize material properties, structures, and manufacturing processes for Army applications in protection, maneuver, power, sensing, and signature management necessary to rapidly respond to emerging and unknown threats in a battlefield environment.

This work is done in coordination with Program Element (PE) 0602145A (Next Generation Combat Vehicle Technology), 0602143A (Soldier Lethality Technology) and 0603118A (Soldier Lethality Advanced Technology).

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

Work in this Project is performed by the Army Research Laboratory (ARL)

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Additive Manufacturing Research	3.348	3.382	3.383
Description: This effort Investigates new additive manufacturing (AM) capabilities that enable production of lightweight materials for protection, survivability, and maneuverability that cannot be produced through traditional manufacturing methods. Efforts include the design and development of new feedstock materials engineered specifically for low-volume additive processes to produce net-shape materials with desired properties and functionalities; integrated process models and real-time monitoring for closed-loop control and production of lightweight materials with optimal architectures, property gradients, and interfaces; and design optimization capabilities that connect materials and manufacturing to access the full design space enabled by additive manufacturing. ***FY 2024 Plans:*** Will validate machine learning guided process control for metal AM builds of munition components; design printed munition casings with microstructure driven fragmentation schemes using novel next generation alloys; validate modeling tools that predict the fragmentation behavior of printed metals based on process specific thermal history for precision control of lethality; validate			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BL1 / *Materials and Manufacturing Research Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
full 3-Dimensional electronic processes, milled circuit traces, conductive traces, circuit component placement in microcontroller, and seeker circuits for Army-relevant applications; validate high accelerative loading conditions on printed electronics to determine that AM conformal electronics can withstand accelerative loading; finalize development of integrated circuits, fuze, and initiators for high g-force reliability. ***FY 2025 Plans:*** Will assess printed fragmenting munition casing of novel metal alloys for active protection and explore improved conversion of casing-to-fragmentation to increase lethality; develop advanced manufacturing feedstock alloys and explore recycled feedstocks for advanced manufacturing; investigate controlled warhead fragmentation methods and develop methods to tailor fragmentation patterns; assess ultra-high strength steel and high strength/lightweight alloys for vehicle protection; investigate novel methods of creating controlled warhead fragmentation for higher energy density munition propulsion and consistent burn performance; develop and mature materials and processes for cost effective light weighting of combat vehicles for indirect fire platforms; assess 3D printed electronics for fuzing, guidance, navigation, and control (GNC), and communication links for high g-force survivability; optimize tailored fragmentation pattern utilizing computational optimization of tailored fragmentation utilization advanced manufacturing techniques. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Title: Energy Sources and Storage ***Description:*** This effort focuses on the design and characterization of chemistries, materials, and components for advanced batteries, fuel reformers, and fuel cells. Potential Army applications include hybrid power sources, smart munitions, hybrid power vehicles, and soldier power applications. This effort also investigates the applicability of photosynthesis to provide fuel and electricity for Soldier power applications and investigates silicon carbide power module components that could enable compact, high-efficiency, high-temperature, and high-power density converters for motor drive and pulse power applications. ***FY 2024 Plans:*** Will identify most promising compositions and methods for chemical modification of silicon as high capacity Li-ion battery anode; characterize the nature, quality, and robustness of the solid electrolyte interface layer forming at the silicon anode-electrolyte interface to determine its ability to provide necessary passivation (chemical process) of the Li-ion battery anode, and its impact on charge rate, temperature, and cycle life performance; explore Li-ion battery safety, through thermal, electrical short, and penetration assessments; investigate spinel, garnet, and monolithic solid electrolyte interphase (SEI), and complementary electrode integration for high energy Li-ion batteries; explore low-cobalt or cobalt-free, high-voltage, and high-capacity battery cathodes. ***FY 2025 Plans:***	0.901	0.939	0.945

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BL1 / *Materials and Manufacturing Research Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will identify and assess electrolytes compatible with silicon anode batteries to optimize cycle life, charge rate, thermal stability, and low temperature performance; determine the failure modes of chemically modified silicon anodes and the stability as a function of utilization and pressure; investigate the origin of safety issues in both graphite and silicon anode high energy battery cells that are new and have been recharged many times; investigate thermal behavior of Lithium (Li)-ion battery cells at elevated temperatures; investigate the thermal stability of low cobalt or cobalt free high energy battery cathodes; assess Li-ion battery cells using oxide and rock-salt based anodes; investigate fast ion conductors for monolithic solid electrolytes, and complementary electrode integration for high energy Li-ion batteries. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Title: Novel Armor Materials and Processes for Vehicle Protection ***Description:*** This effort designs, develops, fabricates, and assesses a variety of materials (e.g. metals, ceramics, polymers, and composites) to enable more survivable, lighter weight armor, protection, and electronics for vehicle structures. Research focuses on novel material properties, developing physics-based models, materials characterization techniques, non-destructive testing methods, and traditional and advanced fabrication/processing methods to transition candidate solutions for maturation, scale-up, and integration into Army systems. ***FY 2025 Plans:*** Will continue work restructured from PE 0602145A, Project BI4 Materials Application and Integration Tech, to develop lightweight, low cost, damage resistant transparent armor glass/polymer laminates with optical transmissivity at wavelengths suitable for personnel and sensor protection; assess transparent armor material processing methodologies; develop new materials or laminates for vehicle and sensor protection; assess performance of dissimilar material joints (welded, solid state, adhesively joined) under high rate/complex loading conditions; design and develop weldable high toughness, high hard steel armor plate; assess novel metals for ground vehicle propulsion systems. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding restructured from Program Element (PE) 0602145A (Next Generation Combat Vehicle Technology) / Project BI4 (Materials Application and Integration Tech).	-	-	3.451
Accomplishments/Planned Programs Subtotals	4.249	4.321	7.779

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BL1 / *Materials and Manufacturing Research Technology*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army										Date: March 2024		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*				Project (Number/Name) BL2 / *Explosives Forensics Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
BL2: *Explosives Forensics Technology*	-	1.612	1.707	1.025	-	1.025	1.026	1.729	1.747	1.765	0.000	10.611

A. Mission Description and Budget Item Justification

This Project investigates and develops analytical methods for the trace detection of military explosives, homemade explosives (HME), and solid chemical hazards found on contaminated surfaces. This project pursues research in signatures and algorithms required to provide improved trace analysis of chemical hazards to enable integration and augmentation into chemical and explosive detection equipment for the warfighter.

