Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army											Date: February 2020	
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 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
Total Program Element	-	0.000	69.961	42.425	-	42.425	45.824	45.587	46.013	44.071	0.000	293.881
AH5: *Projectile and Multi-Function Warhead Technologies*	-	0.000	3.446	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.446
AH6: *Disruptive Energetics and Propulsion Technologies*	-	0.000	8.275	8.432	-	8.432	8.602	8.775	8.874	8.874	0.000	51.832
AH7: *Lethal and Scalable Effects Technologies*	-	0.000	1.869	1.057	-	1.057	1.954	1.328	1.540	1.540	0.000	9.288
AH8: *Lethality Materials and Processes Technology*	-	0.000	3.954	4.046	-	4.046	4.109	4.026	4.071	4.112	0.000	24.318
AH9: *Advanced Warheads Technology*	-	0.000	9.417	23.802	-	23.802	27.069	27.610	29.416	29.545	0.000	146.859
AI1: *Advanced Terrain Shaping Technology*	-	0.000	0.000	5.088	-	5.088	4.090	3.848	2.112	0.000	0.000	15.138
BS6: *Lethality Technology (CA)*	-	0.000	43.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	43.000

Note

In Fiscal Year 2020 (FY20), funding in this Program Element (PE) was realigned with continuity of effort from the following PEs:
* 0602105A Materials Technology
* 0602618A Ballistics Technology
* 0602624A Weapons and Munitions Technology

A. Mission Description and Budget Item Justification

Work done in this 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).

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality 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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	26.961	30.215	-	30.215
Current President's Budget	0.000	69.961	42.425	-	42.425
Total Adjustments	0.000	43.000	12.210	-	12.210
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	43.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	12.210	-	12.210

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2019	FY 2020
Project: BS6: *Lethality Technology (CA)*		
Congressional Add: *Medium Range Railgun Weapon System*	-	20.000
Congressional Add: *Additive Manufacturing Research*	-	5.000
Congressional Add: *Mobile Environment Contaminant Sensors*	-	5.000
Congressional Add: *Hybrid Additive Manufacturing*	-	8.000
Congressional Add: *Next Generation Air-Breathing Propulsion Technology*	-	5.000
Congressional Add Subtotals for Project: BS6	-	43.000
Congressional Add Totals for all Projects	-	43.000

Change Summary Explanation

FY20 increase was due to $43.000 million of Congressional Add funding.

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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*

FY21 increase due to realignment of PE 0602147A (Long Range Precision Fires Technology)/Project AG8 (Advanced Energetics Technology) to PE 0602141A (Lethality Technology)/Project AH9 (Advanced Warheads Technology).

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / *Lethality Technology*	Project (Number/Name) AH5 / *Projectile and Multi-Function Warhead Technologies*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AH5: *Projectile and Multi-Function Warhead Technologies*	-	0.000	3.446	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.446

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
Program Element (PE) 0602618A Ballistics Technology
* Project H80 Survivability and Lethality Technology

In FY21, this Project is being realigned to:
PE 0602143A Soldier Lethality Technology
* Project AY6 Soldier Squad Small Arms Armaments Technology
PE 0602145A Next Generation Combat Vehicle Technology
* Project BK5 Adv Direct In-Direct Armament Sys (ADIDAS) Tech

A. Mission Description and Budget Item Justification

This Project designs and validates novel lethal mechanism technologies to reduce energy or mass required to defeat emerging armor threats and provide multipurpose options for revolutionary capability to include defeat of advanced Tier 1 adversary vehicle and body armors.

