Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Army											Date: May 2017	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602307A / *Advanced Weapons Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**Cost To Complete**	**Total Cost**
Total Program Element	-	36.906	28.803	22.785	-	22.785	29.502	24.457	26.190	26.780	-	-
042: *High Energy Laser Technology*	-	28.306	28.803	22.785	-	22.785	29.502	24.457	26.190	26.780	-	-
NA5: *Advanced Weapons Components (CA)*	-	8.600	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

A. Mission Description and Budget Item Justification

This Program Element (PE) investigates enabling technologies for High Energy Laser (HEL) weapons. Project 042 develops component technologies such as efficient, high energy, solid state lasers; advanced beam control components; and lethality / effectiveness measurements that enable better models and simulations for future HEL weapon designs.

Work in this PE is related to, and fully complements, efforts in PE 0601101A (In-House Laboratory Independent Research), PE 0602120A (Sensors and Electronic Survivability) Project EM8, PE 0603004A (Weapons and Munitions Advanced Technology) Project L96 and Air Force PE 0602890F (HEL Research).

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

Work is performed by the United States Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT) in Huntsville, AL, and the High Energy Laser Systems Test Facility at White Sands Missile Range, NM.

B. Program Change Summary ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	38.028	28.803	22.774	-	22.774
Current President's Budget	36.906	28.803	22.785	-	22.785
Total Adjustments	-1.122	0.000	0.011	-	0.011
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.122	-			
• Civ Pay Adjustments	0.000	0.000	0.011	-	0.011

Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Army	Date: May 2017
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602307A *I Advanced Weapons Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2016	FY 2017
Project: NA5: *Advanced Weapons Components (CA)*		
Congressional Add: *Directed energy/thermal management program increase*	8.600	-
Congressional Add Subtotals for Project: NA5	8.600	-
Congressional Add Totals for all Projects	8.600	-

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602307A / *Advanced Weapons Technology*	Project (Number/Name) 042 / *High Energy Laser Technology*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
042: *High Energy Laser Technology*	-	28.306	28.803	22.785	-	22.785	29.502	24.457	26.190	26.780	-	-

A. Mission Description and Budget Item Justification

This Project investigates and develops advanced technologies for High Energy Laser (HEL) weapon systems to enable more efficient laser systems with greater power output. 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, and thermal management systems to remove excess heat. In addition, this effort validates laser lethality performance and conducts analyses against a variety of targets and investigates the impact of low-cost laser countermeasures. This project includes laboratory efforts for HEL applied research as well as concepts analysis for United States Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT) Technical Center competencies in directed energy, missile defense, and space technical areas. Solid State Laser (SSL) efforts continue to leverage other funds provided by the HEL Joint Technology Office (JTO), the Air Force, and the Navy to develop multiple technical approaches that reduce program risk and maintain competition.

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

Work is performed by USASMDC/ARSTRAT in Huntsville, AL, and the High Energy Laser Systems Test Facility (HELSTF) at White Sands Missile Range, NM.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Solid State Laser Effects	5.221	3.557	3.674
Description: This effort provides the underlying data required to support high energy laser weapon system effectiveness analyses. This activity includes the full spectrum of lethality testing from fundamental physics investigations to the 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.			
FY 2016 Accomplishments: Concluded SSLT lethality data collection effort on representative rocket, artillery and mortar (RAM) and basic unmanned aerial system (UAS) targets; conducted field performance validation, analyze results; developed plan and schedule, and procured targets for follow-on threats to include cruise missiles and advanced UAS threats; and analyzed data and provided results from validation of 1.06 micron laser propagation models.			
FY 2017 Plans: Will investigate and collect data on advanced aimpoints for RAM and UAS threats; develop models and methodologies for energy efficient kill mechanisms for targets such as RAM, UAS, Man-Portable Air Defense System (MANPADS), and Cruise Missiles;			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602307A / *Advanced Weapons Technology*	**Project (Number/Name)** 042 / *High Energy Laser Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
develop a database for advanced materials for UAS and Cruise Missile threats and validate the weapon effectiveness against current and emerging threats, material compositions and threat protection layering combinations. ***FY 2018 Plans:*** Assess laser countermeasure effectiveness to include hardened materials, optical countermeasures, and tactics. Begin assessment of advanced threats to include: Anti-Tank Guided Missiles, Radar Systems, Rocket-Propelled Grenades (RPGs), and ground vehicles.			
Title: Advanced Beam Control Component Development ***Description:*** This effort investigates technologies to enable lighter, more agile beam control systems that are robust enough to be used in Army platforms. This work is done in collaboration with the HEL JTO and other Services. ***FY 2016 Accomplishments:*** Validated performance of an advanced, tactical, light-weight beam director during representative tactical laser engagements; validated advanced tracking concepts and atmospheric beam compensation at the SSLT in representative tactical laser engagements; continued development of All-Weather Tracker technologies, to include algorithms and component hardware; completed analysis and subscale experiments using segmented mirrors to validate improved ability to correct wavefront errors in a HEL; developed breadboard All-Weather Tracker that integrates algorithms and the sensor sub-system that will be compatible with the HEL mobile demonstrator (MD); developed data fusion algorithms and high frame rate image processing hardware and software; and developed adverse weather testing methods and equipment. ***FY 2017 Plans:*** Will conduct research on advanced methods of mitigating the effects of fog, rain, and dust on acquisition and tracking functions of an Army HEL system; further mature key sensor and track algorithm components of the enhanced tracking sensor for a high energy laser system; investigate integration of advanced sensors and components to improve acquisition and tracking at extended ranges; begin development of an advanced beam control system for demonstration on an Army platform. ***FY 2018 Plans:*** Complete the risk-reduction effort on adaptive optics performance in degraded atmospheric conditions. Validate performance requirements and the initial design of the beam control system (BCS) for the Preliminary Design Review for the next generation High Energy Laser system for an Army platform. This BCS will support an integrated demonstration of a laser weapon system prototype for potential transition into a Program of Record. This applied research on BCS components is part of the HEL technology demonstration.	3.158	3.781	7.342
Title: High Efficiency Laser Development	18.372	20.015	10.294