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

Work in this Project is performed by the Chemical Biological Center (CBC)

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Forensic Analysis of Explosives Signatures Applied Research	1.612	1.707	1.025
Description: This effort investigates forensics analytical methods for military explosives, homemade explosives (HME), HME precursors, and residue analysis for attribution. ***FY 2024 Plans:*** Will further mature collimated Raman system for real time detection of liquid and solid visual and non-visual contaminated surfaces; continue to examine surface-enhanced Raman spectroscopy nano-metallic substrates to augment normal Raman handheld devices for trace level detection of explosives and opioids, and continued development of chemical depositions systems for quantifiable test standards for point and standoff sensors. ***FY 2025 Plans:*** Will continue to investigate candidate new technology phenomenon to improve and enhance the location and detection of trace level solid explosive contamination on surfaces, focusing on bio-inspired explosive and chemical sensing technology, implementation of machine learning techniques, and impedance-based spectroscopy. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change is consistent with the planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	1.612	1.707	1.025

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BL2 / *Explosives Forensics Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) BL5 / *Expedient Passive Protection Technology*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
BL5: *Expedient Passive Protection Technology*	-	4.303	2.957	2.726	-	2.726	4.194	4.168	3.464	3.264	0.000	25.076

A. Mission Description and Budget Item Justification

This Project designs and develops rapidly deployable passive protective solutions; algorithms for decision support applications and software; and tactics, techniques, and procedures to increase the survivability of personnel, critical assets, and facilities. Through experimental and computational investigation and design, this project develops force protection technologies for complex and urban environments. This Project also develops expedient solutions and decision support applications for protection against advanced energetic threats and large caliber rockets, missiles, and other emerging weapons.

Work in this Project complements Program Element (PE) 0603119A (Ground Advanced Technology) / Project BL6 (Expedient Passive Protection Advanced Technology).

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Assessments of Solutions for Survivability from Emerging Threats (ASSET)	4.303	2.957	-
Description: This effort investigates emerging threat weapon effects on critical assets, theater of operation facilities, and existing protection technologies; designs and develops rapidly deployable passive protective solutions; algorithms for decision support applications and software; and tactics, techniques, and procedures to increase the survivability of personnel, critical assets, and facilities against emerging threats, such as high trajectory large caliber rockets and missiles as well as Unmanned Aircraft Systems (UAS) threats. This effort integrates experimental and computational analysis. ***FY 2024 Plans:*** Will conduct experiments of newly designed rapidly deployable protection systems against emerging threats, such as large caliber rockets and missiles and will enhance high-fidelity models and fast-running algorithms to predict emerging threat effects. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned completion of this effort and transition to PE 0603119 / Project BL6 (Expedient Passive Protection Advanced Technology).			
Title: Deliberate Expedient Protection for Large-scale Operations Yielding Survivability (DEPLOYS)	-	-	2.726

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BL5 / *Expedient Passive Protection Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Description: This effort investigates expedient survivability solutions for large-scale combat operations; designs and develops expediently employed operationally feasible protective solutions; develops algorithms for decision support applications to incorporate multiple aspects of survivability; and develops tactics, techniques, and procedures (TTPs) to increase the survivability of personnel and assets at critical sites such as logistical supply locations with considerations for operations in varying climate, vegetation, and terrain environments. ***FY 2025 Plans:*** Will investigate the protection requirements for logistic supply locations associated with large-scale combat operations with considerations for multiple aspects of survivability, and investigate the variability of blast and ballistic response of protection materials when employed in relevant operational environments. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned initiation of this effort.			
Accomplishments/Planned Programs Subtotals	4.303	2.957	2.726

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) BL7 / *Power Projection in A2AD Environments Technology*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
BL7: *Power Projection in A2AD Environments Technology*	-	1.844	2.963	2.161	-	2.161	3.618	2.572	1.952	1.849	0.000	16.959

A. Mission Description and Budget Item Justification

This Project designs and develops remote assessment technologies to determine entry and maneuver corridors, develops site selection tools and decision support technologies for all climates in all season conditions including aviation site selection tools, enhanced automated route reconnaissance technologies, mobility models for extreme climates, and road capacity assessment technologies. These technologies reduce reliance on manned on-site reconnaissance for projection platform assessments and provide all season capacity predictions to ensure air and ground battlespace entry and maneuver. This Project also designs and develops material solutions to repair, rebuild and construct infrastructure required for movement and maneuver in highly contested, complex operational environments such as Anti-Access/Area Denial (A2/AD).

Work in this PE complements PE 0603119A (Ground Advanced Technology) / Project BL8 (Power Projection in A2AD Environments Adv Tech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center Geotechnical and Structures Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Engineering for Battlespace Maneuver	1.844	2.963	-
Description: This effort develops the capability to rapidly repair and upgrade damaged infrastructure along mobility corridors and restaging areas to maintain and enhance freedom of maneuver achieving tactical advantage in contested complex environments. ***FY 2024 Plans:*** Will develop a framework for automated decision support tools that will determine requirements for planning tools to task route repair and upgrades; will develop optimization routine for selecting equipment and materials to perform repair missions. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned completion of this effort and transition to PE 0603119A / Project BL8 (Power Projection in A2AD Environments Adv Tech).			
Title: Force Projection in Multi-Domain Operations	-	-	2.161
Description: This effort develops capabilities for maneuver across air/land/sea domains using Combat Engineer assets to assess, modify, and upgrade transitional regions (such as beaches and coastal swamps) critical to force projection. Develops new methodologies for reconnaissance and analysis methods to provide predictive capabilities for selecting and prioritizing maneuver			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BL7 / *Power Projection in A2AD Environments Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
corridors for ground forces. Develops technologies that enable movement and maneuver through expanded terrain environments (i.e., soil stabilization) for distributed operations. ***FY 2025 Plans:*** Will conduct site investigations in multiple littoral environments and determine vehicle mobility performance limitations; will develop scaled designs of site stabilization material or loose sand soils; will complete laboratory testing of geotextile materials (strong permeable fabrics used in construction and soil stabilization) available for fabrication. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned initiation of this effort.			
Accomplishments/Planned Programs Subtotals	1.844	2.963	2.161

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) BL9 / *Protection from Advanced Weapon Effects Technology*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
BL9: *Protection from Advanced Weapon Effects Technology*	-	5.037	5.211	5.033	-	5.033	4.818	5.523	7.205	6.798	0.000	39.625

A. Mission Description and Budget Item Justification

This Project designs and develops structural hardening, high-performance computing capabilities, and force protection technologies to enhance survivability of personnel and critical assets. This project investigates and develops advanced materials for protection against blast, fragmentation, and penetration through physical experiments and modeling and simulation. Additionally, this project investigates, designs, and develops passive protection technologies and protective design criteria to mitigate attack from emerging advanced threats.