This research is coordinated with PE 0602141A (Lethality Technology) / Project AH7 (Lethal and Scalable Effects Technologies), PE 0602143A (Soldier Lethality Technology / Project AY6 (Soldier Squad Small Arms Armaments Technology), and PE 0603462A (Next Generation Combat Vehicle Advanced Technology) / Project BF5 (Adv Lethality & Accuracy System for Med Cal Adv Tech) 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 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 2019	FY 2020	FY 2021
Title: Defeat of Adversary Vehicle Armors	-	2.219	-
Description: This effort designs, models and evaluates longer range, higher velocity munitions though reduction of parasitic mass required to launch and deliver lethality via new composite materials and architecture; Develops higher energy, more lethal cannon			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AH5 / *Projectile and Multi-Function Warhead Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
(1.5X M256) through modification of blast field. This effort provides testing and modeling and simulation of Lightweight 50mm Armor Piercing round for advanced, direct-fire medium caliber weapons. ***FY 2020 Plans:*** Will develop projectiles that resist ricochet and maintain fragmentation lethality. Demonstrate robust penetrator concept versus threat Tier 1 armor. Demonstrate full scale tank gun muzzle blast mitigation to enable defeat of threat Tier 1 armor. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** In FY21, this effort is realigned to PE 0602145A (Next Generation Combat Vehicle) / Project BK5 (Adv Direct In-Direct Armament Sys (ADIDAS) Tech).			
Title: Defeat of Adversary Body Armor ***Description:*** This effort designs, models and evaluates defeat mechanisms for adversary body armor through time-resolved penetration mechanics and energy efficient munitions. This effort supports the development of small caliber lethal mechanisms for PE 0602143A (Soldier Lethality Technology) / Project AY6 (Soldier Squad Small Arms Armaments Technology). ***FY 2020 Plans:*** Will develop high fidelity computer models to predict the performance of novel penetrators versus body armors and metallic targets; Perform high spatial and temporal resolution radiographic and phase contrast imaging during ballistic impact of conventional and advanced penetrator systems to assist in computational model calibration, parameterization and validation; Develop and apply new diagnostic techniques to highly transient dynamic impact problems. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** In FY21, this effort is realigned to PE 0602143A (Soldier Lethality Technology) / Project AY6 (Soldier Squad Lethality Tech).	-	1.071	-
Title: FY 2020 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.156	-
Accomplishments/Planned Programs Subtotals	-	3.446	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AH5 / *Projectile and Multi-Function Warhead Technologies*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AH6: *Disruptive Energetics and Propulsion Technologies*	-	0.000	8.275	8.432	-	8.432	8.602	8.775	8.874	8.874	0.000	51.832

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602618A Ballistics Technology:
* Project H80 Survivability and Lethality Technology

A. Mission Description and Budget Item Justification

This Project investigates, models and evaluates 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 five 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 2019	FY 2020	FY 2021
Title: Synthesis, Formulation and Diagnostics of Energetic Materials	-	4.827	5.072
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 2020 Plans: Will develop new materials and formulations with 50% better performance than current state of the art. Potential molecules for transition as melt cast / eutectics formulations are (go/no-go depending on passing safety, scale-up, and performance			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
parameters). Will utilize previous or currently under development micro-scale diagnostic techniques to characterize and evaluate traditional and disruptive energetic candidates for use as high performing rocket / gun propellants or explosive formulations. ***FY 2021 Plans:*** Will continue to develop new materials and formulations with 50% better performance than current state of the art; develop scale-up processes of molecules for transition as melt cast / eutectics formulations (go/no-go depending on passing safety, scale-up, and performance parameters); develop new energetic plasticizers and high-temperature materials; formulate new explosive and propellants using synthesized materials (both energetic and polymer); utilize previous or currently under development micro-scale diagnostic techniques to characterize and assess traditional and disruptive energetic candidates for use as high performing rocket / gun propellants or explosive formulations. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding increase to support planned new material development activities.			
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 2020 Plans:*** Will incorporate 1) improved predictive software capability for gun interior ballistics design and 2) equation of state and reactivity from first principles into the warhead design continuum software suite. Simulation results will be transitioned to formulators and advanced concept designers. ***FY 2021 Plans:*** Will continue to investigate improved predictive capability for gun interior ballistics design into energetics and munitions software and equation of state and reactivity from first principles into the warhead design continuum software suite; will design simulation results with and transitioned to formulators and advanced concept designers. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding increase to support additional simulations needed to mature models for predicted response of energetic materials.	-	1.627	1.787
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 2020 Plans:***	-	1.445	1.573

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Will develop and evaluate advanced additively manufactured propellant designs and geometries to produce higher muzzle energy, longer range gun launched munitions. Will evaluate novel nanocrystalline gun barrel coatings for increased temperature/pressure tolerance produced from Project AH8 (Lethality Materials and Processes Technologies) within this PE. ***FY 2021 Plans:*** Will continue to develop and assess advanced additively manufactured propellant designs and geometries to produce higher muzzle energy, longer range gun launched munitions; will develop new gun geometries to maximize muzzle velocity while decreasing system weight. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Nominal planned change of scope			
Title: FY 2020 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.376	-
Accomplishments/Planned Programs Subtotals	-	8.275	8.432