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602307A / *Advanced Weapons Technology*	**Project (Number/Name)** 042 / *High Energy Laser Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Description: This effort develops component technologies that increase SSL efficiencies, which will lead to reductions in size and weight for multiple subsystems that greatly improve the ability to integrate SSL systems into Army weapon platforms. This work is done in collaboration with the HEL JTO and other Services. Selected laser design will be fabricated and integrated onto an Army platform to demonstrate a high energy laser system functionality and is fully coordinated with PE 0603004A, Project L96. ***FY 2016 Accomplishments:*** Completed laser subcomponent fabrication and integration; completed fabrication of 28 double density high power fiber laser modules (>2kW each); demonstrated maintenance concept plan in the laboratory with the laser line replaceable units; completed the laboratory performance validation of the rugged, high efficiency laser to at least the ~50kW power level; began preparation of laser for integration, developed detailed integration plan for laser subsystem integration into an Army platform, and completed all the interface specifications; validated performance of a laser system integrated refrigerant cooling subsystem; and completed assessment of efficient laser power scaling to >100kW. ***FY 2017 Plans:*** Will complete populating a laser with mature fiber laser modules, bringing the system to the 50 kW-class performance level; conduct laser system performance verification and transition laser to PE 0603004A, Project L96 for further development and integration. Upon transition of the laser, assist (as the original equipment manufacturer) with the integration of the laser into the Army platform; improve the power density of the laser subsystem to allow scaling up to and potentially beyond 100 kW power output; investigate and develop fiber laser component technology to reduce system component size and weight for alternative platform applications. ***FY 2018 Plans:*** Complete the Preliminary Design Review of the next generation High Energy Laser system for an Army platform which includes validating performance requirements. Complete the majority of the work to hold the Critical Design Review of the laser system. This laser will provide the required power in the size and weight compatible with the selected Army platform for next pre-prototype system demonstration. The laser development is part of the HEL technology demonstration.			
Title: HEL Research and Development and Concepts Analysis Laboratories ***Description:*** This effort focuses on developing in-house expertise through SSL assessments and starting in Fiscal Year (FY) 2015, other USASMDC/ARSTRAT technical core competencies, including air and missile defense, responsive space, and small satellites. ***FY 2016 Accomplishments:*** Completed preliminary design and conducted experiments to verify Xenon laser design is scalable for potential next generation electric laser compactness, efficiency, and thermal management properties; began algorithm development and established an	1.555	1.450	1.475

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602307A / *Advanced Weapons Technology*	**Project (Number/Name)** 042 / *High Energy Laser Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
experimental testbed for non-beacon-based adaptive optics (AO) that could eliminate the need for the beacon illuminator as part of a HEL system, which would further reduce the size and weight of the system; characterized AO performance limits during horizontal beam propagation in a relevant environment; investigated radar enhancements to HEL MD fire control loop; refined models of space environmental effects on small satellites; and investigated small satellite propulsion and control designs for acquisition and tracking. ***FY 2017 Plans:*** Will conduct research into the development of a high efficiency, low Size, Weight and Power (SWaP) direct diode HEL as a next generation beyond the diode-pumped rare gas laser; investigate methods for AO systems to compensate for broader environmental effects, such as turbulence and low elevation battlespace. ***FY 2018 Plans:*** Complete investigation of candidates for suitability for Enhanced Tracking Sensor (ETS) to support the next generation BCS. This sensor will provide more capable acquisition and track of targets in degraded atmospheric conditions. Select candidate(s) and conduct laboratory level experiments to validate sensor performance satisfies requirements. Begin collecting field data to support model verification.			
Accomplishments/Planned Programs Subtotals	28.306	28.803	22.785

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: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602307A / *Advanced Weapons Technology*	Project (Number/Name) NA5 / *Advanced Weapons Components (CA)*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
NA5: *Advanced Weapons Components (CA)*	-	8.600	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Advanced Weapons Components applied research.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017
Congressional Add: Directed energy/thermal management program increase	8.600	-
FY 2016 Accomplishments: Directed energy/thermal management program increase		
Congressional Adds Subtotals	8.600	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A