Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army											Date: April 2022	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
Total Program Element	-	117.484	91.626	87.717	-	87.717	77.976	79.845	90.480	93.176	Continuing	Continuing
AH6: *Disruptive Energetics and Propulsion Technologies*	-	8.124	8.413	8.682	-	8.682	8.713	8.756	8.759	8.757	0.000	60.204
AH7: *Lethal and Scalable Effects Technologies*	-	1.018	1.911	1.346	-	1.346	1.567	1.565	1.566	1.565	Continuing	Continuing
AH8: *Lethality Materials and Processes Technology*	-	4.254	4.019	1.868	-	1.868	1.898	1.895	1.895	1.895	0.000	17.724
AH9: *Advanced Warheads Technology*	-	22.933	25.032	26.780	-	26.780	28.319	27.085	29.067	31.722	0.000	190.938
AI1: *Advanced Terrain Shaping Technology*	-	4.655	-	-	-	-	-	-	-	-	0.000	4.655
BS6: *Lethality Technology (CA)*	-	76.500	27.500	-	-	-	-	-	-	-	0.000	104.000
CF7: *Solid-state Laser Concepts and Architectures*	-	-	7.547	8.567	-	8.567	9.848	9.837	9.840	9.838	0.000	55.477
CF8: *Terminal Effects Against Critical Targets Tech*	-	-	4.040	3.938	-	3.938	2.170	1.026	5.141	4.299	0.000	20.614
CG4: *Advanced Radar Concepts and Technologies*	-	-	4.687	5.891	-	5.891	5.982	5.996	8.932	8.929	0.000	40.417
CI1: *Advanced Armaments Lethality Technology*	-	-	-	1.544	-	1.544	1.677	2.568	3.065	3.754	0.000	12.608
CJ1: *Lethality Enabling University Applied Research*	-	-	5.794	6.570	-	6.570	7.165	7.814	8.284	8.282	0.000	43.909
CJ6: *Advanced Energetics for Missile Technologies*	-	-	1.185	-	-	-	-	-	-	-	0.000	1.185
CJ7: *Future Air Defense Missile Enabling Tech*	-	-	1.498	14.655	-	14.655	2.314	4.573	4.574	4.573	0.000	32.187
CZ9: *Foundational Hypersonic Weapons Research*	-	-	-	7.876	-	7.876	8.323	8.730	9.357	9.562	0.000	43.848

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602141A *I Lethality Technology*

Note

Project CI1 (Advanced Armaments Lethality Technology) and Project CZ9 (Foundational Hypersonic Weapons Research) are New Starts for Fiscal Year 2023 (FY23). Project CJ6 (Advanced Energetics for Missile Technologies) is Terminated starting in FY23.

A. Mission Description and Budget Item Justification

Work done in this Program Element (PE) researches technologies, methodologies, and models required to enable next generation lethality. The effort focuses on: lethal mechanism technologies for projectiles and warheads that provide revolutionary capability to defeat Tier 1 adversary vehicle and body armors; selection of propulsion and energetic materials and technology to validate novel energetic materials concepts to exploit controllable energy release for future gun/missile systems; scalable effects for mixed target defeat while simultaneously decreasing warhead mass; development of materials solutions for improvement of weight and volume efficiency, lethal effects and sustainability for the warfighter in the Army of today and beyond; and multiple pathways to enhance lethal effects by investigating synergistic effects of novel micro warheads using advanced materials. Funding in this PE is a continuation of work done in PEs 0602105A (Materials Technology), 0602618A (Ballistics Technology), and 0602624A (Weapons and Munitions Technology).

Work in this PE complements PEs 0602147A (Long Range Precision Fires Technology), 0602150A (Air and Missile Defense Technology), 0602143A (Soldier Lethality Technology), 0602144A (Ground Technology), 0602145A (Next Generation Combat Vehicle Technology), and 0603116A (Lethality Advanced Technology).

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

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

B. Program Change Summary ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	117.484	64.126	0.000	-	0.000
Current President's Budget	117.484	91.626	87.717	-	87.717
Total Adjustments	0.000	27.500	87.717	-	87.717
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	27.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	87.717	-	87.717

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Project: BS6: *Lethality Technology (CA)*		

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602141A *I Lethality Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: *Program increase - next generation remote sensing*	5.000	3.000
Congressional Add: *Program increase - Advanced lethality concepts and analysis*	7.500	-
Congressional Add: *Program increase - counter UAS technology in arctic environments*	10.000	-
Congressional Add: *Program Increase- Hybrid additive manufacturing*	10.000	5.000
Congressional Add: *Program increase - novel and sustainable energetic materials*	24.000	-
Congressional Add: *Program increase - quantum technologies for armament systems*	10.000	-
Congressional Add: *Program increase - solid fuel propulsion technology*	10.000	-
Congressional Add: *Hypersonic Wind Tunnel Development*	-	6.500
Congressional Add: *Materials Processing Manufacturing Technology*	-	10.000
Congressional Add: *Universal Nanocrystalline Alloys*	-	3.000
Congressional Add Subtotals for Project: BS6	76.500	27.500
Congressional Add Totals for all Projects	76.500	27.500

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) AH6 / *Disruptive Energetics and Propulsion Technologies*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AH6: *Disruptive Energetics and Propulsion Technologies*	-	8.124	8.413	8.682	-	8.682	8.713	8.756	8.759	8.757	0.000	60.204

