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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>					R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>							
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	-	-	8.066	9.796	-	9.796	14.361	15.493	12.415	10.382	0.000	70.513
<i>CG2: Lethality Enabling University Adv Development</i>	-	-	6.981	7.653	-	7.653	8.556	8.080	8.517	8.515	0.000	48.302
<i>CH5: Terminal Effects Against Critical Targets Adv Tech</i>	-	-	1.085	2.143	-	2.143	4.002	5.139	1.026	1.867	0.000	15.262
<i>DB2: Future Armaments Scalable Technologies*</i>	-	-	-	-	-	-	1.803	2.274	2.872	-	0.000	6.949

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2023

A. Mission Description and Budget Item Justification

Work done in this Program Element (PE) matures technologies, methodologies, and models required to enable next generation lethality. The PE 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; experimentation 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.

This PE continues to mature and demonstrate technology developed under PE 0602141A (Lethality Technology).

Work in this PE complements PE 0603118A (Soldier Lethality Advanced Technology), PE 0603462A (Next Generation Combat Vehicle Advanced Technology), PE 0603464A (Long Range Precision Fires Advanced Technology), 0603465A (Future Vertical Lift Advanced Technology), and 0603466A (Air and Missile Defense Advanced Technology).

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

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

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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	0.000	8.066	0.000	-	0.000
Current President's Budget	0.000	8.066	9.796	-	9.796
Total Adjustments	0.000	0.000	9.796	-	9.796
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	9.796	-	9.796

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.

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Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>				Project (Number/Name) CG2 / <i>Lethality Enabling University Adv Development</i>			
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
CG2: <i>Lethality Enabling University Adv Development</i>	-	-	6.981	7.653	-	7.653	8.556	8.080	8.517	8.515	0.000	48.302
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Project leverages advanced developments and technological innovations from academia, of lethal directed energy, laser diagnostics and accelerated design of future hypersonics and their scramjet engine combustion, deep learning and novel materials of importance to the Army, by maturing developments and performs demonstrations focused on getting technology to the warfighter more quickly. This Project exploits advanced research and development 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 maturation and demonstration of various advanced technologies originating from extramural applied research in academia pertaining to lethal directed energy, laser diagnostics, future hypersonic glide body and scramjet propulsor design, deep learning, novel materials, and expansion of the Ballistic, Aero-Optics and Materials (B.A.M.) range applied to lethality. This effort validates advanced research and performs demonstrations leading to potential emerging technologies in areas of strategic importance to the Army in directed energy, future hypersonic glide body design, deep learning 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 PE 0620141A (Lethality Technology), PE 0602147A (Long Range Precision Fires), PE 0603464A (Long Range Precision Fires Advanced Technology), and PE 0603466A (Air and Missile Defense Advanced Technology)

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

	FY 2021	FY 2022	FY 2023
Title: Laser Diagnostics for Hypersonics and Directed Energy	-	2.144	2.208
Description: This effort matures laser diagnostics to assess turbulence and boundary layer transition, leading to validation of hypersonic flight models and enhanced directed energy system effectiveness and range through improved targeting, prediction and beam control.			
FY 2022 Plans:			

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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>	Project (Number/Name) CG2 / <i>Lethality Enabling University Adv Development</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Will mature a suite of laser diagnostics for hypersonic ground testing and models to predict effects of atmospheric turbulence on laser propagation. Advanced development to inform the expansion of the Ballistic, Aero-Optics and Materials (BAM)) range for testing and evaluation of hypersonic and directed energy systems.</p> <p>FY 2023 Plans: Will continue to mature a suite of laser diagnostics for hypersonic ground testing and models to predict effects of atmospheric turbulence on laser propagation. Develop capabilities to capture time volumetric gas density hypersonic flow imagery. Advanced development to inform the expansion of the BAM range for testing and evaluation of hypersonic and directed energy systems.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Turbulence and Transition Modeling and Validation for Hypersonic Vehicles</p> <p>Description: This effort matures modeling turbulence and transition for hypersonic vehicles to accelerate design of future hypersonic glide bodies and systems through modeling and sub scale testing.</p> <p>FY 2022 Plans: Will accelerate and mature the design and advancement of hypersonic glide bodies and systems through turbulence and transition modeling. Reduce flight test risk through modeling and sub scale wind tunnel testing of effects of new design features. Advanced development to inform the expansion of the Ballistic, Aero-Optics and Materials (B.A.M.) range for testing and evaluation of aerothermodynamic performance at hypersonic speeds.</p> <p>FY 2023 Plans: Will continue to accelerate and mature the design and advancement of hypersonic glide bodies and systems through turbulence and transition modeling. Will mature boundary layer transition code development. Reduce flight test risk through modeling and sub scale wind tunnel testing of effects of new design features. Advanced development to inform the expansion of the Ballistic, Aero-Optics and Materials (B.A.M.) range for testing and evaluation of aerothermodynamic performance at hypersonic speeds.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	2.789	2.718
<p>Title: Novel Materials for Extreme Environments</p> <p>Description: This effort matures and validates computational and multiscale models of high strain rate materials to mitigate the effects of hypervelocity impacts (HVIs) and offer thermal protection.</p> <p>FY 2022 Plans:</p>		-	0.737	0.800