Work in this Program Element (PE) complements PE 0603119A (Ground Advanced Technology) / Project BM1 (Protection from Advanced Weapon Effects Adv Tech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center Geotechnical and Structures Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Advanced Materials and Modeling for Force Protection	1.548	1.595	1.598
Description: This effort designs and develops capabilities in the use of poorly-understood and indigenous materials. This effort develops multi-scale material modeling frameworks incorporating physics of deformation and damage mechanisms; a 3D multi-physics material modeling capability to allow for weapons effects models to be informed by remote sensing; and advanced material technologies for force protection.			
FY 2024 Plans: Will implement thermodynamics-based geomaterial modeling into multi-scale modeling framework; investigate advanced composite, metal, and hybrid materials developed through materials-by-design approaches; and will investigate system-level integration of advanced materials into force protection systems.			
FY 2025 Plans: Will mature component-level materials-by-design tools to further advance materials and manufacturing approaches . Will focus on materials inspired by geological systems (e.g., rock, clay, granular materials) for structural hardening as well as lightweight and small form factor materials for force protection requirements.			
FY 2024 to FY 2025 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BL9 / *Protection from Advanced Weapon Effects Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding increase is an economic adjustment.			
Title: Protection from Advanced Penetrators ***Description:*** This effort designs and develops protective material solutions and enhances modeling and simulation (M&S) tools for designing, analyzing and improving these advanced protective materials to be used in large hardened protective structures; investigates and validates computational models and passive protective solutions for large hardened structures from advanced precision penetrating threat weapons. ***FY 2024 Plans:*** Will design, develop and conduct sub-scale experiments to predict weapon effects from advanced penetrators on protective structures. Will update M&S based on experiments. ***FY 2025 Plans:*** Will develop and validate efficient modeling and simulation (M&S) tools to support planning, designing, constructing, and maintaining hardened protective structures to mitigate the weapons effects of advanced penetrators of peer and near peer adversaries. Will enhance the M&S tools for high fidelity analyses and damage prediction of hardened protective structures from increased velocity advanced penetrators. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned milestones for this effort.	3.489	3.616	3.435
Accomplishments/Planned Programs Subtotals	5.037	5.211	5.033

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) BN8 / *Ground Technology Materials(CA)*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
BN8: *Ground Technology Materials(CA)*	-	204.900	-	-	-	-	-	-	-	-	0.000	204.900

Note

Congressional Interest Item funding provided for Ground Technology Materials.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Ground Technology Materials.

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 2023	FY 2024
Congressional Add: Program increase - INTEGRITY OF TRANSPARENT ARMOR ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Integrity of Transparent Armor	4.400	-
Congressional Add: Program increase - ENVIRONMENTAL QUALITY ENHANCED COATINGS ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Environmental Quality Enhanced Coatings	5.000	-
Congressional Add: Program increase - MATERIALS RECOVERY TECHNOLOGIES FOR DEFENSE SUPPLY RESILIENCY ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Materials Recovery Technologies for Defense Supply Resiliency	10.000	-
Congressional Add: Program increase - RAPID ADVANCED DEPOSITION ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Rapid Advanced Deposition	10.000	-
Congressional Add: Program Increase - RARE EARTH INITIATIVE ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Rare Earth Initiative	10.000	-
Congressional Add: Program Increase - VERIFIED INHERENT CONTROL ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Verified Inherent Control	10.000	-
Congressional Add: Program Increase - ADVANCED CERAMIC TECHNOLOGIES	2.000	-

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BN8 / *Ground Technology Materials(CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024
FY 2023 Accomplishments: Congressional Interest Item funding provided for Advanced Ceramic Technologies		
Congressional Add: Program Increase - ALTERNATIVE ENERGY RESEARCH ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Alternative Energy Research	20.000	-
Congressional Add: Program Increase - AUTONOMOUS DIGITAL DESIGN ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Autonomous Digital Design	5.000	-
Congressional Add: Program Increase - CARBON NANOMATERIALS AS FUNCTIONAL ADDITIVES ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Carbon nanomaterials as Functional Additives	6.500	-
Congressional Add: Program Increase - COLD REGION RESEARCH ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Cold Region Research	5.000	-
Congressional Add: Program Increase - DEFENSE RESILIENCY AGAINST EXTREME COLD WEATHER ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Defense Resiliency Against Extreme Cold Weather	11.000	-
Congressional Add: Program Increase - DEFENSE RESILIENCY PLATFORM ADDRESSING EXTREME COLD WEATHER ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Defense Resiliency Platform Addressing Extreme Cold Weather	10.000	-
Congressional Add: Program Increase - DETECTION AND DEFEAT OF BURIED MUNITIONS ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Detection and Defeat of Buried Munitions	4.000	-
Congressional Add: Program Increase - EARTHEN STRUCTURES SOIL ENHANCEMENT ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Earthen Structures Soil Enhancement	4.000	-
Congressional Add: Program Increase - ELECTROLYZER ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Electrolyzer	7.000	-
Congressional Add: Program Increase - EXTREME BATTERY TECHNOLOGIES	10.000	-

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BN8 / *Ground Technology Materials(CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024
FY 2023 Accomplishments: Congressional Interest Item funding provided for Extreme Battery Technologies		
Congressional Add: Program Increase - FLEXIBLE HYBRID ELECTRONICS	15.000	-
FY 2023 Accomplishments: Congressional Interest Item funding provided for Flexible Hybrid Electronics		
Congressional Add: Program Increase - FUNCTIONAL POLYMERIC MATERIALS AND COMPOSITES FOR EXTREME TEMPERATURE ENVIRONMENTS	5.000	-
FY 2023 Accomplishments: Congressional Interest Item funding provided for FUNCTIONAL POLYMERIC MATERIALS AND COMPOSITES FOR EXTREME TEMPERATURE ENVIRONMENTS		
Congressional Add: Program Increase - GROUND TECHNOLOGY FOR CHEMICAL AND BIOLOGICAL DEFENSE	1.000	-
FY 2023 Accomplishments: Congressional Interest Item funding provided for GROUND TECHNOLOGY FOR CHEMICAL AND BIOLOGICAL DEFENSE		
Congressional Add: Program Increase - HIGH PERFORMANCE POLYMER COMPOSITES AND COATINGS	10.000	-
FY 2023 Accomplishments: Congressional Interest Item funding provided for High Performance Polymer Composites and Coatings		
Congressional Add: Program Increase - LIGHTWEIGHT HIGH ENTROPY METALLIC ALLOY DISCOVERY COLLABORATION	5.000	-
FY 2023 Accomplishments: Congressional Interest Item funding provided for Lightweight High Entropy Metallic Alloy Discovery Collaboration		
Congressional Add: Program Increase - LOGISTICS OVER-THE-SHORE CAPABILITIES	10.000	-
FY 2023 Accomplishments: Congressional Interest Item funding provided for Logistics Over-The-Shore Capabilities		
Congressional Add: Program Increase - POLAR PROVING GROUND	5.000	-
FY 2023 Accomplishments: Congressional Interest Item funding provided for Polar Proving Ground		
Congressional Add: Program Increase - PROTECTIVE COATINGS	10.000	-
FY 2023 Accomplishments: Congressional Interest Item funding provided for Protective Coatings		
Congressional Add: Program Increase - ULTRA-HIGH DENSITY STORAGE	10.000	-

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** BN8 / *Ground Technology Materials(CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024
FY 2023 Accomplishments: Congressional Interest Item funding provided for Ultra-High Density Storage		
Congressional Adds Subtotals	204.900	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) CG6 / *Ground Vehicle Power and Energy Concepts and Tech*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CG6: *Ground Vehicle Power and Energy Concepts and Tech*	-	2.504	2.605	4.678	-	4.678	6.061	6.015	6.061	6.121	0.000	34.045

A. Mission Description and Budget Item Justification

This Project investigates and develops advanced power and energy technologies for combat ground vehicles that are necessary for parallel hybrid, series hybrid, and all- electric vehicle systems. This Project investigates, designs, and develops electric conversion technologies to reduce size and weight of military vehicles while increasing performance and capabilities to support current and future mission loads and provide improved military vehicle mobility.