A. Mission Description and Budget Item Justification

This Project investigates, models, and assesses energetic material and propulsion technologies to validate novel concepts such as maximizing total energy density and power delivered on target. This Project also optimizes propellant grains for increased range, and altering gun configurations to increase energy on target in order to exploit the controllable/scalable energy release required for improving effectiveness and reducing vulnerability of future gun/missile systems. This Project builds upon disruptive energetic materials discovery efforts to synthesize new materials with energy content from 50% to up to two times that of Research Department Explosive (RDX) in PE 0601102A (Defense Research Sciences) / Project AA7 (Mechanics and Ballistics). This Project also leverages the advanced additive manufacture efforts of PE 0602144A (Ground Technology) / Project BL1 (Materials and Manufacturing Research 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 is performed by the United States (US) Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Synthesis, Formulation and Diagnostics of Energetic Materials	4.764	4.838	-
Description: This effort pursues novel approaches to synthesize and scale up disruptive and traditional energetic materials with increased performance as well as design new formulation avenues in order to discover new materials and formulations to extend range and increase effect on target. This effort also investigates and develops revolutionary ways to release energy and characterize energetic behavior at early time and small length scales for rapid determination of detonation and propellant performance parameters to enable a ?fail early, fail often? strategy.			
FY 2022 Plans: Will synthesize and scale-up novel high energy density materials, polymer precursors, plasticizers, and high temperature energetics for inclusion in formulations (melt-cast, cast-cure, and additively manufactured) targeting 50% increased performance in explosive and propellant applications; develop novel small scale rapid experimental assessment methodologies and apply these methodologies to characterize novel energetic material candidates and formulations to assess enhancements in both range and lethality.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AH6 / *Disruptive Energetics and Propulsion Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Funding realigned to ?Synthesis, Formulation, Modeling and Diagnostics of Energetic Materials for Explosive and Propellant Applications? within this Project.			
Title: Modeling and Simulation of Energetics and Munitions ***Description:*** This effort develops, codes, and subsequently employs advanced models to predict multiscale response of energetic materials for both propellant and explosive purposes. Develops new simulation methods for understanding and design of advanced concepts and energetic formulations to rapidly iterate and optimize towards increased range and enhanced lethality. ***FY 2022 Plans:*** Will further develop novel grain scale modeling capability for inclusion into engineering continuum scale codes for explosive applications; predict expanded sets of chemical kinetic rates for usage in continuum propulsion software for modeling of novel propellants and propulsion concepts; support synthesis and formulation chemists in the prediction of material properties prior to synthesis through the development of machine learning toolsets. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding realigned to ?Synthesis, Formulation, Modeling and Diagnostics of Energetic Materials for Explosive and Propellant Applications? within this Project.	1.787	1.738	-
Title: Advanced Weapon Concepts ***Description:*** This effort investigates new propellants and grain designs, burn rate/combustion modifier ingredients, as well as new gun and munition designs for extended range. ***FY 2022 Plans:*** Will develop, validate, and transition novel weapon concepts, advanced additively manufactured propellant designs, printing technologies, and solid fuel ramjet concepts to partners to enable extended ranges, higher muzzle velocities, and reduced system mass. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding realigned to ?Synthesis, Formulation, Modeling and Diagnostics of Energetic Materials for Explosive and Propellant Applications? within this Project	1.573	1.530	-
Title: Synthesis, Formulation, Modeling, and Diagnostics of Energetic Materials for Explosive and Propellant Applications ***Description:*** This effort pursues novel approaches to synthesize and scale up disruptive and traditional energetic materials with increased performance as well as design new formulation avenues in order to discover new materials and formulations to extend range and increase effect on target. This effort develops, codes, and subsequently employs advanced models to predict multiscale response of energetic materials for both propellant and explosive purposes. This effort develops new simulation and	-	-	8.682

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AH6 / *Disruptive Energetics and Propulsion Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
small scale experimental methods and techniques for understanding and design of advanced concepts and energetic formulations to rapidly iterate and optimize parameters to enable a "fail early, fail often" strategy towards increased range and enhanced lethality. This effort also investigates new propellants and grain designs, burn rate/combustion modifier ingredients, as well as new gun and munition designs for extended range. ***FY 2023 Plans:*** Will synthesize, scale up, and formulate high temperature resistant energetic materials, energetic polymers, and novel high energy density metallic fuels into new higher performing explosives and propellants; develop rapid laboratory scale diagnostic techniques to rapidly screen candidate materials and formulations, mitigating need for mass production for evaluation and therefore achieve faster time-to-solution for extended range and enhanced lethality; develop and experimentally validate mesoscale models an order of magnitude larger than FY21 state of the art and link with engineering scale software for explosive modeling; develop chemical kinetics for solid fuel ramjet continuum modeling for enhanced ranges; develop machine learning models of performance and material sensitivity to reduce phase space for synthetic chemists to explore; develop and transition novel propellant grain designs and initiation schemes to enable increased range for very large caliber cannon systems; develop capability to design solid fuel ramjets for increased rocket ranges; develop lightweight, increased muzzle velocity Soldier weapon systems. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding realigned from ?Synthesis, Formulation and Diagnostics of Energetic Materials?, ?Modeling and Simulation of Energetics and Munitions?, and ?Advanced Weapon Concepts? within this Project.			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.307	-
Accomplishments/Planned Programs Subtotals	8.124	8.413	8.682

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AH6 / *Disruptive Energetics and Propulsion Technologies*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) AH7 / *Lethal and Scalable Effects Technologies*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AH7: *Lethal and Scalable Effects Technologies*	-	1.018	1.911	1.346	-	1.346	1.567	1.565	1.566	1.565	Continuing	Continuing