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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>	Project (Number/Name) CG2 / <i>Lethality Enabling University Adv Development</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Will mature and validate critical high temperature materials and characterization testing and analysis capability for the design of thermal protection systems to defeat emerging threats from hypersonic weapons. Provide protection overmatch from high kinetic energy impacts through material layering and unique structures.</p> <p>FY 2023 Plans: Will continue to mature and validate critical high temperature materials and characterization testing and analysis capability for the design of thermal protection systems to defeat emerging threats from hypersonic weapons. Mature numerical algorithms of select materials. Provide protection overmatch from high kinetic energy impacts through material layering and unique structures.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Intelligent Hypersonics and Other Missile Defense Systems</p> <p>Description: This effort matures and validates hypersonic vehicle flight systems with deep learning neural networks that can adapt to changing conditions and become more lethal. Integration of air and missile defense (AMD) command and control (C2) systems and their instrumentation, simulation, and stimulation.</p> <p>FY 2022 Plans: Will validate ablation characteristics and the semi-autonomous synthetic flight control systems performance utilizing machine learning and deep neural network tools for hypersonic vehicle geometries. Will integrate robust and extensible instrumentation, simulation, and stimulation prototype capability for prototype development, and operational testing of air and missile defense (AMD) C2 systems.</p> <p>FY 2023 Plans: Will validate ablation characteristics and the semi-autonomous synthetic flight control systems performance utilizing machine learning and deep neural network tools for hypersonic vehicle geometries. Will fabricate and mature axisymmetric prototype scramjet propulsor with transpiration fuel delivery system for high-speed projectiles. Will integrate robust and extensible instrumentation, simulation, and stimulation prototype capability for prototype development, and operational testing of AMD C2 systems.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The increased funding provides to develop an optimally designed scramjet propulsor that leverages transpiration fuel supply and boundary layer mixing enhancement to reduce aerodynamic drag, increase impact velocity and extend range of precision strike munitions.</p>		-	1.057	1.927
<p>Title: SBIR/STTR Transfer</p> <p>FY 2022 Plans:</p>		-	0.254	-

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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		-	6.981	7.653
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>				Project (Number/Name) CH5 / <i>Terminal Effects Against Critical Targets Adv Tech</i>			
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
CH5: <i>Terminal Effects Against Critical Targets Adv Tech</i>	-	-	1.085	2.143	-	2.143	4.002	5.139	1.026	1.867	0.000	15.262
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates engineering tools and high-fidelity modeling and simulation capabilities to predict and optimize weapon performance to ensure lethality against structures and critical assets. This project provides validated engineering tools and technologies to rapidly evaluate and predict weapon performance.

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

Research 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).

Research in this Project complements PE 0602141A (Lethality Technology) / Project CF8 (Terminal Effects Against Critical Targets Tech).

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

	FY 2021	FY 2022	FY 2023
Title: Advanced Terminal Effects Demonstration	-	1.045	2.143
Description: Demonstrates and provides a predictive capability for terminal effects and lethality and a fast running engineering tool to support Long Range Precision Fires (LRPF) weaponeering on critical structural and geological targets of interest.			
FY 2022 Plans: Provide engineering codes for blast effects against structures and critical targets and will demonstrate damage detection algorithms for Battle Damage Assessment (BDA) tools.			
FY 2023 Plans: Will demonstrate and provide high fidelity and fast-running runway cratering tools for damage prediction of Army Fires munitions; and provide and integrate steel penetration algorithms for army munitions on critical target sets into weapon effects code.			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort to demonstrate and provide technologies completed in PE 0602141A (Lethality Technology) / Project CF8 (Terminal Effects Against Critical Targets Tech).			
Title: FY 2022 SBIR/STTR Transfer	-	0.040	-

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
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				
Accomplishments/Planned Programs Subtotals		-	1.085	2.143
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
N/A				
D. Acquisition Strategy				
N/A				