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AH7: *Lethal and Scalable Effects Technologies*	-	0.000	1.869	1.057	-	1.057	1.954	1.328	1.540	1.540	0.000	9.288

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602618A Ballistics Technology:
* Project H80 Survivability and Lethality

A. Mission Description and Budget Item Justification

Work in this Project designs, fabricates and evaluates 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 evaluate 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 2019	FY 2020	FY 2021
Title: Munition Efficiency and Scalability	-	1.869	1.057
Description: This effort investigates, designs, models and evaluates technologies to produce blast-fragment warheads with tailored fragment geometries to optimize target defeat; Identifies and develops warhead impact patterns to optimize target defeat with reduced collateral damage; Designs, codes and evaluates 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 2020 Plans: Will develop warhead impact patterns to optimize target defeat with minimum energy, reduced number of warheads and minimum collateral damage; Will additively manufacture and evaluate tailored fragment geometries for optimal target defeat; Will build			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
upon FY19 progress to evaluate methodologies for tailored warhead delivery. Demonstrate preprogrammed, predefined pattern delivery of three warheads. ***FY 2021 Plans:*** Will conduct experiments, simulations, and analytic analyses to determine spatial and temporal requirements to achieve synergistic effects; will continue to design high fidelity models to optimize munition for mixed target sets and improved models for weapons effects in urban environments; will perform vulnerability and lethality studies to select lethal mechanisms for modular munitions ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funds realigned to higher priority Army Science and Technology efforts.			
Accomplishments/Planned Programs Subtotals	-	1.869	1.057

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AH8: *Lethality Materials and Processes Technology*	-	0.000	3.954	4.046	-	4.046	4.109	4.026	4.071	4.112	0.000	24.318

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602105A Materials Technology:
* Project H84 Material

A. Mission Description and Budget Item Justification

Work in this Project designs, fabricates, and evaluates, 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 Projects 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 2019	FY 2020	FY 2021
Title: Materials for Advanced Lethality	-	3.774	4.046
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 2020 Plans: Will develop three-dimensional woven carbon-carbon (C-C) composite preform and new resins, guided by modeling and simulation, to create low defect C-C composite structures for hypervelocity missile components; will develop 3-dimensional (3D) printable energetic polymers for gun and rocket propellant applications, along with computational capabilities to optimize burn rates and temperature profiles of printed propellant architectures and transition to Project AH6 (Disruptive Energetics and Propulsion Technologies); will create novel materials and processing methods to enable printing of integrated conductive and dielectric structures onto highly maneuverable flight bodies for PE 0602147A (Long Range Precision Fires Technology) / AH4			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
(Precision and Coop Weapons in a Denied Env Tech); will finalize optimal copper-tantalum alloy design and scale-up processing to enable performance demonstrations and for Project AH5 (Projectile and Multi-Function Warhead Technologies) within this PE. ***FY 2021 Plans:*** Will conduct performance testing on C-C composites to withstand the high temperature regimes of large caliber gun launch and flight while retaining structural integrity; conduct three-dimensional printing at 100 micron resolution optimized with energetic propellants to achieve designed progressive burn rates sufficient to increase projectile speeds and ranges in support of PE 0602147A (Long Range Precision Fires Technology). ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Nominal change of scope			
Title: FY 2020 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.180	-
Accomplishments/Planned Programs Subtotals	-	3.954	4.046

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AH9: *Advanced Warheads Technology*	-	0.000	9.417	23.802	-	23.802	27.069	27.610	29.416	29.545	0.000	146.859

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602624A Weapons and Munitions Technology:
* Project H28 Warheads / Energetics Technology