A. Mission Description and Budget Item Justification

Work in this Project designs, determines and assesses technology options for scaling warhead lethality and providing extreme efficiency for highly effective, simultaneous mixed/multi target defeat and collateral damage. This Project will also design and assess scalable structure defeat to mitigate collateral damage for disruptive urban Warfighting. This research is coordinated with Project AH5 (Projectile and Multi-Function Warhead Technologies) and Project AH6 (Disruptive Energetics and Propulsion Technologies) within this PE and builds upon disruptive energetic and ballistic sciences research in PE 06011102A 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 and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Munition Efficiency and Scalability	1.018	1.841	1.346
Description: This effort investigates, designs, determines, and assesses technologies to produce blast-fragment warheads with tailored fragment geometries to optimize target defeat. This effort identifies and develops warhead impact patterns to optimize target defeat with reduced collateral damage. This effort also designs, models, and assesses technologies for the cost effective, preprogrammed delivery of multiple scalable warheads capable of simultaneously engaging multiple targets. This effort leverages guidance technologies from PE 0602147A (Long Range Precision Fires) / Project AH4 (Precision and Coop Weapons in a Denied Env Tech), and metal additive manufacturing from PE 0602144A (Ground Technology) / Project BL1 (Materials and Manufacturing Research Technology).			
FY 2022 Plans: Will continue conducting experiments and lethality studies, will select promising materials and mechanisms for preliminary component-level terminal ballistic experiments; will design and develop devices incorporating improved metals and energetics and integrate concepts into warheads for assessments in full-scale experiments.			
FY 2023 Plans: Will conduct experiments to quantify the performance of the devices designed and built in FY2022; provide model updates and revised lethality analyses based on the outcome of terminal ballistic experiments conducted in Fiscal Year 2022 (FY22); continue			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AH7 / *Lethal and Scalable Effects Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
design studies to examine performance gains provided by improved manufacturing techniques, novel energetics, and metals designed for warhead applications. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding reduction due to decrease in number of lethality studies planned for FY23 in accordance with the lifecycle plan for the effort.			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.070	-
Accomplishments/Planned Programs Subtotals	1.018	1.911	1.346

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) AH8 / *Lethality Materials and Processes Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AH8: *Lethality Materials and Processes Technology*	-	4.254	4.019	1.868	-	1.868	1.898	1.895	1.895	1.895	0.000	17.724

A. Mission Description and Budget Item Justification

Work in this Project designs, determines, and assesses innovative materials solutions aimed at achieving leap ahead increases in lethality and weapons effectiveness through improvements in weight and volume efficiency, lethal effects, and sustainability of military systems. This research is coordinated with Project AH6 (Disruptive Energetics and Propulsion Technology) and Project AH7 (Lethal and Scalable Effects Technologies) within this PE, and PE 0602147A (Long Range Precision Fires Technology) / AH4 (Precision and Cooperative Weapons in a Denied Environment) and builds upon and ballistic sciences 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 and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Materials for Advanced Lethality	4.007	3.872	1.868
Description: This effort researches innovative materials aimed at achieving leap-ahead increases in lethality and weapons effectiveness through improvements in weight and volume efficiency, lethal effects, and sustainability of military systems that can only be achieved through advances in materials technology.			
FY 2022 Plans: Will develop algorithms to design novel geometries of propellant grains that give progressive or other novel burn behaviors to increase projectile speeds and ranges; assess the effect of ceramic powder modifications for long wave infrared transmission capability on the material toughness and light transmission in the this regime.			
FY 2023 Plans: Will print and validate various energetic systems, including three-dimensional (3D) printed rocket motor, topology-optimized gun propellant, and shaped-charge explosive; develop energetic polymer feedstocks for additive manufacturing; develop additive manufacturing capable high-strength energetics binder for gun-launch applications; perform thermal drawing of nanocrystalline-based energetic materials and solid filled energetic materials.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AH8 / *Lethality Materials and Processes Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Funding reduced/realigned to support the creation of PE 0602141A (Lethality Technology), Project CZ9 (Foundational Hypersonic Weapons Research).			
Title: High Temperature Materials for Lethality. ***Description:*** Improve survivability, extend range, and reduce weight of hypersonic systems operating under extreme thermal and aerodynamic loads.	0.247	-	-
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.147	-
Accomplishments/Planned Programs Subtotals	4.254	4.019	1.868

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) AH9 / *Advanced Warheads Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AH9: *Advanced Warheads Technology*	-	22.933	25.032	26.780	-	26.780	28.319	27.085	29.067	31.722	0.000	190.938

A. Mission Description and Budget Item Justification

This Project explores multiple pathways to enhance lethal efforts for future warheads against emerging peer/near peer target sets. Investigates synergistic effects of novel micro warheads using advance materials. This Project investigates innovative energetic materials and novel processing techniques for the next generation of explosives and propulsion applications to enable an increase in range, lethality, and utility of munitions. It also directly supports Army Modernization Priorities through researching and developing energetic (propellant) technologies and processes for increased performance, expanded operation temperature bounds, and improved safety and environmental compliance of missile systems.