Work in this Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology) / PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

Work in this Project is performed by the Army Research Laboratory (ARL) and Data and Analysis Center (DAC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Advanced Distributed Power for Autonomous Systems	2.504	0.955	0.449
Description: This effort designs and develops technologies for electrification of both manned and unmanned Next Generation Combat Vehicle platforms. Electrification of these platforms will enable advanced lethality and protection systems, reduced battlefield fuel consumption, and provide new capabilities such as burst acceleration, extended silent mobility, and silent watch. The effort investigates, designs, and develops electric conversion technologies to reduce size and weight while increasing performance and capabilities to support current and future mission loads and provide improved military vehicle mobility. Research focuses on high power/ temperature power electronics, magnetic gears, electric drive motors, and adaptive device and component level control that optimized operation in real time. Investigation of advanced control methods at the module and conversion component levels provides an understanding of the impact real time optimization and energy tracking can have on power conversion optimization and mission effectiveness. The research enables the integration of component state and behavior into system level management algorithms that support non-autonomous and autonomous operations while providing modular and scalable electrification architectures. Efforts will also investigate non-contact magnetic gear technologies coupled with electrical motors and generators to reduce size and weight with an increase in reliability and performance through increased torque and speed operational range. Results of the research inform PE 0602145A (Next Generation Combat Vehicle Technology) / BH5 (Platform Electrification and Mobility Tech).			
FY 2024 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** CG6 / *Ground Vehicle Power and Energy Concepts and Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will experimentally validate battery charger and characterize battery charger performance. Will validate battery management concepts and characterize effect of battery management concepts. ***FY 2025 Plans:*** Will validate battery charger performance against military relevant metrics; enhance charger models based on performance analysis. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned lifecycle of this effort.			
Title: Power Conversion for Platforms ***Description:*** This effort investigates, designs, and assesses technologies for platform electrification that will reduce Army impact to the environment through electrified systems that more effectively utilize energy and improve resiliency. Transitioning to hybrid electric and all electric platforms provides improved energy utilization while reducing emissions providing the Warfighter increased capabilities. Reduction in impact to the environment also improves Warfighter survivability by reducing emissions that can be used for tracking and locating. Research focuses on material and design concepts for compact high-power transformers required by power conversion components, fabrication of new power semiconductor packaging, and advances in control and component power management methods. ***FY 2024 Plans:*** Will utilize co-design and co-engineering methodologies and laboratory experiments to validate performance of advanced power packaging concepts to increase efficiency, power transfer, and reliability. Will experimentally validate component level monitoring and control concepts and determine performance of prediction and optimization control algorithms. Will validate advanced transformer designs and thermal performance under high power. ***FY 2025 Plans:*** Will mature thermo-mechanical co-design and co-engineering models through the addition of circuit and electrical analysis capabilities; investigate high voltage power packaging concepts that utilize active material control to vary material properties in-situ; investigate energy-informed mission optimization methods to better manage energy distribution; develop transformer models based on experimental validation. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.	-	1.650	2.204
Title: Prognostics and Predictive Maintenance Data Science and Analytics ***Description:*** This effort investigates Predictive Logistics capabilities to enable the Army to execute Unified Action in Multi-Domain Operations (MDO) by 2030. The effort also develops Predictive Logistics methodologies and analytics to inform the design of	-	-	2.025

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** CG6 / *Ground Vehicle Power and Energy Concepts and Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Army 2040 by delivering Decision Dominance through the integration of Mission Command and Readiness to provide capabilities ahead of need to generate and sustain combat power. As part of the overall Predictive Logistics efforts, research focuses on the tasks, conditions, and standards required to achieve Prognostics and Predictive Maintenance and development of accurate predictions of component and system failures within Army systems. The outcomes provide the Army with greater understanding of when equipment/system performance is degraded or about to be degraded, optimizing Readiness and maximizing combat power. ***FY 2025 Plans:*** Will investigate the taxonomy for components of Prognostics and Predictive Maintenance associated or beginning with Army ground systems; Will begin to develop ground system/component algorithms using advanced Artificial Intelligence and Machine Learning techniques; Will identify performance metrics for maturation of ground system health assessment methodologies, diagnostic requirements, and component and/or platform life prediction techniques and standards. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Increase in FY2025 reflects initiation of ground system/component algorithms development and investigation of the taxonomy for components of Prognostics and Predictive Maintenance.			
Accomplishments/Planned Programs Subtotals	2.504	2.605	4.678

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) CG7 / *Ground Protection Concepts and Technologies*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CG7: *Ground Protection Concepts and Technologies*	-	12.194	10.473	8.328	-	8.328	10.264	11.548	11.702	11.819	0.000	76.328

A. Mission Description and Budget Item Justification

This Project investigates advanced materials and mechanisms to defeat the most common and most dangerous threats that are expected to be encountered by our ground forces in near-, mid-, and far-term. This Project also designs and develops experimental and computational tools and techniques (high resolution instrumentation to observe impact events, theories, and algorithms to explain these phenomena and numerical implementation of these algorithms) for the development of mass-efficient armor mechanisms. This project designs and develops armor mechanisms that will be integrated to create multi-threat armor technologies and form the building blocks for Adaptive and Cooperative Protection Technologies in the Advanced Concepts for Active Defense Project (Program Element (PE) 0602145A Next Generation Combat Vehicle Technology). Additionally, research will focus on subcomponent/component models to predict performance of early concepts and the means to assess effectiveness on ground platforms. The Project will balance designs and developments of active threat defeat measures with the necessary advanced passive and reactive components that will ultimately provide for full system solutions which meet the requirements of current and next generation ground tactical and combat vehicles.

This Project is coordinated with and transition to Projects in PE 0603462A (Next Generation Combat Vehicle Advanced Technology), PE 0602145A (Next Generation Combat Vehicle Technology), and builds upon weapon target interaction research in PE 0601102A (Defense Research Sciences) / Project AA7 (Mechanics and Ballistics).

