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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	92.926	88.768	33.301	-	33.301	31.432	32.574	42.236	42.836	0.000	364.073
AD2: High Energy Laser (HEL) Enabling and Support Techn	-	5.856	-	-	-	-	-	-	-	-	0.000	5.856
AD3: Maneuver Air Defense Technology	-	7.604	-	-	-	-	-	-	-	-	0.000	7.604
AD5: Next Generation Fires Radar Technology	-	1.433	-	-	-	-	-	-	-	-	0.000	1.433
AE2: Unconventional Countermeasures-Survivability Tech	-	3.783	3.947	3.384	-	3.384	2.766	3.769	3.772	3.363	0.000	24.784
BN6: Advanced Weapons Components (CA)	-	74.250	61.752	-	-	-	-	-	-	-	0.000	136.002
CV7: High Energy Laser Direct Diode Apl Tech	-	-	2.902	1.495	-	1.495	3.218	3.030	7.411	8.971	0.000	27.027
CV8: Vulnerability Modules for Multi-Domain Operations	-	-	8.083	8.987	-	8.987	7.734	7.952	8.691	8.786	0.000	50.233
DA9: Radar Survivability through Dis Sensing Tech	-	-	5.803	4.703	-	4.703	4.076	3.767	2.304	2.329	0.000	22.982
DC1: Next Generation DE Concept Development & Analysis	-	-	6.281	6.446	-	6.446	13.638	14.056	20.058	19.387	0.000	79.866
DE3: Adv Beam Control Component Development for C-CM	-	-	-	8.286	-	8.286	-	-	-	-	0.000	8.286

A. Mission Description and Budget Item Justification
 This Program Element (PE) line is directly aligned with the Air & Missile Defense (AMD) Army Modernization Priority. Work in this PE investigates and develops AMD technologies to enable defense of ground forces and selected geopolitical assets from aerial attack, missile attack, and surveillance. Major focus areas for AMD Science and Technology include: Missiles, Directed Energy, Gun-Based Air Defense Technologies, and Battlefield Sensors and Supporting AMD Technologies. Missiles Applied Research investigates and develops a broad range of Missile technologies to enhance Army integrated AMD capabilities at extended range. Directed Energy

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Applied Research investigates and develops critical High Energy Laser (HEL) technologies to explore performance against Air Defense threats and for other Directed Energy applications across Army Modernization Priorities. Gun-Based Air Defense Technologies Applied Research investigates and develops Combined Arms for Air Defense (CAFAD) technologies and components in a laboratory environment. Sensors and Supporting AMD Technologies Applied Research investigates and develops Battlefield Sensor and radar technologies required for detection, acquisition and tracking of air defense targets as well as supporting technologies that enhance AMD.

Work in this PE complements PE 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 is performed by the United States Army Futures Command (AFC), the United States Army Space and Missile Defense Command/Army Strategic Forces Command (SMDC/ARSTRAT), and the United States Army Rapid Capabilities and Critical Technologies Office (RCCTO).

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	93.549	27.016	29.409	-	29.409
Current President's Budget	92.926	88.768	33.301	-	33.301
Total Adjustments	-0.623	61.752	3.892	-	3.892
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	61.752			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.623	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	3.892	-	3.892

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

Project: BN6: *Advanced Weapons Components (CA)*

Congressional Add: *Program Increase - BEAM CONTROL SYSTEMS AND INDUSTRY GRADE OPTICAL FIBER FABRICATION FOR ENERGY LASER*

Congressional Add: *Program Increase - COUNTER UAS CENTER FOR EXCELLENCE*

Congressional Add: *Program Increase: High Energy Laser Testing and Expansion*

Congressional Add: *Program Increase: HIGH ENERGY LASER AND OPTICAL TECHNOLOGY*

Congressional Add: *Program Increase: High Energy Laser Technology Integration*

Congressional Add: *Program Increase - ARMY MISSILE RISK-BASED MISSION ASSURANCE*