Work in this Project complements PE 0602147A (Long Range Precision Fires Technology) / AG6 (Energetic Materials and Advanced Processing Techno), PE 0603464A (Long Range Precision Fires Advanced Technology / AG7 (Energetic Materials and Adv Processing Adv Tech),PE 0602150A (Air and Missile Defense Technology), PE 0602148A (Future Vertical Lift Technology), and 0602145A (Next Generation Combat Vehicle 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 is performed by the United States (US) Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Advanced Warheads	10.488	10.370	11.922
Description: This effort explores multiple pathways to enhance lethal effects for future warheads against emerging peer/near peer target sets; Investigates synergistic effects of novel warheads using advanced concepts of operations, materials, geometries, and manufacturing processes.			
FY 2022 Plans: Will continue to investigate reactive and novel materials including advanced fragmentation designs for integration in warheads that can survive high-g gun environments during projectile launch. Will investigate advanced manufacturing methods, designs and materials for warhead and lethal mechanism concepts to create advances in lethality at increased range and standoff across a broad spectrum of applications. Will investigate advanced Explosively Formed Penetrators (EFP) concepts for increased performance. Will design and develop advanced Modeling and Simulation capabilities using deep learning methods to optimize Shape Charge, Fragmentation and EFP Designs. Will conduct experiments to validate these materials and designs for integration into future munition projects. Will investigate the utility of novel warhead geometries for increased lethality in distributed scenarios.			
FY 2023 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AH9 / *Advanced Warheads Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will design reactive and novel materials, including advanced fragmentation, and alternate disruptive effects to enhance lethal effects on target operating in a high-g environment. Will investigate potential lethal mechanism technologies for potential unmanned, multi-mission, ground & aerial target engagements. Will investigate technology advances to mature warhead designs that are effective across multiple domains. Will continue to develop advanced Modeling and Simulation capabilities using available technologies, including advanced algorithms to optimize Shape Charge, Fragmentation and EFP Designs. Will conduct experiments to validate materials and advanced warheads designs In a high-G environment. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding increase to focus on acceleration to mature novel warhead component technologies for application across various platforms.			
Title: Advanced Energetics ***Description:*** This effort develops advanced energetic materials and novel processing techniques for future explosives and propulsion applications that enable an increase in range, lethality, and utility of ammunitions. ***FY 2022 Plans:*** Will investigate novel energetic materials; will conduct experiments of enhanced lethality explosive formulations; will conduct experiments of enhanced novel propellant formulations. Will mature advanced initiation concepts and conduct experiments of high energy formulations in representative munitions. Will validate processing parameters necessary to produce energetic materials for additive manufacturing; will investigate modeling and simulation tools required to accurately predict energetic materials performance in novel and unique geometries. Will investigate analytical and experimental capabilities to characterize advanced energetic materials. ***FY 2023 Plans:*** Will continue to investigate novel energetic materials; will design enhanced lethality explosive formulations; will conduct experiments of enhanced novel propellant formulations for use in representative munitions. Will develop advanced initiation concepts and advanced ignition concepts. Will conduct experiments to: prepare energetic components via additive manufacturing processing technologies; validate modeling and simulation tools required to accurately predict energetic materials performance in novel and unique geometries; embed ignition for additively manufactured gun propulsion charges. Will design analytical and experimental capabilities to characterize advanced energetic materials. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.	11.246	12.342	13.297
Title: Energetics (Propellants)	1.199	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AH9 / *Advanced Warheads Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Description: This effort investigates new and emerging energetic ingredients and processes for propellant formulations to enable enhanced performance and mission flexibility by extending the reach and effects of tactical and strategic missile systems.			
Title: Advanced Pyrotechnics ***Description:*** This effort investigates compositions, components, and technologies to provide novel pyrotechnic formulations and devices to increase overall system performance and survivability. Coordinates research, strategic assessments and development of novel pyrotechnic technologies that will enable disruptive capabilities for Multidomain Operations. This effort supports the Army Modernization Priorities. ***FY 2022 Plans:*** Will investigate novel pyrotechnic materials, components, and configurations. Will investigate pyrotechnic concepts and evaluate the performance and effectiveness for military utility. Will conduct experiments on pyrotechnic components and formulations supporting Army Modernization and Multi-Domain Operations. ***FY 2023 Plans:*** Will design novel pyrotechnic materials, components, and configurations. Will design advanced pyrotechnic concepts and assess the performance and effectiveness for military utility through modeling and experimental validation. Will continue to conduct experiments on pyrotechnic components and formulations supporting Army Modernization and Multi-Domain Operations. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding increase for exploration of novel pyrotechnic technologies for application across all Army priorities.	-	1.406	1.561
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.914	-
Accomplishments/Planned Programs Subtotals	22.933	25.032	26.780

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AH9 / *Advanced Warheads Technology*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) AI1 / *Advanced Terrain Shaping Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AI1: *Advanced Terrain Shaping Technology*	-	4.655	-	-	-	-	-	-	-	-	0.000	4.655

A. Mission Description and Budget Item Justification

This Project designs and develops engineering tools and high-fidelity modeling and simulation capabilities for materials and structural response to predict high-velocity weapons performance to ensure lethality against structures and critical assets. Through dynamic impact experiments for a broad range of velocities against conventional and advanced structural materials, this project develops engineering tools and technologies to rapidly evaluate and predict weapon performance.

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

Work in this Project is performed by the United States (U.S.) Engineer Research and Development Center (ERDC) in coordination with U.S. Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Advanced Terminal Weapons Effects Technology ***Description:*** This effort develops and validates terminal weapons effects prediction capabilities for Long Range Precision Fires (LRPF) weapons against geomaterials, structures, and other critical assets.	4.655	-	-
Accomplishments/Planned Programs Subtotals	4.655	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) BS6 / *Lethality Technology (CA)*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BS6: *Lethality Technology (CA)*	-	76.500	27.500	-	-	-	-	-	-	-	0.000	104.000

Note

Congressional Interest Item funding provided for Lethality Technology.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
Congressional Add: Program increase - next generation remote sensing ***FY 2021 Accomplishments:*** Conducted applied research in Next Generation Remote Sensing. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Next Generation Remote Sensing	5.000	3.000
Congressional Add: Program increase - Advanced lethality concepts and analysis ***FY 2021 Accomplishments:*** Conducted applied research in Advanced Lethality Concepts and Analysis. Work executed by Army Futures Command.	7.500	-
Congressional Add: Program increase - counter UAS technology in arctic environments ***FY 2021 Accomplishments:*** Conduct applied research in Counter UAS Technology in Artic Environments. Work executed by Army Futures Command.	10.000	-
Congressional Add: Program Increase- Hybrid additive manufacturing ***FY 2021 Accomplishments:*** Conducted applied research in Hybrid Additive Manufacturing.	10.000	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** BS6 / *Lethality Technology (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Hybrid Additive Manufacturing for Advanced Lethality		
Congressional Add: Program increase - novel and sustainable energetic materials ***FY 2021 Accomplishments:*** Conducted applied research in Novel and Sustainable Energetic Materials. Work executed by Army Futures Command.	24.000	-
Congressional Add: Program increase - quantum technologies for armament systems ***FY 2021 Accomplishments:*** Conducted applied research in Quantum Technologies for Armament Systems. Work executed by Army Futures Command.	10.000	-
Congressional Add: Program increase - solid fuel propulsion technology ***FY 2021 Accomplishments:*** Conducted applied research in Solid Fuel Propulsion Technology. Work executed by Army Futures Command.	10.000	-
Congressional Add: Hypersonic Wind Tunnel Development ***FY 2022 Plans:*** Congressional Interest Item funding provided for Hypersonic Wind Tunnel Development	-	6.500
Congressional Add: Materials Processing Manufacturing Technology ***FY 2022 Plans:*** Congressional Interest Item funding provided for Materials Processing Manufacturing Technology	-	10.000
Congressional Add: Universal Nanocrystalline Alloys ***FY 2022 Plans:*** Congressional Interest Item funding provided for Universal Nanocrystalline Alloys	-	3.000
Congressional Adds Subtotals	76.500	27.500

