Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army												Date: March 2019
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602150A *I Air and Missile Defense Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
Total Program Element	-	0.000	0.000	50.771	-	50.771	58.558	55.680	45.556	46.059	0.000	256.624
AC9: *High Energy Laser Tactical Vehicle Demonstrator Te*	-	0.000	0.000	11.114	-	11.114	11.358	0.000	0.000	0.000	0.000	22.472
AD2: *High Energy Laser (HEL) Enabling and Support Techn*	-	0.000	0.000	7.963	-	7.963	8.123	8.286	8.452	8.546	0.000	41.370
AD3: *Maneuver Air Defense Technology*	-	0.000	0.000	4.200	-	4.200	11.000	8.000	0.000	0.000	0.000	23.200
AD5: *Next Generation Fires Radar Technology*	-	0.000	0.000	9.256	-	9.256	9.421	9.588	8.210	8.301	0.000	44.776
AD7: *Missile Fire Control Sensors Technology*	-	0.000	0.000	1.608	-	1.608	1.640	1.673	1.706	1.725	0.000	8.352
AD9: *Close Combat High Energy Laser Technology*	-	0.000	0.000	7.357	-	7.357	8.705	20.374	21.029	21.263	0.000	78.728
AE2: *Unconventional Countermeasures-Survivability Tech*	-	0.000	0.000	5.756	-	5.756	4.719	3.840	2.162	2.182	0.000	18.659
AE4: *Collaborative ISR Sensors Technology*	-	0.000	0.000	3.517	-	3.517	3.592	3.919	3.997	4.042	0.000	19.067

Note

In Fiscal Year (FY) 2020, this Program Element (PE) is realigned with continuity of effort from the following PEs:
* 0602120A Sensors and Electronic Survivability
* 0602303A Missile Technology
* 0602307A Advanced Weapons Technology
* 0602705A Electronics and Electronic Devices
* 0602784A Military Engineering Technology

A. Mission Description and Budget Item Justification

Work in this Program Element (PE) investigates and develops Air and Missile Defense (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

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army	Date: March 2019
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602150A *I Air and Missile Defense Technology*

technologies to enhance Army integrated AMD capabilities at extended range. Directed Energy 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 Gun-Based Air Defense 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 work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work is performed by the United States Army Futures Command (AFC) and the United States Army Space and Missile Defense Command/Army Strategic Forces Command (SMDC/ARSTRAT).

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	50.771	-	50.771
Total Adjustments	0.000	0.000	50.771	-	50.771
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	50.771	-	50.771

Change Summary Explanation

FY20 increase related to science and technology financial restructuring.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / *Air and Missile Defense Technology*				Project (Number/Name) AC9 / *High Energy Laser Tactical Vehicle Demonstrator Te*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
AC9: *High Energy Laser Tactical Vehicle Demonstrator Te*	-	0.000	0.000	11.114	-	11.114	11.358	0.000	0.000	0.000	0.000	22.472

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) PE 0602307A Advanced Weapons Technology
* Project 042 High Energy Laser Technology

A. Mission Description and Budget Item Justification

This Project investigates component technologies for a 100 kilowatt (kW)-class, mobile high energy laser (HEL) weapon system to protect fixed and semi-fixed sites from Rocket, Artillery, and Mortars (RAM) and UAS threats. The project researches advanced technologies for HEL weapon systems to enable more efficient laser systems with greater power output, which in-turn enables future laser weapons on smaller vehicles for additional missions. This includes technologies to support development of alternate laser sources, precision optical pointing and tracking components, adaptive optics to overcome laser degradation due to atmospheric effects, more compact and lighter weight energy generation and storage devices, and more efficient thermal management systems to remove excess heat.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy and supports the Army's future capability opportunities for leap-ahead technology for directed energy.

Work is performed by United States Army Space and Missile Defense Command/Army Strategic Forces Command (SMDC/ARSTRAT).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: High Energy Laser Tactical Vehicle Demonstrator Technology	-	-	11.114
Description: This effort develops technologies for more robust beam control and solid state laser (SSL) subsystems for the HEL Tactical Vehicle Demonstrator (TVD). Beam control technologies are to enable lighter, more agile beam control systems that are robust enough to be used in tactical Army platforms. SSL development is to increase SSL efficiencies, which will lead to reductions in size, weight and power (SWaP) requirements improving the ability to integrate SSL systems into multiple Army weapon platforms. ***FY 2020 Plans:*** Will complete development of the gimbal, telescope and main optics bench for the HEL TVD beam control system; Will utilize knowledge/design from FY19 Adaptive Optics component demonstration and incorporate state-of-the-art optical focal planes to extend effectiveness of laser system in challenging environments to make the HEL TVD beam control system more robust; Will prepare beam control subsystem for integration with other subsystems in the system integration laboratory; Will complete			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602150A / *Air and Missile Defense Technology*	**Project (Number/Name)** AC9 / *High Energy Laser Tactical Vehicle Demonstrator Te*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
development of the 100 kW laser subsystem for the HEL TVD; Will prepare laser system for integration with beam control, power and thermal subsystems in the system integration laboratory. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602307A (Advanced Weapons Technology) / Project 042 (High Energy Laser Technology) in FY 20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	11.114