	FY 2022	FY 2023
	12.000	9.000
	5.000	5.000
	10.000	-
	6.000	10.000
	10.000	-
	15.000	5.000

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

	FY 2022	FY 2023
Congressional Add: <i>Kill Chain Automation</i>	8.000	-
Congressional Add: <i>Machine Learning Optimized Power Electronics</i>	3.000	-
Congressional Add: <i>Program Increase - Precision Long Range Integrated Strike (PLRIS)</i>	5.250	6.752
Congressional Add: <i>Program Increase - SMALL UAS TRACKING AND TARGETING DEVICES</i>	-	14.000
Congressional Add: <i>Program Increase - CYBER ELECTROMAGNETIC ACTIVITIES MISSILE DEFENDER</i>	-	2.000
Congressional Add: <i>Program Increase - MISSILE RISK-BASED MISSION ASSURANCE</i>	-	10.000
Congressional Add Subtotals for Project: BN6	74.250	61.752
Congressional Add Totals for all Projects	74.250	61.752

Change Summary Explanation

Increased funding due to revised economic assumptions.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology				Project (Number/Name) AD2 / High Energy Laser (HEL) Enabling and Support Techn			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AD2: High Energy Laser (HEL) Enabling and Support Techn	-	5.856	-	-	-	-	-	-	-	-	0.000	5.856

A. Mission Description and Budget Item Justification

This Project conducts static and dynamic High Energy Laser (HEL) vulnerability and lethality analyses and investigates advanced component technologies to enhance performance of future HEL weapons systems against advanced threats. In addition, this Project includes laboratory efforts for HEL applied research as well as concepts analysis for Army core competencies in Directed Energy (DE). This Project investigates low cost, advanced laser technologies based on unconventional solid-state laser concepts, architectures, beam control and advanced beam control schemes for the development of improved size, weight, and power (SWaP) Army DE weapons and tactical laser developers.

Work in this effort compliments other Army DE efforts conducted under PE 0602150A (Air and Missile Defense Technology) and PE 0603466A (Air and Missile Defense Advanced Technology).

The cited research is consistent with the Army's 31+4 programs, the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and supports the Army's future capability opportunities for leap-ahead technology for Directed Energy.

Research is performed by the United States Army Space and Missile Defense Command - Technical Center (USASMDC-TC) with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.

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

	FY 2022	FY 2023	FY 2024
Title: High Energy Laser Enabling and Support Technology	5.856	-	-
Description: This effort provides the underlying data for future High Energy Laser weapons to effectively engage an array of threats. The data includes prioritized aim points on each threat as well as time to defeat the threats for each aim point. This activity includes the full spectrum of target lethality investigations and engagement of flying targets in relevant scenarios. This part of the activity is primarily executed at the Solid State Laser Testbed facility at White Sands Missile Range, New Mexico.			
This effort also focuses on developing core Army expertise through laser and beam control technology assessments, applied research, and other technical core competencies. This effort focuses on developing in-house expertise in Adaptive Optics, Beam Control, laser diodes, target illuminators lasers and beacon illuminator lasers, laser diagnostics, and new tracking algorithms. These technologies can be integrated into future laser systems to locate, identify, and engage critical targets. Results of this research will improve the size, weight and power requirements, and the efficacy of laser weapons systems on Army platforms in the future.			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>	Project (Number/Name) AD2 / <i>High Energy Laser (HEL) Enabling and Support Techn</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Accomplishments/Planned Programs Subtotals	5.856	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) AD3 / Maneuver Air Defense Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AD3: <i>Maneuver Air Defense Technology</i>	-	7.604	-	-	-	-	-	-	-	-	0.000	7.604

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priority Air and Missile Defense capabilities by investigating and developing critical missile technologies and components necessary for an 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 Project also designs and develops technologies to provide 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.

Work in this Project complements Program Element (PE) 0603466A (Air and Missile Defense Advanced Technology) / Project AD4 (Maneuver Air 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 Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Maneuver Air Defense Technology	7.604	-	-
Description: Investigates and develops critical missile technologies and components necessary for an affordable short range air defense interceptor capability to defeat RW, Tactical / Lethal UAS, and FW threats.			
Accomplishments/Planned Programs Subtotals	7.604	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) AD5 / Next Generation Fires Radar Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AD5: Next Generation Fires Radar Technology	-	1.433	-	-	-	-	-	-	-	-	0.000	1.433

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priority Air and Missile Defense capabilities by investigating and developing advanced radar technologies for insertion into Multi-Mission Army Radar systems. This Project addresses challenges facing simultaneously achieving high linearity and efficiency at high frequencies, accuracy in the underlying high frequency device and circuit models, integration of new material into Silicon complementary metal-oxide-semiconductor (CMOS) processing flows, and electronics reliability that appear as new semiconductor materials are developed and feature sizes shrink.