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) CF7 / *Solid-state Laser Concepts and Architectures*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CF7: *Solid-state Laser Concepts and Architectures*	-	-	7.547	8.567	-	8.567	9.848	9.837	9.840	9.838	0.000	55.477

A. Mission Description and Budget Item Justification

This Project provides the research and development of advanced solid-state laser materials and architectures to support the Army Directed Energy Strategy for laser-based directed energy (DE) weapons. This Project investigates advanced laser technologies based on unconventional solid-state laser concepts and designs, scalable and intelligent power modules, and advanced thermal management systems for the development of less complex, low size, weight, and power (SWaP) Army DE weapons and tactical lasers with much improved capabilities.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: High Energy Laser (HEL) Enabling Technologies for Tactical Directed Energy Weapons	-	7.271	8.567
Description: Investigate novel solid-state laser concepts, architectures, and components in support of the Army?s HEL weapons strategy.; develop innovative laser gain materials with much improved spectral, thermal, thermo-mechanical, and thermo-optical properties; and develops increased power while reducing size and weight, and complexity of all HEL components			
FY 2022 Plans: Will further explore the potential of fiber laser power scaling based on crystalline core/crystalline cladding (C4) fiber designs, as it pertains to power scaling to a 5 kW power level, continuous wave (CW); design and develop new high power pump couplers with reduced insertion loss and advanced heat management; investigate advanced fiber end-capping techniques, enabling power scaling out of a single fiber aperture well beyond the current state-of-the-art; model and analyze wide band gap semiconductor performance in the power switching system with the goal of providing higher efficiency.			
FY 2023 Plans: Will investigate potential of fiber laser power scaling out of a single fiber aperture by a factor of upwards 10X based on state-of-the-art glass laser fibers with modified glass composition aimed at: significantly reducing losses and instabilities from optical and thermal non-linearities; improve C4 fiber designs by adding a splicing capability of C4 fibers with silica-based pump couplers and pump-signal combiners; improve designs and further power scale directly-diode-pumped fiber lasers; assess new thermal storage			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CF7 / *Solid-state Laser Concepts and Architectures*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
materials and thermal management techniques; funds research of new compact and efficient DE specific power conversion topology concepts. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding increase supports additional research into Directed Energy power conversion topology concepts.			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.276	-
Accomplishments/Planned Programs Subtotals	-	7.547	8.567

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) CF8 / *Terminal Effects Against Critical Targets Tech*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CF8: *Terminal Effects Against Critical Targets Tech*	-	-	4.040	3.938	-	3.938	2.170	1.026	5.141	4.299	0.000	20.614

A. Mission Description and Budget Item Justification

This Project designs and develops engineering tools and high-fidelity modeling and simulation capabilities for materials and structural response to predict and enhance weapons performance to ensure lethality against structures and critical assets. Through dynamic impact experiments for a broad range of velocities against conventional and advanced structural materials, this project develops engineering tools and technologies to rapidly evaluate and predict weapon performance.

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

Work in this Project is performed by the United States (U.S.) Engineer Research and Development Center (ERDC) in coordination with U.S. Army Futures Command (AFC).

Work in this Project complements PE 0603116A (Lethality Advanced Technology) / Project CH5 (Terminal Effects Against Critical Targets Adv Tech).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Advanced Terminal Weapons Effects Technology	-	3.893	3.938
Description: This effort develops and validates terminal weapons effects prediction capabilities for Long Range Precision Fires (LRPF) weapons against geomaterials, structures, and other critical assets. ***FY 2022 Plans:*** Conduct lab and scaled field experiments of blast/fragmentation munitions against critical protective materials; design and develop fast running engineering tools to support LRPF weapon design and performance evaluation; and investigate Battle Damage Assessment (BDA) using Non-Line-of-Sight (NLOS) imagery. ***FY 2023 Plans:*** Will investigate low velocity and low aspect ratio impact conditions for penetration code prediction capabilities of army warheads, will develop models for shock propagation to expand predictive capabilities for enhanced blast effects, will implement single-degree-of-freedom (SDOF) models into BlastX tool for coupled blast/frag interactions with structures, and will develop two-dimensional (2D) to three-dimensional (3D) rapid conversion capabilities for NLOS BDA methods. ***FY 2022 to FY 2023 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CF8 / *Terminal Effects Against Critical Targets Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Funding change reflects the planned lifecycle of this effort to realign resources to PE 0603116A (Lethality Advanced Technology) / Project CH5 (Terminal Effects Against Critical Targets Adv Tech) as technologies are transitioned for maturation and demonstration.			
Title: FY 2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.147	-
Accomplishments/Planned Programs Subtotals	-	4.040	3.938

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 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) CG4 / *Advanced Radar Concepts and Technologies*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CG4: *Advanced Radar Concepts and Technologies*	-	-	4.687	5.891	-	5.891	5.982	5.996	8.932	8.929	0.000	40.417

A. Mission Description and Budget Item Justification

This Project conducts experiments on single crystal diamond and diamond hetero-structure semiconductor materials, layered structures, and novel devices for Diamond Electronics and integrated photonics structures and devices for Radar, Communications, and improved Size, Weight, and Power (SWaP) Department of Defense systems. Efforts include multiscale modeling, material and structure growth and characterization, and novel device design and fabrication as well as two-dimensional (2-D) electronics for bio-inspired neuromorphic sensors, processors, and memory. This research has application to radars, communication systems, electronic warfare, directed energy, electronics for hypersonic systems, radiation hard systems, quantum sensing, and others. This Project directly supports Air and Missile Defense modernization priority capabilities by investigating essential component technologies for insertion into Multi-Mission Army Radar systems. This Project addresses the challenges of integrating new materials into Silicon Complementary Metal Oxide Semiconductor (CMOS) processing flows, and electronics reliability including protection against unintended adversarial use of state-of-the-art semiconductor materials, devices, and systems for Air and Missile Defense in contested environments.