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

Work in this Project is performed by the Army Research Laboratory (ARL).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Advanced Armor and Protection Technologies	7.136	5.241	3.101
Description: This effort designs and develops the next generation of lightweight protective concepts and technologies for defeat of current and future threats by combining real-time information and threat knowledge to provide increased protection. This effort investigates the fundamental physics of new terminal effects concepts and provides an understanding of interaction between the platform's defeat mechanism and the threat. The effort also investigates the ability to analytically simulate complex threat interactions. Experiments will be conducted to validate the efficacy of the designs.			
FY 2024 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** CG7 / *Ground Protection Concepts and Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will validate the predictive modeling capability of advanced armor with an emphasis on hybrid armor systems and armor efficiency; incorporate machine learning (ML) / high-throughput data directly into simulations to design new materials for specific threats; explore coupling laser shock experiments to reduce uncertainty in material behavior. ***FY 2025 Plans:*** Will design layered armor systems with unique heat treatments configured for a range of threats; design dynamic indentation apparatus and associated simulation framework to assess strength, strain hardening, strain rate, and temperature performance of materials. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decreased in Fiscal Year (FY) 2025 to support research in Decisive Lethality in PE 0602145A (Next Generation Combat Vehicle Technology) Project BK5 (Adv Direct In-Direct Armament Sys (ADIDAS) Tech).			
Title: Computational and Experimental Capability	5.058	5.232	5.227
Description: This effort will design and develop computational design tools along with diagnostic and experimental capabilities that support the development of advanced protection systems. Such systems include passive, active, and hybrid solutions for defeating (multiple) anti-armor threats and exploit solid-dynamic, explosive-driven, and magneto-hydrodynamic target interactions. This work allows for predicting armor performance and understanding mechanisms regardless of vehicle platform, with improved and quantified confidence. This effort leverages the Department of Defense and Department of Energy (DOE) Technical Coordination Group Memorandum of Agreement and directly leverages DOE investments in computational platforms for problems in solid dynamics and impact mechanics. ***FY 2024 Plans:*** Will design and develop combined explosive effects mechanism software which, coupled with experimental data, will enable the rapid assessment of threats against existing and future armor designs; explore experimental diagnostics for explosive effects to improve understanding of threat loading on armor solutions; conduct computational studies of armor mechanisms to assess the defeat of current and future shape charge threats; develop multi-physics model enhancements to continue to improve the capability to assess threats and armor mechanisms to defeat those threats. ***FY 2025 Plans:*** Will design and develop enhanced computational modeling and simulation tools to assess threat explosives, running on High Performance Computing systems to shorten development times for new advanced armor concepts; develop techniques to measure electromagnetic fields during dynamic experiments and enhance material models to improve fundamental understanding of complex armor designs. ***FY 2024 to FY 2025 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** CG7 / *Ground Protection Concepts and Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	12.194	10.473	8.328

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*				Project (Number/Name) CG8 / *Human Autonomy Teaming*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
CG8: *Human Autonomy Teaming*	-	8.952	9.263	9.284	-	9.284	9.345	9.352	9.467	9.562	0.000	65.225

A. Mission Description and Budget Item Justification

This Project performs applied research for capabilities that support teams of Soldier and Artificial Intelligence (AI)-enabled systems to execute missions in complex, dynamic, multi-domain operations environments. Centered on ground vehicle mission planning and operations, this Project is focused on core technologies to enable Soldiers and AI-enabled systems to function as a team, to perform at high levels, and to adapt to adversarial actions and new mission requirements. This Project will enable future Soldiers with AI-enabled systems to perform complex missions with increasingly sophisticated technologies, and in increasingly complex, dynamic, sociotechnical environments. The applied research will provide the fundamental technologies to enable scalable Soldier-AI teams and team-centered dynamic tasking to effectively utilize the full capabilities of team and technologies. The research will include considerations to reduce data requirements for AI adaptation, increasing appropriate Soldier trust and use of technology, and ensuring ethical behavior by teams of Soldier and AI-enabled systems. The capabilities created by this research will lead to increased overall Soldier-AI team mission performance, improved Soldier-centric situation awareness technologies, and units that can effectively integrate within a multi-domain battlefield.

Work in this Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), PE 0603462A (Next Generation Combat Vehicle Advanced Technology) and PE 0602143A (Soldier Lethality Technology).

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 Ground and Next Generation Combat Vehicle portfolios.

Work in this Project is performed by the Army Research Laboratory (ARL)

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Soldier-AI Team Mission Planning for Dynamic Complex Environments	1.313	1.357	-
Description: Planning in multi-domain operations environments is complex and has increased temporal and spatial sensitivities for Soldiers to integrate with AI-enabled systems to plan and execute missions. This effort investigates the fundamental concepts and technologies to enable Soldier and AI to team together to plan for multidomain operations from a ground vehicle perspective. This effort determines planning enablers to maximize manned-unmanned team performance across squads and platoons and includes mid- to far-term crew station-based emerging technologies in the areas of human interaction with AI technologies and human-guided machine intelligence. Designs and develops models of both Soldier and AI capabilities and their limitations as a function of the mission environment and mission requirements and apply those models to form mission plans.			
FY 2024 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** CG8 / *Human Autonomy Teaming*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will design and develop route/mission planning tools that incorporate operator load and autonomous system interaction cost functions to improve performance from mission to mission. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects administrative realignment to Soldier AI-Team Operational Planning within this project.			
Title: Dynamic Soldier-AI Team Resource Allocation ***Description:*** This effort designs and develops the concepts and technologies necessary to dynamically allocate Soldiers and unmanned systems during missions to adapt mission plans to adversarial actions and other events at a squad and platoon level, including responding to degradation or loss of team capabilities, changes in mission goals or priorities, and responding to adversarial actions. The effort investigates the allocation of Soldiers, platforms, and platform sub-system capabilities with the focus to ensure that future AI and automation capabilities are focused on the circumstances and conditions where they are most likely to be successful, and to ensure that the Soldier's cognition is focused appropriately to ensure mission success. ***FY 2024 Plans:*** Will investigate approaches to mitigate performance penalties due to task switching in a human-autonomy team to enable rapid team reconfiguration and improve team performance in dynamic environments; refine methodology and algorithms designed to provide a Commander with suggested courses of action to reconfigure the team based on changes in operator or agent state, mission requirements, and environment. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects administrative realignment to Soldier AI-Team Operational Planning within this project	2.562	2.638	-
Title: Soldier Cognition-Centric Interface Technologies ***Description:*** This effort designs and develops cognitive-centric displays that ensure Soldiers are focused on aspects of situational awareness, mobility, target engagements, and communications that are critical to mission performance as future crew stations and displays provide vast amounts of multi-domain information that has the potential to distract, overwhelm, and mislead Soldiers. This effort ensures that our systems do not capture and misdirect Soldier attention and/or cognition, maximizing the utility of AI enabled systems to the Soldier. This effort also enables Soldiers to better understand the actions, goals, intents, and general reasoning of the AI systems to ensure they are effectively used, but not inappropriately relied upon. ***FY 2024 Plans:*** Will conduct experiments to assess the effectiveness and impact of integrating Soldier-trained autonomous systems into reconfigurable human-autonomy teams; create and empirically validate team assessment toolkit for measuring human-autonomy team trust and cohesion from data collected during the mission. ***FY 2024 to FY 2025 Increase/Decrease Statement:***	1.677	1.772	-