Work in this Project complements Program Element (PE) 0603466A (Air and Missile Defense Advanced Technology) / Project AD6 (Next Generation Fires Radar 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 Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Multi-Mode Air Defense Radar	1.433	-	-
Description: This research supports the technical challenges associated with air defense radar technology. In particular, this effort will analyze current and emerging radio frequency (RF) spoofing, RF jamming, and RF signature management technologies to determine their impact on the performance of air defense radars. Electromagnetic modeling, RF measurements, and experiments will be used to identify mitigation techniques for spoofing and jamming, and to identify useful signature management technologies. This will also include research in electronic devices, sub-assembly design, and laboratory experiments to advance the state-of-the-art of air defense radars operating in contested electronic environments.			
Accomplishments/Planned Programs Subtotals	1.433	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology				Project (Number/Name) AE2 / Unconventional Countermeasures-Survivability Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AE2: Unconventional Countermeasures-Survivability Tech	-	3.783	3.947	3.384	-	3.384	2.766	3.769	3.772	3.363	0.000	24.784

A. Mission Description and Budget Item Justification

This Project designs and develops technologies to deter tactical surveillance and targeting by adversarial area denial systems and munitions. The Project investigates methods to increase survivability of critical assets against precision-guided near-peer advanced weapons threats, investigates and develops tonedown methods for signature management, and computationally develops novel countermeasures. This Project also develops a suite of high-fidelity, physics-based modeling and simulation tools for the design and development of unconventional countermeasures and survivability enhancers applicable to a wide range of operating environments.

Work in this Project complements Program Element (PE) 0603466A (Air and Missile Defense Advanced Technology) / Project AE3 (Unconventional Countermeasures-Survivability ATech).

The work cited 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 Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Model-Based Assessment of Sensors and Countermeasures	2.309	1.878	-
Description: This effort develops a suite of high-fidelity, physics-based modeling and simulation tools for the design and development of unconventional countermeasures for a wide range of operating environments; develops tools for the evaluation of threat detection and object identification.			
FY 2023 Plans: Integrate and blend small high-fidelity models within larger low resolution domains to enable end-to-end modeling of environmental and unconventional countermeasure effects on terminal sensing modalities.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the planned lifecycle conclusion of this effort with transition of technologies to PE 0603466A (Air and Missile Defense Advanced Technology) / Project AE3 (Unconventional Countermeasures-Survivability ATech).			
Title: Advanced Integrated Unconventional Countermeasures Applications	1.330	2.018	1.651

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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) AE2 / Unconventional Countermeasures-Survivability Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Description: This effort develops methods and materials to defeat peer advanced reconnaissance, surveillance, targeting methods through advancements in material science and computational prototyping to reduce targetable signatures and confuse targeting systems.</p> <p>FY 2023 Plans: Develop concepts for systems incorporating organic materials for targeting hyperspectral and multispectral sensor bands, and develop advanced thermal generation technologies for lightweight structural panels for integration into survivability enhancement systems.</p> <p>FY 2024 Plans: Will develop computational tools and validate material science solutions to aid in the optimization of signature management by coupling material science and computational simulations within a closed-loop computational architecture for targeted countermeasure applications.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the planned lifecycle of this effort to transition technologies to PE 0603466A (Air and Missile Defense Advanced Technology) / Project AE3 (Unconventional Countermeasures-Survivability ATech) for maturation and demonstration.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		0.144	0.051	-
<p>Title: Virtual Unconventional Countermeasure Environment</p> <p>Description: This effort develops physics-based modeling and simulation tools for rapid prototyping of novel unconventional countermeasures across multiple relevant operational environments and sensing modalities on an assortment of platforms.</p> <p>FY 2024 Plans: Will conduct studies to investigate effects on countermeasure development and effectiveness assessment under rapidly developed physics-based geo-typical scenes.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		-	-	1.733

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding increase reflects the planned lifecycle initiation of this effort.			
Accomplishments/Planned Programs Subtotals	3.783	3.947	3.384

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

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) BN6 / Advanced Weapons Components (CA)
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BN6: <i>Advanced Weapons Components (CA)</i>	-	74.250	61.752	-	-	-	-	-	-	-	0.000	136.002

Note

Congressional Interest Item funding provided for Advanced Weapons Components.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Advanced Weapon Components.