Work in this Project complements PE 0603466A (Air and Missile Defense Advanced Technology) Project AD6 (Next Generation Fires Radar Advanced Technology).

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Antennas and Radio Frequency (RF) Device Components for Advanced Electronic Systems	-	4.516	4.952
Description: Conduct experiments into novel diamond material and silicon photonic device structures operable in the RF electromagnetic spectrum with high radiated power density for increased radar range and better target detection, improved efficiency of communications systems, smaller SWaP for electronics/cooling of autonomous systems, high temperature electronics for hypersonics, and radiation hardened electronics.			
FY 2022 Plans: Will investigate the growth and properties of single crystal diamond and diamond/boron nitride heterostructures, including different carbon-boron-nitrogen compositions, n-type and p-type doping of the alloys, and the generation of defects associated with growth techniques and fundamental studies on chip-scale.			
FY 2023 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CG4 / *Advanced Radar Concepts and Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will conduct assessment of RF phased array beam steering embodiments and down select to optimal design in terms of SWaP and manufacturability; assess techniques for high polarization isolation and minimizing grating lobes from wideband and distributed antennas; fabricate and characterize diamond and boron nitride substrates and device test structures for correlation between the fundamental properties and the measured electrical performance. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Title: Distributed Radar Architectures ***Description:*** This research seeks to validate critical functions and perform proof-of-concept laboratory experimentation to develop phase synchronous, coordinated radar and multi-function effects that enable distributed, global positioning system (GPS)-independent, autonomous capabilities. This effort validates critical synchronized distributed networked sensor functions and novel signal processing methods. This effort validates advanced antenna designs for low size, weight, power and cost (SWAP-C), multi-function systems. ***FY 2023 Plans:*** Will design spatially distributed radar nodes experiments to validate wireless time synchronization and frequency synchronization for coherent microwave beamforming; determine antenna requirements for individual nodes and develop SWaP-efficient approaches to optimize radar network performance; design and validate algorithms for node synchronization to establish time, phase, and frequency lock and to reduce antenna beam sidelobes created by the distributed, sparse apertures. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding administratively realigned from PE 0602148A (Future Vertical Lift Technology) / Project AL8 (Holistic Situational Awareness and Dec Making Tech), to support the creation of this ?Distributed Radar Architectures? task.	-	-	0.939
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.171	-
Accomplishments/Planned Programs Subtotals	-	4.687	5.891

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CG4 / *Advanced Radar Concepts and Technologies*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) CI1 / *Advanced Armaments Lethality Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CI1: *Advanced Armaments Lethality Technology*	-	-	-	1.544	-	1.544	1.677	2.568	3.065	3.754	0.000	12.608

Note

This is a new start in FY 2023.

This Project is a New Start for Fiscal Year 2023 (FY23).

A. Mission Description and Budget Item Justification

This Project designs and develops novel armament systems concepts and enabling technologies in weapons, munitions, and fire control, in order to advance range and accuracy capabilities.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Advanced Armaments Lethality Technology	-	-	1.544
Description: This project designs and develops novel armament systems concepts and enabling technologies in weapons, munitions, and fire control required to enable and dominate Multi Domain Operations (MDO). This includes advancing state of the art armament system technologies to provide overmatch against current and future threats. ***FY 2023 Plans:*** Will investigate novel multi-role and multi-mission armament concepts, increasing lethal effectiveness across calibers and platforms; investigate novel payloads, effects, and deployment schemes across current and future platforms to defeat and/or disrupt: material, personnel, and broad spectrum targets. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** In FY 2023 this effort is a new start.			
Accomplishments/Planned Programs Subtotals	-	-	1.544

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CI1 / *Advanced Armaments Lethality Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) CJ1 / *Lethality Enabling University Applied Research*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CJ1: *Lethality Enabling University Applied Research*	-	-	5.794	6.570	-	6.570	7.165	7.814	8.284	8.282	0.000	43.909

A. Mission Description and Budget Item Justification

The Project leverages research and technological innovations from academia, of lethal directed energy, laser diagnostics and accelerated design of future hypersonics and their scramjet engine combustion, deep learning (DL) guidance tools and novel materials of importance to the Army, by accelerating research and conducting experiments focused on getting technology to the warfighter more quickly. 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 Long Range Precision Fires and Air and Missile Defense. This Project focuses on employment of research technologies originating from extramural applied research in academia pertaining to lethal directed energy, laser diagnostics, future hypersonic glide body and scramjet propulsor design, DL guidance tools, novel materials, and expansion of the Ballistic, Aero-Optics and Materials (B.A.M.) range applied to lethality. This effort conducts applied research and development leading to potential emerging technologies in areas of strategic importance to the Army in directed energy, future hypersonic glide body design, DL and novel materials, etc., by bringing competitively selected Universities with research and development teams into Technical Alliances.

Work in this Project supports the Army Modernization Priority Long Range Precision Fires and Air and Missile Defense.