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
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 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AD2: *High Energy Laser (HEL) Enabling and Support Techn*	-	0.000	0.000	7.963	-	7.963	8.123	8.286	8.452	8.546	0.000	41.370

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (FY) 0602705A Electronics and Electronic Devices
* Project EM8 High Power And Energy Component Technology

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. Solid State Laser (SSL) efforts continue to leverage other funds provided by the HEL Joint Technology Office , the Air Force, and the Navy to develop multiple technical approaches that reduce program risk and maintain competition. This Project also investigates advanced laser technologies based on unconventional solid-state laser concepts, architectures, and thermal/power management schemes for the development of low size, weight, and power (SWaP) Army directed energy (DE) weapons and tactical laser developers.

The cited work is consistent with 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.

Work is performed by the United States Army Space and Missile Defense Command / Army Strategic Forces Command (SMDC/ARSTRAT) and the United States Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: High Energy Laser Enabling and Support Technology	-	-	6.774
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 activity is primarily executed at the Solid State Laser Testbed (SSLT) 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.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Will complete an assessment of rocket, artillery and mortar (RAM) fuzes vulnerability to laser weapons; Will complete vulnerability modules and lethality database inputs for Groups 1, 2, and 3 Unmanned Aerial Systems. Will continue development of lethality data base input for RAM threats supporting HEL Tactical Vehicle Demonstrator (TVD) and Multi-Mission High Energy Laser (MMHEL). Will begin data collection on vulnerability of manned fixed- and rotary-wing aircraft components. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602705A (Electronics and Electronic Devices) / Project EM8 (High Power And Energy Component Technology) in FY20 as part of the financial restructuring.			
Title: High Energy Laser (HEL) Enabling Technologies for Tactical Directed Energy Weapons ***Description:*** Research novel solid-state laser concepts, architectures, and components in support of the Army?s HEL weapons strategy; exploit breakthroughs in laser technology, develop and employ innovative laser gain material, and utilize photonics to meet the stringent weight/volume requirements for Army platforms, especially to enhance and improve the generation, transmission, and reception of lasers. ***FY 2020 Plans:*** Will investigate advanced ?crystalline core/crystalline cladding? designs (a.k.a. CCCC = C4) to enable single transverse mode HEL with single fiber laser power scaling potential 10X over the current state of the art; will explore directly diode-cladding pumped Raman fiber laser architectures enabling power scaling out of a single fiber laser for 10X improvement over the current state of the art; and will conduct feasibility experiments of optical-phased arrays to beam steer and condition the phase of laser emissions. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602705A (Electronics and Electronic Devices) / Project EM8 (High Power And Energy Component Technology) in FY20 as part of the financial restructuring.	-	-	1.189
Accomplishments/Planned Programs Subtotals	-	-	7.963

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
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*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AD3: *Maneuver Air Defense Technology*	-	0.000	0.000	4.200	-	4.200	11.000	8.000	0.000	0.000	0.000	23.200

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602303A Missile Technology:
* Project 214 Missile Technology

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 Rotary Wing (RW), Tactical / Lethal Unmanned Aerial System (UAS), and Fixed Wing (FW) threats.

Work in this Project complements PE 0603466A (Air and Missile Defense Advanced Technology) / Project AD4 (Maneuver Air Defense Advanced Technology.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Maneuver Air Defense Technology	-	-	4.200
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. ***FY 2020 Plans:*** Will conduct Maneuver Short Range Air Defense (MSHORAD) trade studies to develop the system concept and derive system level requirements for interceptor sub-systems; will determine the optimum launcher configuration to maximize magazine depth on a maneuver platform; Investigate and develop critical missile technologies and components that support the development of an interceptor capability for the MSHORAD requirement; and evaluate application of common guidance electronic unit and low cost RF seeker. Characterization of threat signatures and develop Hardware In the Loop (HWIL) techniques to emulate them. ***FY 2019 to FY 2020 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
This research effort was realigned from Program Element (PE) 0602303A (Missile Technology) / Project 214 (Missile Technology) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	4.200

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
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*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
AD5: *Next Generation Fires Radar Technology*	-	0.000	0.000	9.256	-	9.256	9.421	9.588	8.210	8.301	0.000	44.776

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602303A Missile Technology:
* Project 214 Missile Technology
PE 0602120A Sensors and Electronic Survivability
* Project H16 S3I Technology
PE 0602705A Electronics and Electronic Devices
* Project H94 Elect & Electronic Devices

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 CMOS processing flows, and electronics reliability that appear as new semiconductor materials are developed and feature sizes shrink.