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 2022	FY 2023
<p>Congressional Add: Program Increase - BEAM CONTROL SYSTEMS AND INDUSTRY GRADE OPTICAL FIBER FABRICATION FOR ENERGY LASER</p> <p>FY 2022 Accomplishments: Work in FY 2022 is a continuation of and furthers efforts executed under FY 2021.</p> <p>The effort will characterize and optimize a diverse set of fiber laser systems, optics, and photonics to support development, maturation, and suitability assessments for technology insertion for High Energy Laser weapon systems.</p> <p>Additionally, this effort will develop and mature next generation direct diode laser systems. Finally, this effort will research crystalline fiber lasers and techniques for high energy pulsed power applications for next generation High Energy Laser systems.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p> <p>FY 2023 Plans: Work in FY 2023 is a continuation of and furthers efforts executed under FY 2022.</p> <p>This effort will continue to characterize and optimize a diverse set of fiber laser systems, optics, and photonics to support development, maturation, and suitability assessments for technology insertion for High Energy Laser (HEL) weapon systems.</p>	12.000	9.000

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	
<p>Additionally, this effort will continue development and mature the next generation direct diode laser systems. Finally, this effort will research crystalline fiber lasers and techniques for high energy pulsed power applications for next generation High Energy Laser systems.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p>			
<p>Congressional Add: Program Increase - COUNTER UAS CENTER FOR EXCELLENCE</p> <p>FY 2022 Accomplishments: Congressional Interest Item funding provided for Counter UAS Center for Excellence</p> <p>FY 2023 Plans: Congressional Program Increase for Advanced Weapons Components</p>	5.000	5.000	
<p>Congressional Add: Program Increase: High Energy Laser Testing and Expansion</p> <p>FY 2022 Accomplishments: Program increase supporting applied research in high energy laser lethality testing and expansion.</p> <p>This effort will develop and refine High Energy Laser (HEL) Lethality Testing using the Solid-State Laser Testbed (SSLT) at White Sands Missile Range (WSMR). Effort ensures upgrades to maintain relevancy and responsiveness to today's programs (cruise missiles, larger UAVs). Additionally, this effort will conduct HEL testing to support development of HEL atmospheric propagation codes to account for ground battlefield conditions, while providing traceability to current and future Army HEL systems. Defines lethality requirements for future and current Army HEL programs and acquisition Program of Records.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p>	10.000	-	
<p>Congressional Add: Program Increase: HIGH ENERGY LASER AND OPTICAL TECHNOLOGY</p> <p>FY 2022 Accomplishments: Program increase supporting applied research in high energy laser optical technology.</p> <p>This effort will develop and mature power scalable laser subsystem optical technologies. Conduct laboratory and field experiments to validate performance of the technologies. Develop beam control technologies, e.g. adaptive optics for atmospheric compensation and advanced tracking sensors, to increase effectiveness of Army HEL</p>	6.000	10.000	

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	
<p>weapon systems against stressing threats. Finally, this effort will enable beam director subsystem refinement, development, and systematic maturation, while enhancing the industrial base critical materials and technologies.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p> <p>FY 2023 Plans: Work in FY 2023 is a continuation of and furthers efforts executed under FY 2022.</p> <p>This effort continues to develop and matures improvements in tracking, targeting, cueing, and battle damage assessment. Leverages previous development efforts to integrate and demonstrate an integrated laser ranger/ illuminator with time gated camera that provides improved targeting and engagement in complex and cluttered environments.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p>			
<p>Congressional Add: Program Increase: High Energy Laser Technology Integration</p> <p>FY 2022 Accomplishments: Program increase supporting applied research in high energy laser technology integration.</p> <p>This effort supports increased Science and Technology (S&T) investment to improve High Energy Laser (HEL) capability for operational analysis and system development. Leverages increased model and simulation capability to support technical analysis, operational assessments and systems engineering in areas such as Direct Diode approaches for HEL. Finally, this effort will research and develop automated detection, tracking, identification and engagement algorithms to enable integration with higher echelon battle management systems.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p>	10.000	-	
<p>Congressional Add: Program Increase - ARMY MISSILE RISK-BASED MISSION ASSURANCE</p> <p>FY 2022 Accomplishments: Congressional Interest Item funding provided for Army Missile Risk-Based Mission Assurance</p> <p>FY 2023 Plans: Congressional Program Increase for Advanced Weapons Components</p>	15.000	5.000	
<p>Congressional Add: Kill Chain Automation</p>	8.000	-	