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

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

This work is done in coordination with Program Element 0602147A (Long Range Precision Fires) andProgram Element 0602150A (Air and Missile Defense Technologies)

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Laser Diagnostics for Hypersonics and Directed Energy	-	1.925	1.689
Description: This effort researched systematic expansion in laser diagnostics technologies to assess hypersonic turbulence and boundary layer transition. Work is conducted in collaboration with university partners to advance the effects of atmospheric turbulence on laser propagation and gain applied knowledge in directed energy systems effectiveness and range. ***FY 2022 Plans:*** Will investigate methods to expand laser diagnostics and the flight envelope of the existing glide body, accelerate design of block upgrades and future hypersonic glide bodies; reduce flight test risks. Will investigate new backward lasing guidestar methods to			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CJ1 / *Lethality Enabling University Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
improve correction for atmospheric distortion. Will conduct experiments to inform the development of the B.A.M. range for testing and evaluation of hypersonic and directed energy systems. ***FY 2023 Plans:*** Will continue to investigate methods to expand laser diagnostics and the flight envelope of the existing glide body, accelerate design of future hypersonic glide bodies; reduce flight test risks. Will investigate methods to improve directed energy system lethality. Will investigate methods to improve correction for atmospheric distortion. Will conduct experiments to inform the development of the B.A.M. range for testing and evaluation of hypersonic and directed energy systems. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Title: Turbulence and Transition Modeling and Validation for Hypersonic Vehicles ***Description:*** This effort is conducted in collaboration with university partners to develop modeling tools to help inform the flight envelope of existing hypersonic vehicles to accelerate design of future hypersonic glide bodies. ***FY 2022 Plans:*** Will design and develop modeling techniques to expand the flight envelop and control of the existing glide body. Funds applied research to inform the development of the B.A.M. range for testing and evaluation of aerothermodynamic performance at hypersonic speeds. ***FY 2023 Plans:*** Will continue to design and develop modeling techniques to expand the flight envelop and control of the existing glide body. Will investigate methods to accelerate design of future hypersonic glide bodies and systems. Investigate methods to reduce flight test risk through modeling and sub-scale wind tunnel testing of effects of new design features. Will conduct experiments to inform the development of the B.A.M. range for testing and evaluation of aerothermodynamic performance at hypersonic speeds. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.	-	1.800	1.783
Title: Novel Materials for Extreme Environments ***Description:*** This effort produces a test environment for thermal and ablation evaluation of novel materials relevant to hypersonic vehicles. Work is conducted in collaboration with university partners to assess material characteristics and develop computational models of high strain rate materials to mitigate the effects of high kinetic energy impacts. ***FY 2022 Plans:***	-	1.047	1.200

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CJ1 / *Lethality Enabling University Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will develop critical high temperature materials and characterize for the design of thermal protection systems to overmatch from high temperatures and high kinetic energy impacts. Will investigate material ablation models and the effect of material layering on ballistics and hypervelocity impact energy absorption, damage mitigation, and penetration resistance. ***FY 2023 Plans:*** Will continue to develop critical high temperature materials and characterize for the design of thermal protection systems to overmatch from high temperatures and high kinetic energy impacts. Will investigate material ablation models and the effect of material layering on ballistics and hypervelocity impact energy absorption, damage mitigation, and penetration resistance. Will investigate models that account for high strain rate materials performance. Will conduct experiments to inform the development of the B.A.M. range for materials testing at hypersonic speeds. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Title: Intelligent Hypersonics and Other Vehicle Systems ***Description:*** This effort develops and designs geometrically relevant testing hardware required to study aerothermodynamic performance, increase impact velocity and extend range of precision strike munitions. Work is conducted in collaboration with university partners to collect experimental data and insights required to train deep learning neural networks used for the development of hypersonic vehicle flight systems with adaptability and increased lethality. ***FY 2022 Plans:*** Will investigate characterization of hardware ablation (or structural deformation) using Mach 5 or above wind tunnel. Will design and develop testing hardware for data collection and training of deep neural network using wind tunnel data and synthetic flight control system of a geometrically relevant vehicle. Will develop intelligent defense vehicle systems using DL algorithms for improved surveillance, detection, and tracking and overcoming line-of-sight constraints. ***FY 2023 Plans:*** Will continue to develop intelligent defense vehicle systems using DL algorithms for improved surveillance, detection, and tracking and overcoming line-of-sight constraints. Will develop axisymmetric scramjet propulsor with transpiration fuel delivery system for high-speed projectiles. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Increase funding supports optimal designs of scramjet propulsor leveraging new innovation concepts.	-	0.811	1.898
Title: SBIR/STTR Transfer ***FY 2022 Plans:***	-	0.211	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CJ1 / *Lethality Enabling University Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	5.794	6.570

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) CJ6 / *Advanced Energetics for Missile Technologies*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CJ6: *Advanced Energetics for Missile Technologies*	-	-	1.185	-	-	-	-	-	-	-	0.000	1.185

Note

This Project is Terminated for Fiscal Year 2023 (FY23).

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priorities through funding research and developing energetic (propellant) technologies and processes for increased performance, expanded operation temperature bounds, and improved safety and environmental compliance of missile systems.

Work in this Project complements PE 0602147A (Long Range Precision Fires Technology), PE 0602150A (Air and Missile Defense Technology); and 0602141A (Lethality Technology) / Project AH9 (Advanced Warheads Technology).

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Advanced Energetics Technology (Missiles)	-	1.142	-
Description: This effort investigates new and emerging energetic ingredients and processes for propellant formulations to enable enhanced performance and mission flexibility by extending the reach and effects of tactical and strategic missile systems. ***FY 2022 Plans:*** Will investigate current and future substances that provide higher delivered specific impulse density in rocket propellants; novel binders (both energetic and inert); will mature processing techniques to improve mass fraction; and will investigate explore concepts for improved combustion properties to improve efficiency. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** This effort completes in FY22.			
Title: FY2022 SBIR/STTR Transfer	-	0.043	-
Description: Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CJ6 / *Advanced Energetics for Missile Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	1.185	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) CJ7 / *Future Air Defense Missile Enabling Tech*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CJ7: *Future Air Defense Missile Enabling Tech*	-	-	1.498	14.655	-	14.655	2.314	4.573	4.574	4.573	0.000	32.187

A. Mission Description and Budget Item Justification

This Project investigates, develops, and evaluates critical missile technologies and components necessary for advanced lethal capability in support of future/mid to far term affordable short range air defense interceptor capability to defeat Cruise Missile (CM), Rotary Wing (RW), Tactical / Lethal Unmanned Aerial System (UAS), and Fixed Wing (FW) threats. This effort designs and develops technologies to provide advanced materials, seekers, guidance and control, and propulsion for reduced size weight and power and cost for Maneuver Short Range Air Defense (MSHORAD), Short Range Air Defense (SHORAD), and Lower Tier essential to maintain overmatch against mid-/far-term threats. This project supports Air and Missile Defense Modernization priority efforts.