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** CG8 / *Human Autonomy Teaming*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects administrative realignment to Soldier AI-Team Operational Planning within this project.			
Title: Enabling Soldier-AI Technology Adaptation	3.400	3.496	3.520
Description: This effort designs and develops technologies to rapidly adapt and upgrade AI-enabled system capabilities in response to advancements in AI in the commercial and adversary environments. Focus areas include enabling rapid technology adaption during Soldier experimentation and enabling data to be collected during these events for rapid development of technology updates and modifications. This effort has four goals: 1) increasing the ability of Soldier-AI teams to rapidly adapt to adversarial actions, new technologies, environmental changes, and mission requirements; 2) decreasing the data requirements to train and adapt AI-enabled systems; 3) increasing appropriate Soldier trust and use of technology; and 4) ensuring ethical decisions by using Soldiers to guide the actions and in-field adaptations of Soldier-AI team behaviors. ***FY 2024 Plans:*** Will design and develop capability to use unobtrusively-sensed information from Soldier-based sensors to adapt autonomy behavior; validate autonomy adaptation methods leveraging multiple forms of Soldier interactions. Will mature and validate the effectiveness of algorithms that infer Soldier intent from natural Soldier-system interactions in order to adapt team dynamics. ***FY 2025 Plans:*** Will investigate approaches for within and across-mission adaptation of autonomous system behaviors; explore scalability of machine learning techniques to echelons above the platoon level; design and develop simulation environment for training multi-agent coordinated autonomous behaviors. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Title: Soldier-AI-Enabled System Team Operational Planning	-	-	2.656
Description: This effort focuses on complementary Soldier and machine capabilities that support the rapid planning and replanning of higher-echelon distributed operations. This effort will provide capabilities for distributed Soldier-AI-enabled system teams to rapidly adapt within complex, dynamic, multi-domain environments and identify fleeting windows of opportunity. This effort has four goals: (1) enable Soldier-AI-enabled system teams to rapidly generate mission plans, (2) enable Soldier-AI-enabled system teams to assess mission plans, (3) enable Soldier-AI-enabled system teams to continuously analyze mission progress and predict outcomes and the potential need to re-plan, and (4) identify necessary changes to operational structure and skills caused by the introduction of AI-based systems and tools. ***FY 2025 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** CG8 / *Human Autonomy Teaming*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will investigate capabilities to enable Soldiers and AI-enabled systems to team together to rapidly generate operational plans for multi-domain operations; create approaches to rapidly assess multiple mission plans; explore methods to predict effectiveness of mission plans within a single domain of operation. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects administrative realignment from Dynamic Soldier-AI Team Resource Allocation within this project.			
Title: Soldier-AI-Enabled System Team Tactical Planning ***Description:*** This effort focuses on complementary Soldier and machine capabilities that support rapid adaptive command and control (C2) of lower-echelon distributed operations. This effort designs and develops capabilities that support teams of Soldiers and AI-enabled systems to conduct tactical C2 in complex, dynamic, multi-domain environments. Focused on ground vehicle centric missions, this effort will research core technologies to enable Soldiers and AI-enabled systems to lead isolated units capable of exploiting narrow windows of opportunity by creating and adapting coordinated team behaviors across mission phases. This effort will focus on four goals: (1) enabling coordinated Soldier-AI-enabled system pre-mission planning within constraints of higher echelon plans, (2) enabling within-mission adaptation of mission plans, (3) developing tools and techniques for after-action review-based adaptation of coordinated Soldier-AI-enabled system team behaviors, and (4) identifying necessary changes to team structure and skills caused by the introduction of AI-based systems and tools. ***FY 2025 Plans:*** Will design a capability to leverage Soldier feedback and previous mission-data to enable mission-to-mission adaptation of coordinated Soldier-AI team behaviors; explore approaches to assess trust across multiple Soldiers, AI-enabled systems, as well as teams that cross echelon; assess capability of Soldier-AI-enabled system tactical teams to rapidly adapt to changing operational plans. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects administrative realignment from Soldier Cognition-Centric Interface Technologies and Soldier-AI Team Mission Planning for Dynamic Complex Environments within this project	-	-	3.108
Accomplishments/Planned Programs Subtotals	8.952	9.263	9.284

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) CI2 / *Ground Enabling University Applied Research*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CI2: *Ground Enabling University Applied Research*	-	3.548	3.906	5.533	-	5.533	4.630	4.633	4.684	4.731	0.000	31.665

A. Mission Description and Budget Item Justification

The Project leverages applied research from academia, in the focus areas of ground autonomy, Artificial Intelligence/Machine Learning (AI/ML) and robotics, occupant/vehicle survivability and other ground platform technologies of importance to the Army. This Project performs discovery research efforts to focus more on mid to far-term Army modernization priorities while also maintaining delivery of near-term technologies critical to the next generation combat vehicles. This Project focuses on employment of research technologies originating from extramural applied research in academia pertaining to navigation/routing, autonomous robotic vehicles with the use of artificial intelligence and machine learning as applied to ground mobility and maneuver, and other innovative ground enabling applied research technologies. This effort conducts applied research and development leading to potential emerging technologies in areas of strategic importance to the Army in autonomy, robotics and AI/ML, protection of both platform and occupant, and other ground platform technologies in propulsion, survivability, powertrain, etc., by bringing competitively selected Universities with research and development teams into Technical Alliances.

Work in this Project complements Program Element (PE) 0603119A (Ground Advanced Technology), PE 0602145A (Next Generation Combat Vehicle Technology) and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

Work in this Project is performed by the University Technology Development Division.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Robust autonomous capabilities for ground vehicles	1.879	2.059	3.608
Description: This effort investigates AI/ML and autonomous mobility-enabled ground vehicles to conduct off-road maneuvers to transition from tele-operated to either autonomous, or semi-autonomous scenarios. This effort improves autonomous behaviors and reduces the need for human interaction during operation. Research is conducted in collaboration with university partners to advance autonomous mobility and protection of both occupant and platform in optionally manned and autonomous ground vehicles.			
FY 2024 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** CI2 / *Ground Enabling University Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will continue to investigate and develop multi-robot long-term autonomy, ML for autonomous navigation, off-road autonomy software. Will investigate and develop multi-layered situational awareness, cooperative tactical reasoning, and communication frameworks solutions for multiple autonomous air and ground vehicles used for route and area reconnaissance. ***FY 2025 Plans:*** Will design and develop capability models for unified air/ground scene representations and demonstrations in a fleet of unmanned ground and air vehicles; designs and develops reasoning-based cooperative maneuvers, such as bounding over-watch, with multiple vehicles; mature a second phase of marsupial robotic deployment and recovery technologies; research software to quickly enable Soldiers to customize robotic assets in the field for varied mission requirements; design and develop a modular software tool that interfaces with existing Army software to combine terrain layers to create mobility maps that support autonomous ground vehicle route planning; research emerging technology for autonomous ground vehicles and ground-air teaming. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned milestones and increase research to support Robotic Technical Kernel development.			
Title: Human-robot/AI interactions ***Description:*** This effort designs and develops systems involving physical and cognitive levels of interactions between humans and robots, with the use of reinforcement learning (an area of ML research) from human feedback, learning from demonstration, and safe human-aware controllers. Work is conducted in collaboration with university partners to advance autonomous mobility as well as other areas of ground platform technologies in propulsion, survivability, powertrain, etc. The benefit of this effort is improvements to machine learning and artificial intelligence with human-robot interactions. ***FY 2024 Plans:*** Will continue to investigate AI/ML research for robust autonomous capabilities, real-time basic feature extraction, multi-robot long-term autonomy, human-AI collaboration, human-in-the-loop ML for autonomous navigation. ***FY 2025 Plans:*** Will research sensing, contact-capable navigation, and activity recognition for vehicles to move without stopping among crowds; continues to investigate AI/ML research for robust autonomous capabilities, real-time basic feature extraction from sensor data, multi-robot long-duration autonomy, human-AI-enabled system collaboration, and human-in-the-loop ML for autonomous navigation. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.	1.669	1.847	1.925
Accomplishments/Planned Programs Subtotals	3.548	3.906	5.533