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Advanced Fire Control Radar Technologies	-	-	4.000
Description: This effort develops advanced radar technologies for insertion into Multi- Mission Army Radar systems			
FY 2020 Plans: Will further develop Digital Array Radar technologies; will complete the design and development the full array hardware and begin testing with Radio Frequency (RF) characterization, digital beam forming evaluations, and algorithm and scenario development;			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
begin implementation of Future Fires Radar open systems architecture back-end processing; will refine and increase capabilities for target identification and discrimination algorithms utilizing threat flight dynamics and multiple sensors. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602303A (Missile Technology) / Project 214 (Missile Technology) in FY20 as part of the financial restructuring.			
Title: Multi-Mode Air Defense Radar ***Description:*** This research supports the technical challenges associated with air defense radar technology. In particular, this effort will analyze current and emerging 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. ***FY 2020 Plans:*** Will research techniques and algorithms for the calibration of digital phased array radars and create electromagnetic models of performance; and will assure algorithms are compatible with an existing Army open software architecture in support of air defense radar mission. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602120A (Sensors and Electronic Survivability) / Project H16 (S3I Technology) in FY20 as part of the financial restructuring.	-	-	1.510
Title: Antennas and RF Device Components for Advanced Electronic Systems ***Description:*** This effort designs, characterizes, and validates high performance antennas, microwave components, and software for multifunction radar, RF sensing, and communication and position/timing systems. Research areas include scanning techniques, broadbanding, beamforming, polarization, platform integration, and affordability. For microwave components, research areas include software defined radios, analog-to-digital conversion rates, bandwidth resolution, bit accuracy, circuit design and affordability. ***FY 2020 Plans:*** Will demonstrate counter-RF jamming algorithms utilizing digital RF hardware; will characterize meta-ferrite antennas for enhanced RF situational awareness; will design and develop antennas, front end technologies, and enabling devices and integrated circuits operating at millimeter wave frequencies (at/near 5G frequencies) to support directional communications; will mature RF microelectromechanical systems (MEMS) components to enable frequency agile operation of tactical communication	-	-	3.746

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
and next generation fires radar using reconfigurable impedance matching between disparate RF components and antenna tuning; and will explore and develop machine learning techniques and algorithms for RF modulation recognition and target classification. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602705A (Electronics and Electronic Devices) / Project H94 (Elect & Electronic Devices) in Fy20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	9.256

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / *Air and Missile Defense Technology*				Project (Number/Name) AD7 / *Missile Fire Control Sensors Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
AD7: *Missile Fire Control Sensors Technology*	-	0.000	0.000	1.608	-	1.608	1.640	1.673	1.706	1.725	0.000	8.352

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602303 Missile Technology:
* Project 214 Missile Technology.

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priority Air and Missile Defense capabilities by designing and developing technologies for advancements in next generation fire control sensor technology and target signature modeling.

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Missile Fire Control Sensors Technology	-	-	1.608
Description: Design and develop technologies for advancements in next generation fire control sensor technology and target signature modeling. ***FY 2020 Plans:*** Will continue to develop modulated waveforms for next generation radars and seekers in order to improve target resolution and discrimination for challenging air defense scenarios; will develop engagement planning algorithms to include target identification and discrimination based on emerging threat information, advanced capabilities of emerging sensors, and future interceptor capabilities. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602303A (Missile Technology) / Project 214 (Missile Technology) in Fy20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	1.608

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602150A / *Air and Missile Defense Technology*	**Project (Number/Name)** AD7 / *Missile Fire Control Sensors Technology*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / *Air and Missile Defense Technology*	Project (Number/Name) AD9 / *Close Combat High Energy Laser Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AD9: *Close Combat High Energy Laser Technology*	-	0.000	0.000	7.357	-	7.357	8.705	20.374	21.029	21.263	0.000	78.728

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0062307A Advanced Weapons Technology
* Project 042 High Energy Laser Technology

A. Mission Description and Budget Item Justification

This effort investigates and develops technologies for compact, highly efficient lasers, and compact beam control for close-combat platforms. This project investigates and develops advanced technologies for High Energy Laser (HEL) weapon systems to enable more efficient laser systems with greater power output, which in-turn enables laser weapons on smaller vehicles for additional missions. This includes technologies to support development of alternate laser sources, precision optical pointing and tracking components, adaptive optics to overcome laser degradation due to atmospheric effects, more compact and lighter weight energy generation and storage devices, and more efficient thermal management systems to remove excess heat.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy and supports the Army's future capability opportunities for leap-ahead technology for directed energy.