This research is coordinated with Program Element (PE) 0602141A (Lethality Technology) / Project CJ6 (Advanced Energetics for Missile Technologies); PE 0602147A (Long Range Precision Fires Technology / Project AF3 (Extended Range Propulsion Technology) and Project AF8 (Affordable Extended Range Precision Technology). The research complements PE 0602150A (Air and Missile Defense Technology) / Project AD3 (Maneuver Air Defense Technology) and PE 0603466A (Air and Missile Defense Advanced Technology) / Project AD4 (Maneuver Air Defense Advanced Technology).

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Future Air Defense Missile Enabling Technology	-	1.443	14.655
Description: Designs and develops reduced cost advanced Air Defense missile critical components essential to maintain overmatch against mid/far term M-SHORAD, SHORAD, and Lower Tier threats. ***FY 2022 Plans:*** Will conduct component level trade studies and will investigate reduced space, weight, power and cost designs for improved future Air Defense missile seeker, guidance and control, aerostructures, and propulsion technologies. ***FY 2023 Plans:*** Will develop hardware, software, and algorithms for reduced space, weight, power and cost improved future Air Defense missile seeker, guidance and control, aerostructures, and propulsion technologies. Will design, develop and evaluate an Active Electronically Scanned Array (AESA) radar seeker capable of supporting a variety of missions, weapon sizes and threats. Will develop and evaluate seeker-based fuzing; Will develop and evaluate strap-down guidance techniques for maneuvering targets.			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CJ7 / *Future Air Defense Missile Enabling Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will perform trade studies with industry to identify next generation concepts and emerging technology development (including resilient sensors, advanced warhead/fuzing, and propulsion) that is interoperable, scalable and affordable to reduce risk for future air and missile defense interceptor capabilities; Will assess and mature component designs using high-fidelity models and simulation tools against future threats. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Increase in funding required to continue critical and high priority BA 2 investments in advanced seeker technologies and future interceptor concepts to increase lethality and defeat against Tactical / Lethal Unmanned Aerial System (UAS), Cruise Missile (CM), Rotary Wing (RW), and Fixed Wing (FW) threats. Funding realigned from PE 0603466A (Air and Missile Defense Tech) / Project AD4 (Maneuver Air Defense Advanced Technology).			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.055	-
Accomplishments/Planned Programs Subtotals	-	1.498	14.655

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) CZ9 / *Foundational Hypersonic Weapons Research*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CZ9: *Foundational Hypersonic Weapons Research*	-	-	-	7.876	-	7.876	8.323	8.730	9.357	9.562	0.000	43.848

Note

This is a new start in FY 2023.

This Project is a New Start for Fiscal Year 2023 (FY23).

A. Mission Description and Budget Item Justification

This Project investigates foundational problems associated with high-speed weapons and informs the future strategic fires echelon of Long Range Precision Fires capabilities. This Project funds the research of material science subjects such as extreme thermal loading and aero-thermodynamics and control technologies for high-speed vehicles which may encounter high mechanical loads at launch.

Work in this Project transitions foundational research obtained in Program Element (PE) 0601102A (Defense Research Sciences) / AA7 (Mechanics and Ballistics) and complements PE 0602141A (Lethality Technology) / AH4 (Precision and Cooperative Weapons in Denied Environments), AH5 (Projectile and Multi-Function Warhead Technologies), Project AH6 (Disruptive Energetics and Propulsion Technologies), AH7 (Lethal and Scalable Effects Technologies), and AH8 (Lethality Materials and Processes Technology), PE 0602144A (Ground Technology) / BL1 (Materials and Manufacturing Research Technology), and PE 0602145A (Next Generation Combat Vehicle) / BI4 (Materials Application and Integration Tech).

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

This work is consistent with the needs of the Army Research Priority of Hypersonic Flight.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Foundational Hypersonic Weapon Materials	-	-	6.150
Description: This effort investigates materials synthesis and processing (including innovative approaches such as high-throughput materials-by-design using artificial intelligence and machine learning algorithms), novel experimental techniques, and fundamental theoretical modeling to decrease cost, increase availability, and model thermal and mechanical survivability on hypersonic vehicles. Specific research topics include polymer/resin synthesis for composites, novel three-dimensional composite			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** CZ9 / *Foundational Hypersonic Weapons Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
weave architectures, composite processing (process by which the material is made), ceramic window/dome materials, high-temperature metallic alloys, and joining techniques. ***FY 2023 Plans:*** Will investigate means of reducing processing costs for carbon-carbon composites; formulate initial materials-by-design workflow on high temperature metallic alloys and ceramics for leading edges (any regions of a body that encounters the free-stream flow); research manufacturing methods for ceramics and ceramic matrix composites for guidance. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** This effort is a New Start for Fiscal Year 2023 (FY23).			
Title: Foundational Hypersonic Weapons Flight and Control ***Description:*** This effort increases understanding of hypersonic vehicle flight behavior and control approaches for more aggressive, rapid, low risk multi-disciplinary designs of future hypersonic vehicles featuring enhanced agility/stability necessary for survivable delivery to advanced threats of the future. Research includes fundamental flow physics and chemistry, guidance and flight control algorithms, vehicle maneuver control mechanisms, novel vehicle shapes, and the theoretical modeling, computational toolsets, and experimental techniques to achieve these advancements. ***FY 2023 Plans:*** Will improved state-of-the-art toolsets and preliminary flight characterization including boundary layer transition and shock-boundary layer interactions on Army-relevant high-speed vehicle; conduct hypersonic ballistic range experimental capability improvements to refine and enhance the Army?s ability to measure hypersonic vehicle behaviors; develop high-speed munition flight control algorithms to reduce cycle time and compensate for uncertainties. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** This effort is a New Start for Fiscal Year 2023 (FY23).	-	-	1.726
Accomplishments/Planned Programs Subtotals	-	-	7.876

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A