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** CI2 / *Ground Enabling University Applied Research*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) CV3 / *Engineer Enablers Maneuver, LOG, & Sustainment Apl*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
CV3: *Engineer Enablers Maneuver, LOG, & Sustainment Apl*	-	2.426	2.195	1.257	-	1.257	4.179	4.030	6.082	7.375	0.000	27.544

A. Mission Description and Budget Item Justification

This effort designs and develops software tools to modernize the Army's logistics planning capability. The project will research planning of logistics resupply via distributed supply routes through complex terrain and environmental conditions within a contested environment, while also improving the efficiency of logistics planning, enabling planners to develop and compare courses of action, and simulate logistics activities using complex algorithms. This effort links the engineer applications into a geospatial framework and enables planners to better understand the dynamic scenario development providing a simple and clear critical vulnerabilities assessment, easy visual comparison of inventories available, supply needs within the battlespace, and the logistics options to mitigate potential issues.

Work in this Project complements Program Element (PE) 0603119A (Ground Advanced Technology) / Project CV5 (Engineer Enablers Maneuver, LOG, & Sustainment Adv).

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

Work is performed at the United States Army Engineer Research and Development Center Geotechnical and Structures Laboratory, Coastal and Hydraulics Laboratory, and Information Technology Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Planning Logistics Analysis Network System Applied Research	2.426	2.195	1.257
Description: This effort will design and develop new engineering applications and methodologies that support improved logistics planning via distributed networks, investigate methods to link existing data describing complex environmental features that impact planning into the engineer applications, and design new automated algorithm technologies to improve the efficiency and effectiveness of the planning decision making.			
FY 2024 Plans: Will design and develop transportation throughput options for feasible nodes and routes and investigate routing options based on weather and terrain concerns, and investigate cross-country movement options within the transportation network.			
FY 2025 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** CV3 / *Engineer Enablers Maneuver, LOG, & Sustainment Apl*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will mature components of routing algorithms for distributed logistics planning for multiple transportation modalities (i.e., road, watercraft, train) incorporating unique elements associated with military convoy traffic, weather impacts, and intermodal transfer. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects the transition of technologies for maturation and demonstration to PE 0603119A Project CV5 Engineer Enablers Maneuver, LOG, & Sustainment Adv.			
Accomplishments/Planned Programs Subtotals	2.426	2.195	1.257

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*				Project (Number/Name) DA1 / *SAFR Alternatives for Readiness Applied Research*			
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
DA1: *SAFR Alternatives for Readiness Applied Research*	-	3.545	5.171	4.025	-	4.025	6.545	6.681	6.808	6.876	0.000	39.651

A. Mission Description and Budget Item Justification

This Project will develop safer alternative technologies that enable Army readiness, support supply chain resilience, improve Soldier and worker safety and reduce environmental impacts, including reduction of greenhouse gas emissions. The Project investigates alternatives for cross-cutting materials, undergoing or threatened by regulatory scrutiny, found in ground vehicles and all other types of Army weapon systems. Research areas of focus include alloys, ceramics, composites, textiles, maintenance fluids, propellants, explosives, and pyrotechnics. This work addresses increasing threats to readiness associated with carcinogenic, toxic, and restricted materials such as lead, beryllium, perchlorates, volatile organic compounds and per- and polyfluoroalkyl substances (PFAS) (forever chemicals), which can diminish Soldier and community health, restrict training and interrupt critical maintenance activities. Future liabilities and risks are characterized early in the life cycle of material development to ensure truly sustainable alternatives. This Project also investigates, develops and designs technologies to allow Soldiers to rapidly prioritize risk for PFAS to enable informed, timely and cost-effective solutions.

This Project complements and transitions technologies to Program Element (PE) 0603119A (Ground Advanced Technology) / Project DA2 (SAFR Alternatives for Readiness Advanced Tech).

Work in this Project is performed by the Army Research Laboratory (ARL); the Armaments Center (AC); the Aviation and Missile Center (AVMC); the Soldier Center (SC); the Ground Vehicle Systems Center (GVSC); and the U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC).

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2023**	**FY 2024**	**FY 2025**
Title: PFAS Risk Reduction Applied Research	0.729	1.201	-
Description: This effort will design and develop a novel rapid risk characterization framework that will be validated with a rapid fate and transport screen, a breakthrough toxicity screening, and treatment approaches. ***FY 2024 Plans:*** Will develop a rapid risk prioritization database tool validated with per- and polyfluroroalkyl substance (PFAS) case studies. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding administratively realigned to PE 0602144A (Ground Technology) / Project DI7 (Environmental Security Resilience Tech).			
Title: Safer Alternatives for Readiness (SAFR) Applied Research	2.816	3.970	4.025
Description: Design and develop novel cross-cutting solutions to eliminate Soldier and worker exposure to airborne lead from energetic materials; efficiently and safely demilitarize materiel; support the next generation of enhanced and sustainable munitions; reduce the use of toxic and hazardous chemicals in cleaners, degreasers, lubricants and fluids to ensure Soldier			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** DA1 / *SAFR Alternatives for Readiness Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
and ground vehicle readiness; and minimize the life cycle health and safety risks associated with emerging high-performance materials. ***FY 2024 Plans:*** Will research PFAS-free surface treatment for coatings and textile applications; investigate material alternatives for critical energetic materials; and explore lead-free rocket propellants. ***FY 2025 Plans:*** Will investigate PFAS-free engineering fluids for energetics formulation; research reduced solvent energetic primer coating formulations; and optimize lead-free energetic primers and initiators. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Accomplishments/Planned Programs Subtotals	3.545	5.171	4.025

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) DG1 / *Development of Obscurants*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
DG1: *Development of Obscurants*	-	-	2.774	2.807	-	2.807	2.811	2.813	2.815	2.844	0.000	16.864

A. Mission Description and Budget Item Justification

This project will investigate and evaluate obscurants (i.e., materials) and obscurant technologies that are designed to degrade threat force surveillance sensors and defeat the enemy's target acquisition devices, missile guidance, and directed energy weapons. This project investigates advanced, infra-red, and multi-spectral obscurant materials that will provide effective, safe, and efficient screening of deployed units and platforms.