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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Te chnology	Project (Number/Name) BN6 / Advanced Weapons Components (CA)
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
FY 2022 Accomplishments: Congressional Interest Item funding provided for Kill Chain Automation		
Congressional Add: Machine Learning Optimized Power Electronics	3.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Machine Learning Optimized Power Electronics		
Congressional Add: Program Increase - Precision Long Range Integrated Strike (PLRIS)	5.250	6.752
FY 2022 Accomplishments: Congressional Interest Item funding provided for Precision Long Range Integrated Strike		
FY 2023 Plans: Congressional Program Increase for Advanced Weapons Components		
Congressional Add: Program Increase - SMALL UAS TRACKING AND TARGETING DEVICES	-	14.000
FY 2023 Plans: This effort will develop, build and demonstrate a small agile gimbal prototype incorporating enhanced lasers and servos for greater targeting range. The demonstration gimbal for High Energy Laser (HEL) beam direction will be based on requirements and designs for next generation lightweight HEL systems. Project expands U.S. manufactured compact stabilized tracking and targeting devices for Class I, II and III small Unmanned Air Systems (sUAS). Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.		
Congressional Add: Program Increase - CYBER ELECTROMAGNETIC ACTIVITIES MISSILE DEFENDER	-	2.000
FY 2023 Plans: Congressional Program Increase for Advanced Weapons Components		
Congressional Add: Program Increase - MISSILE RISK-BASED MISSION ASSURANCE	-	10.000
FY 2023 Plans: Congressional Program Increase for Advanced Weapons Components		
Congressional Adds Subtotals	74.250	61.752

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

N/A

Remarks

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D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) CV7 / High Energy Laser Direct Diode Applied Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CV7: High Energy Laser Direct Diode Apl Tech</i>	-	-	2.902	1.495	-	1.495	3.218	3.030	7.411	8.971	0.000	27.027

A. Mission Description and Budget Item Justification

This Project designs and develops single mode diode emitters to increase output power to 100 Watts with >60% electrical-to-optical efficiency and packaging for an array of emitters. This Project will also develop and validate a 100 kW-class laser subsystem with 58% electrical-to-optical efficiency and 80% fractional power in bucket (PIB) in a lab setting. This Project will leverage industry and National Labs research to overcome gain limitations through implementing innovative techniques to control the current across the contact in the semi-conductor gain region. This Project also funds research to achieve higher power, 10s of watts, single mode emitters are necessary to make significant improvements to the size, weight, and power (SWaP) of laser subsystems.

Research in this Project complements other Army Directed Energy efforts conducted under Program Element (PE) 0602150A (Air and Missile Defense Technology) and PE 0603466A (Air and Missile Defense Advanced Technology).

The cited research is consistent with the Army's modernization programs, the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and supports the Army's future capability opportunities for leap-ahead technology for Directed Energy.

Research is performed by the United States Army Space and Missile Defense Command - Technical Center (USASMDC-TC) in coordination with RCCTO.