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 2019	FY 2020	FY 2021
Title: Advanced Warheads	-	8.990	10.902
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 micro warheads using advance materials.			
FY 2020 Plans: Will explore multiple pathways to enhance lethal effects and mission kills on a variety of anti-personnel and anti-materiel targets to ensure lethality overmatch in peer/near-peer engagements. Directional and adaptive warhead technologies will be designed using modeling, simulation and experimentation to reduce collateral damage, enhance soldier survivability and augment effect on target.			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
The use of advanced materials and novel warhead designs, in conjunction with the development of novel initiation schemes, will be validated through experimentation to determine their efficacy in providing lethality overmatch and multi-domain capability. ***FY 2021 Plans:*** Will investigate reactive materials and advanced fragmentation technology to increase lethality by imparting additional energy and enhanced effects on target; will investigate novel structural materials and tunable warhead technologies that will provide additional lethality while enabling survivability in high-g gun environments. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding increase due to additional exploration of lethal effects.			
Title: Advanced Energetics ***Description:*** This effort develops advanced energetic formulations and processing techniques to enable an increase in range, lethality, and effectiveness of munitions. ***FY 2021 Plans:*** Will develop nano-energetic component technologies for use in melt-cast formulations. Will develop polymer kinetics for amorphous energetics; investigate next-generation melt-cast and cast-cure ingredients for higher energy formulations. Will investigate reaction kinetics for ingredient synthesis. Investigate energetic materials to enable novel energy release mechanisms; design and develop processing parameters necessary to produce energetic materials for additive manufacturing; develop new techniques to accurately predict energetic materials performance in novel and unique geometries ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding increase due to realignment from PE 0602147A Long Range Precision Fires Technology / Project AG8 Advanced Energetics Technology.	-	-	11.700
Title: Energetics (Propellants) ***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 2021 Plans:*** Will investigate current and future substances that provide higher delivered specific impulse density in rocket propellants; novel binders (both energetic and inert); advanced processing techniques to improve mass fraction; will investigate improved combustion properties to improve efficiency. ***FY 2020 to FY 2021 Increase/Decrease Statement:***	-	-	1.200

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Funding increase due to realignment from PE 0602141A Lethality Technology / Project AG8 Advanced Energetics Technology			
Title: FY 2020 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.427	-
Accomplishments/Planned Programs Subtotals	-	9.417	23.802

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AI1: *Advanced Terrain Shaping Technology*	-	0.000	0.000	5.088	-	5.088	4.090	3.848	2.112	0.000	0.000	15.138

Note

In Fiscal Year (FY) 2021 this Project is being realigned from:
Program Element (PE) 0602141A Lethality Technology
* Project AI2 Rapid Risk Analysis of Fires Technology
PE 0603116A Lethality Advanced Technology
* Project AI3 Rapid Risk Analysis of Fires Advanced Technology

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 effective lethality against structures and critical assets. Through dynamic impact experiments for a broad range of velocities against conventional and advanced structural materials, this project will develop 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 Engineer Research and Development Center (ERDC) in coordination with United States Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Advanced Terminal Weapons Effects Technology	-	-	5.088
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 2021 Plans:*** Will conduct laboratory and field experiments to develop and validate modeling and simulation capabilities for accurate prediction of terminal effects and lethality; will design and develop fast running engineering tools to support LRPF weapon design optimization and performance evaluation; and will design critical structural targets with advanced protective materials to validate weapon performance. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding realigned from other Projects to support terminal weapons effects analysis and predictive modeling research.			
Accomplishments/Planned Programs Subtotals	-	-	5.088

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602141A / *Lethality Technology*	**Project (Number/Name)** AI1 / *Advanced Terrain Shaping Technology*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BS6: *Lethality Technology (CA)*	-	0.000	43.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	43.000

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 2019	FY 2020
Congressional Add: Medium Range Railgun Weapon System	-	20.000
FY 2020 Plans: Medium Range Railgun Weapon System		
Congressional Add: Additive Manufacturing Research	-	5.000
FY 2020 Plans: Additive Manufacturing Research		
Congressional Add: Mobile Environment Contaminant Sensors	-	5.000
FY 2020 Plans: Mobile Environment Contaminant Sensors		
Congressional Add: Hybrid Additive Manufacturing	-	8.000
FY 2020 Plans: Hybrid Additive Manufacturing		
Congressional Add: Next Generation Air-Breathing Propulsion Technology	-	5.000
FY 2020 Plans: Next Generation Air-Breathing Propulsion Technology		
Congressional Adds Subtotals	-	43.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A