Work in this project compliments Program Element (PE) 0602144A (Ground Technology) / Project DG2 (Advanced Development of Obscurants).

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

Work in this Project is performed by the Chemical Biological Center (CBC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Obscuration Enabling Technologies	-	2.774	2.807
Description: This effort investigates new materials and compounds to enable safe and effective screening of personnel and equipment across the electromagnetic spectrum. This effort also provides vulnerability assessments against enemy threat targeting systems. ***FY 2024 Plans:*** Will explore medium range obscurant systems and work towards using novel materials to maximize performance; explore the potential of medium range obscurant systems to disseminate counter unmanned aerial obscurant-based materials; provide further enhancement and support for screening and obscuration module systems. ***FY 2025 Plans:*** Will research millimeter wave obscurant materials and dissemination methodologies. Will integrate obscurant material into safe and effective dissemination technology through the Screening and Obscuration Module. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Accomplishments/Planned Programs Subtotals	-	2.774	2.807

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** DG1 / *Development of Obscurants*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / *Ground Technology*	Project (Number/Name) DI7 / *Environmental Security Resilience Tech*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
DI7: *Environmental Security Resilience Tech*	-	-	-	6.635	-	6.635	9.514	12.755	10.985	11.361	0.000	51.250

Note

In FY2025, project DI7 / Environmental Security Resilience Tech is a new effort realigned within PE0602144A /Ground Technology from project DA1 / SAFR Alternatives for Readiness Applied Research.

A. Mission Description and Budget Item Justification

This Project will focus on investigating environmental, meteorological and other supply-chain security threats that impact Army operations, personnel, and weapon systems (OPW) as well as operational energy generation and demand reduction to gain environmental security resilience. This Project will provide foundational knowledge of the impact of meteorological and climatological processes to feed decision-makers, in particular, boundary layer and complex terrain atmospheric processes at both meteorological and climatological timeframes. This Project also investigates and develops capabilities to inform Army Environmental Security Resilience decisions and support tools, providing new information on environmental factors to include emerging contaminates, biotechnology, extreme weather events, and natural stressors which that impact operations or present security concerns. Project capabilities span the functional domains of strategic support area management, emergency preparedness, environmental protections, climate resilience, and analysis of future operational environment and environmental threats. This effort will inform new models and decision support tools which provide actionable information that affect missions to Army installation managers for operational planning and risk management.

Work in this Project complements Program Element (PE) 0603119A (DI8) / Project (Environmental Security Resilience Adv Tech).

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 Army Research Laboratory (ARL); the Engineer Research and Development Center (ERDC) Environmental Laboratory, Construction Research Engineering Laboratory, and the Cold Regions Research and Engineering Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Atmospheric Impacts for Lethality Overmatch	-	-	2.304
Description: This effort conducts Army-centric applied research in atmospheric impacts and effects on DoD systems and operations. Technology development includes decision support systems for mission commanders, ensuring interoperability, and enhancing the ability to conduct air-ground reconnaissance and combined arms maneuver.			
FY 2025 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** DI7 / *Environmental Security Resilience Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will conduct field tests using the Distributed Virtual Proving Ground - Multi-Sensor Array in relevant scenarios and conditions to collect and investigate meteorological and other operational data to understand the impact of atmospheric phenomena on energy propagation; develop physical and numerical models that are representative of atmospheric effects; investigate sensing algorithms and strategies informed by atmospheric impacts on multi-modal (acoustic/radio frequency (RF)/optical/electromagnetic (EM)) sensors applicable to detection, localization, and tracking; develop techniques, methods, and models for the characterization of ambient atmospheric and threat aerosols (intentional/unintentional release) exploiting primarily optical techniques. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding restructured from Program Element (PE) 0622144A Ground Technology / Project CG7 (Ground Protection Concepts and Technologies)			
Title: Environmental Security Applied Research - Assessing and Mitigating Climate Risk ***Description:*** This effort conducts Army-focused environmental security applied research and collaborations within climatological time frames, to include dynamics and changes in the atmospheric boundary layer in complex Multi-Domain Operations (MDO) environments (complex terrain and dense urban) with particular emphasis on the atmospheric surface layer and the land-surface processes that effect the environmental state. Technology development includes decision support systems for mission commanders, ensuring interoperability, and enhancing the ability to plan air-ground reconnaissance and combined arms maneuver. ***FY 2025 Plans:*** Will investigate climate relationships between teleconnection patterns (causal connections or correlations between meteorological or other environmental phenomena which occur a long distance apart) and the evapo-transporation cycle (i.e. flash drought) for the purpose of designing computational tools to predict the magnitude and impact of climate change on operations, weapon systems, and personnel. Some examples of impacts include effects on resources in areas the US Army provides stability operations. Resource competition hampered by drought lead to resource competition and conflict vulnerability. Additionally, flash drought affects erosion and dust lofting - particles that significantly effect Directed Energy (DE) weapon system propagation/ operation and Hypersonic operations. Effects on the decision-making process of personnel in drought-stricken areas with increased heat and dust ladened atmosphere also need to be understood. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding restructured from Program Element (PE) 0622144A Ground Technology / Project CG7 (Ground Protection Concepts and Technologies)	-	-	1.915
Title: Interagency Council for the Advancement of Meteorological Services Program	-	-	0.166

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** DI7 / *Environmental Security Resilience Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Description: This effort supports the Army's collaboration in the Interagency Council for Advancing Meteorological Services (ICAMS), which was chartered in 2020 per the "Weather Research and Forecasting Innovation Act of 2017" (Public Law 115-25, April 18, 2017). ***FY 2025 Plans:*** Will conduct weather research and forecast innovation based on Army operational environments om coordination with the ICAMS Program. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding restructured from Program Element (PE) 0622144A Ground Technology / Project CG7 (Ground Protection Concepts and Technologies).			
Title: Building Installation Resilience Carbon Sequestration and Reduction ***Description:*** This effort will develop and provide validated models for carbon accounting across Army natural lands to include the use of those lands. These models will not only provide a baseline of current carbon sequestration, but also provide a means to quantify improvement or changes in sequestration capacity. ***FY 2025 Plans:*** Will investigate effects of Army training on soil carbon fluxes and identify key ecosystem processes influencing soil carbon fluxes. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned initiation of this effort.	-	-	1.047
Title: PFAS Risk Reduction Applied Research ***Description:*** This effort will develop a per- and polyfluorinated substances (PFAS) risk-based decision framework to enable rapid PFAS communication and risk decisions on Army installations. This effort will also establish a communications hub to provide distribution of PFAS decisions to Army installation managers. ***FY 2025 Plans:*** Will conduct experiments with the initial version of the communication hub and decision framework using mesocosm case studies and will start to develop PFAS small scale computational chemistry models. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding administratively realigned from Program Element (PE) 0622144A Ground Technology / Project DA1 (SAFR Alternatives For Readiness).	-	-	1.203
Accomplishments/Planned Programs Subtotals	-	-	6.635

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602144A / *Ground Technology*	**Project (Number/Name)** DI7 / *Environmental Security Resilience Tech*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A