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

	FY 2022	FY 2023	FY 2024
Title: High Energy Laser Direct Diode Applied Technology	-	2.902	1.495
Description: This effort designs and develops single mode diode emitters to increase output power to 100 Watts with >60% electrical-to-optical efficiency and develop packaging for an array of emitters. This effort will also design and develop a 100 kW-class laser subsystem with 58% E-O efficiency and 80% fractional PIB; validated in a lab setting. This effort will leverage industry and National Labs research to overcome gain limitations through implementing innovative techniques to control the current across the contact in the semi-conductor gain region. Higher power 10s of watts single mode emitters are necessary to make significant improvements to the SWaP of laser subsystems.			
FY 2023 Plans: Will design and develop the Tapered Amplifier Array in order to fit into spectral locking assembly for laser system to improve Size, Weight and Power for High Energy Laser weapon systems. Will design and develop a 100 Watt, 60% Electrical to Optical Efficient			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) CV7 / High Energy Laser Direct Diode Appl Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Single Mode Tapered Amplifier in order to improve power and efficiency out of single mode tapered amplifiers to improve Size, Weight and Power for a High Energy Laser weapon system.</p> <p>FY 2024 Plans: Complete development of single mode diode array and packaging. Evaluate spectral locking of array beam quality. Complete development of higher power and efficiency single mode diodes. Evaluate performance and optimize single mode diode designs based on findings.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Fiscal Year 24 decrease of \$1.400 million dollars aligns the program with Army modernization priorities in Advanced Beam Control in support of the National Defense Strategy.</p>			
Accomplishments/Planned Programs Subtotals	-	2.902	1.495

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology				Project (Number/Name) CV8 / Vulnerability Modules for Multi-Domain Operations			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CV8: Vulnerability Modules for Multi-Domain Operations	-	-	8.083	8.987	-	8.987	7.734	7.952	8.691	8.786	0.000	50.233

A. Mission Description and Budget Item Justification

This Project will design and develop High Energy Laser (HEL) Vulnerability Modules (VM), engagement tactics data and kill signatures for targeting Unmanned Aerial Systems, Cruise Missiles, and Rotary Wing threats for future HEL weapon systems. Developed smart VMs will enable real time threat feature detection and targeting, increasing the lethality of the HEL weapon systems through optimizing aimpoint selection. The Development of smart VMs will enable optimized targeting across a large range of current and future threat targets due to detection capabilities applied against threat features and not specific threats.

Research in this Project complements other Army Directed Energy efforts conducted under Program element (PE) 0602150A (Air and Missile Defense Technology) and PE 0603466A (Air and Missile Defense Advanced Technology).

The cited research is consistent with the Army's modernization programs, the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and supports the Army's future capability opportunities for leap-ahead technology for Directed Energy.

Research is performed by the United States Army Space and Missile Defense Command - Technical Center (USASMDC-TC) in coordination with RCCTO.

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

	FY 2022	FY 2023	FY 2024
Title: Vulnerability Modules for Multi Domain Operations	-	8.083	8.987
Description: This effort will design and develop Vulnerability Modules for Multi Domain Operations against current and emerging high priority threats. Investigates and conducts experiments on High Energy Laser Lethality against Unmanned Aerial Systems, Cruise Missiles and Rotary Wing aircraft. The effort will fund research and conduct experiments to optimize aimpoints for rapid and effective High Energy Laser weapon systems fire control solutions.			
FY 2023 Plans: This effort will develop Vulnerability Modules on Group 2&3 Unmanned Aerial System (UAS), sub-sonic Cruise Missiles and Rotary Wing Aircraft by conducting vulnerability analysis and experiment activities. Will research Failure Mode Effects Analysis (FMEA), selecting aim points, developing models, and analyze data from intel sources and subject matter experts.			
FY 2024 Plans: This effort will advance Vulnerability Modules (VMs) on Group 2&3 Unmanned Aerial Systems (UASs), Rotary Wing (R-W), and Subsonic and Supersonic Cruise Missiles (CMs) through vulnerability analysis and experiments. Conduct Part Two of UAS and R-W initial coupon/material and specific aimpoint experiments utilizing data gained in Smart VM development to further increase			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) CV8 / Vulnerability Modules for Multi-Domain Operations		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>VM Readiness Levels (RLs). Conduct Subsonic CM complete set of components and full-scale experiments. Conduct studies of Supersonic CM analytical/existing data, intel, and SME operations combined with DoD simulations.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Fiscal Year 24 increase of \$0.900 million dollars is for procurement of advanced threat represented targets in alignment with Army modernization priorities in Multi-Domain Operations in support of the National Military Strategy.</p>				
Accomplishments/Planned Programs Subtotals		-	8.083	8.987
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology				Project (Number/Name) DA9 / Radar Survivability through Dis Sensing Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DA9: Radar Survivability through Dis Sensing Tech	-	-	5.803	4.703	-	4.703	4.076	3.767	2.304	2.329	0.000	22.982