Work is performed by the United States Army Space and Missile Defense Command / Army Strategic Forces Command (SMDC/ARSTRAT).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Close Combat High Energy Laser Technology	-	-	7.357
Description: This effort develops laser and beam control technologies with extremely low size, weight, and power (SWaP) requirements enabling high energy lasers in small, agile tactical vehicles. Extremely low SWaP laser systems will expand the laser weapons? mission set. One goal is to have Maneuver-Short Range Air Defense laser systems on the Joint Light Tactical Vehicle (JLTV) that can protect light forces from rocket, artillery, mortar (RAM) and unmanned aerial systems (UAS). Reduction in SWaP also provides for higher power systems on the large tactical vehicles that enable countering the current threat set at longer ranges as well as laser-hardened threats.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602150A / *Air and Missile Defense Technology*	**Project (Number/Name)** AD9 / *Close Combat High Energy Laser Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Will continue developing and validating laser and beam control technologies with extremely low SWaP to integrate on a risk-reduction platform. Will begin defining risk-reduction system for data collection and validation of technology suitability for Close-Combat Platform risk reduction effort. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602307A (Advanced Weapons Technology) / Project 042 (High Energy Laser Technology) in Fy20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	7.357

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
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 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AE2: *Unconventional Countermeasures-Survivability Tech*	-	0.000	0.000	5.756	-	5.756	4.719	3.840	2.162	2.182	0.000	18.659

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602784A Military Engineering Technology:
* Project T40 Mob/Wpns Eff Tech

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 supports the Army Science and Technology Air and Missile Defense Portfolio. This work is fully coordinated with and complementary to PE 0603466A Air and Missile Defense Advanced Technology.

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

Work in this Project is performed by the Engineer Research and Development Center (ERDC) and coordinated with the Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Development of Unconventional Countermeasures for Enhanced Survivability (DeUCES)	-	-	3.204
Description: This effort investigates and develops countermeasures to defeat near-peer advanced weapons through computational modeling and enhanced tonedown measures.			
FY 2020 Plans: Will complete experiments to develop novel tonedown techniques for critical fixed and semi-fixed assets to include novel application of commercial off the shelf materials.			
FY 2019 to FY 2020 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
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 2018	FY 2019	FY 2020
This research effort was realigned from PE 0602784A (Military Engineering Technology) / Project T40 (Mob/Wpns Eff Tech) in Fy20 as part of the financial restructuring.			
Title: Model-Based Assessment of Sensors and Countermeasures ***Description:*** This effort develops a suite of high-fidelity, physics-based modeling and simulation tools for the design and development of unconventional countermeasures with electro-optical/infrared (EO/IR) sensors for a wide range of operating environments; develops tools for threat detection and object identification using machine learning tools for EO/IR sensors; and builds superior target/threat recognition algorithms. ***FY 2020 Plans:*** Will develop sensor models for EO/IR sensors and generate imagery for machine learning tools; will develop and optimize an initial unconventional countermeasure capability. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602784A (Military Engineering Technology) / Project T40 (Mob/Wpns Eff Tech) in Fy20 as part of the financial restructuring.	-	-	2.552
Accomplishments/Planned Programs Subtotals	-	-	5.756

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / *Air and Missile Defense Technology*				Project (Number/Name) AE4 / *Collaborative ISR Sensors Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
AE4: *Collaborative ISR Sensors Technology*	-	0.000	0.000	3.517	-	3.517	3.592	3.919	3.997	4.042	0.000	19.067

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602270A Electronic Warfare Technology
* Project 906 Tactical Electronic Warfare Applied Research

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priority Air and Missile Defense capabilities by designing and developing Intelligence, Surveillance, Reconnaissance (ISR) sensors with extended range threat detection and enhanced survivability by cooperative sensing while on-the-move.

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Collaborative ISR Sensors Technology	-	-	3.517
Description: Design and develop ISR sensors with extended range threat detection and enhanced survivability by cooperative sensing while on-the-move.			
FY 2020 Plans: Will investigate techniques and waveforms that enable Multi-Domain Battlefield (Land/Air) operations between platforms with non-traditional Radar sensing. Will research the best technology enablers that provide a Multi- Domain capability while identifying novel techniques to exploit those enablers. Investigate methods that improve platform and sensor survivability against emerging future threats in a spectrally complex environment.			
FY 2019 to FY 2020 Increase/Decrease Statement: This research effort was realigned from PE 0602270A (Electronic Warfare Technology) / Project 906 (Tactical Electronic Warfare Applied Research) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	3.517

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602150A / *Air and Missile Defense Technology*	**Project (Number/Name)** AE4 / *Collaborative ISR Sensors Technology*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A