A. Mission Description and Budget Item Justification

This project investigates and develops critical radar capability enhancements to defeat advanced Air and Missile threats and protect Army maneuver forces and critical assets. Radar enhancements are required for advanced Electronic Protection (EP) techniques against advanced jammers, electronic Combat Identification (CID), and resource optimization across the threat spectrum while retaining 360° coverage capability. Technology development includes providing capabilities for: dispersed multi-static operation, classifying/tracking emerging threats and high volume threats; adaptive digital beam forming to enable resource efficiency, performance in a dynamic clutter environment and enhanced survivability in a contested battlespace; and multi-modal tracking and additional discrimination models to support diverse and emerging threats, such as swarms and guided munitions. Enhanced development for the state-of-the-art scalable, digital array radar testbed to include advanced algorithms, transmitted power, antenna gain, detection range and angle accuracy/resolution upgrades to the existing/new radar front/back ends will allow greater performance characterization for Multi-mission Army Radar systems supporting the Multi-domain Operations (MDO).

This research is coordinated with Army Program Element (PE) 0602141A (Lethality Technology) / Project CG4 (Advanced Radar Concepts); PE 0602148A (Future Vertical Lift Technology / Project CC3 (FVL Radar Technology); PE 0602150A (Air and Missile Defense Tech)/Project AD5 (Next Generation Fires Radar Tech); and PE 0601102A (Defense Research Sciences)/ Project AA8 (Foundational Distributed Radar); Additionally this project leverages and works closely with Navy, Air Force, DARPA, and MDA radar research and development efforts.

This research complements Program Element (PE) 0602141A (Lethality Technology)//Project CJ7 (Future Air Defense Missile Enabling Technology) and PE 0603466A (Air and Missile Defense Advanced Technology)/ Project DB3 (Radar Survivability through Dis Sensing Adv Tech)The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

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

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

	FY 2022	FY 2023	FY 2024
Title: Radar Survivability through Dis Sensing (RSDS) Tech	-	5.591	4.703
Description: Investigates and develops critical radar capability enhancements to defeat advanced Air and Missile threats and protect Army maneuver forces and critical assets			
FY 2023 Plans: Will design and develop RSDS software for radar survivability and explore concepts of operations for resource optimization architectures for dispersed multi-static operations implemented in current and future Army Air Defense radars. Will develop a tailored high-fidelity simulation environment to model and evaluate the optimum method of linking multiple radars. Will			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) DA9 / Radar Survivability through Distributed Sensing Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>leverage the new scalable, all-digital front-end antenna aperture Digital Array Radar Testbed (DART) to design and develop next generation capability, flexibility, and supportability to Army radars by increasing the number of digital elements and developing advanced algorithms and architectures to allow greater performance characterization.</p> <p>FY 2024 Plans: Will develop RSDS software technology and radar representative hardware to minimize risks associated with integration into Army Radar systems; continue modeling and simulation efforts to develop concepts in the areas of operations analysis, radar resource optimization, and radar communications; inform performance metrics of distributed sensing in a multi-static radar configuration; utilize the low-cost multi-static radar testbed and execute data collections in distributed sensing configurations in contested environments; perform data analysis to aid with modeling and simulation and the development of a software based RSDS capability for future and current air defense radar systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease due to completing the DART testbed upgrade in FY23. Modeling and simulation efforts to mature the technology will continue in FY24.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.212	-
Accomplishments/Planned Programs Subtotals	-	5.803	4.703

<p>C. Other Program Funding Summary (\$ in Millions) N/A</p> <p>Remarks</p>
<p>D. Acquisition Strategy N/A</p>

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology				Project (Number/Name) DC1 / Next Generation DE Concept Development & Analysis			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DC1: Next Generation DE Concept Development & Analysis	-	-	6.281	6.446	-	6.446	13.638	14.056	20.058	19.387	0.000	79.866

A. Mission Description and Budget Item Justification

This Project researches and investigates lethality effectiveness, adaptive optics, beam control, laser sources, target and beacon illuminator lasers, new tracking algorithms, laser and beam control equipping for High Energy Laser experimentation to improve future High Energy Laser weapon system effectiveness. This Project determines critical activities to enable next generation directed energy technical innovations and funds core competencies in Lethality and Directed Energy.

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

	FY 2022	FY 2023	FY 2024
Title: Next Generation Direct Energy Concept Development and Analysis	-	6.281	6.446
Description: This effort funds foundational core competencies to develop and maintain a competent and skilled Directed Energy workforce as well as develop Science and Technology Labs to support future Directed Energy components, subsystems and system upgrades. This effort funds foundational research for future High Energy Laser weapons to effectively engage an array of threats. Research includes identifying and prioritizing aim points of identified threats by analyzing the time to kill for each aim point. In addition, this effort investigates the full spectrum of target lethality from material analysis, modeling engagement scenarios, and data collection of High Energy Laser engagements with dynamic targets. This effort also funds core in-house technical competencies for adaptive optics, beam control, laser diodes and laser illuminators.			
FY 2023 Plans: Investigates advanced adaptive optics concepts for use in deep turbulence environments. Investigates direct diode laser design concepts and pulsed illuminator / gate fine track sensor design concepts to develop improved size, weight, and power (SWaP) and improve the effective range of HEL weapon systems. System Characterization, Hardware in the Loop (HWIL) and Software in the Loop (SWIL) will increase efficiency in characterizing prototype(s) and HEL science and technology efforts, advancing future HEL weapon component and system effectiveness.			
FY 2024 Plans: Will research and investigate laser sources, beam control and advanced adaptive optics for increased high energy laser (HEL) system effectiveness against a range of threats. Conducts experiments to characterize high energy laser components and subsystem effectiveness. Continues to research and investigate laser source concepts to improve, size, weight, and power (SWaP) of HEL weapon systems. Determines critical activities to enable next generation DE technical innovations and core competencies.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>	Project (Number/Name) DC1 / <i>Next Generation DE Concept Development & Analysis</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Increase of \$0.096M in FY24 to support additional studies and analysis in Directed Energy Priority Research Areas in support of Army priorities and the National Defense Strategy.				
Accomplishments/Planned Programs Subtotals		-	6.281	6.446
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) DE3 / Adv Beam Control Component Development for C-CM
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DE3: Adv Beam Control Component Development for C-CM	-	-	-	8.286	-	8.286	-	-	-	-	0.000	8.286

Note

Adv Beam Control Component Development for C-CM is a new start within the Air and Missile Defense Technology program in FY 2024.

A. Mission Description and Budget Item Justification

Research and develop advanced Beam Control technology to create new sensors, illuminators, deformable mirrors, wave front sensors (WFS), other optical components, and acquisition and tracking concepts and to create Digital Twins of those new elements. Integrate a 60-cm off-axis telescope into the Mobile Beam Control Testbed gimbal and build a 50 kW Phased Array Laser Adaptive Optics Compensator. Develop algorithms for WFS and phased array sensors and integrate a 1-meter class segmented Beam Director with Phased Array High Energy Laser. In order to increase the effective range of the Indirect Fire Protection Capability High Energy Laser weapon system.

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Beam Control Component Developments for C-CM	-	-	8.286
Description: Support Advanced Beam Control Phase I (extend effective range of the Indirect Fire Protection Capability High Energy Laser weapon system). Support Advanced Beam Control Phase II (extend effective range of the Indirect Fire Protection Capability High Energy Laser weapon system). Develop New Technologies for Beam Director Assemblies. Support the Space and Missile Defense Commands efforts in developing Counter Cruise Missile Components/Subsystems.			
FY 2024 Plans: Research and develop advanced beam control technology to improve weapon system effectiveness and extend the effective range. Investigate optimal algorithms and hardware configuration for multiple wavefront sensor architectures.			
FY 2023 to FY 2024 Increase/Decrease Statement: Increase of \$8.250M in FY24 for a New Start Effort (Advanced Beam Control Component Developments for C-CM) in support of Army priorities and the National Defense Strategy.			
Accomplishments/Planned Programs Subtotals	-	-	8.286

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>	Project (Number/Name) DE3 / <i>Adv Beam Control Component Development for C-CM</i>

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

N/A

Remarks

D. Acquisition Strategy

N/A