Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Army											Date: February 2015	
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 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**Cost To Complete**	**Total Cost**
Total Program Element	-	25.310	38.513	29.428	-	29.428	28.803	22.774	21.346	30.378	-	-
042: *High Energy Laser Technology*	-	25.310	28.513	29.428	-	29.428	28.803	22.774	21.346	30.378	-	-
NA5: *Advanced Weapons Components (CA)*	-	-	10.000	-	-	-	-	-	-	-	-	-

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 project 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 U.S. 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 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
Previous President's Budget	26.148	28.528	29.641	-	29.641
Current President's Budget	25.310	38.513	29.428	-	29.428
Total Adjustments	-0.838	9.985	-0.213	-	-0.213
• Congressional General Reductions	-	-0.015			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	10.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.838	-			
• Adjustments to Budget Years	-	-	-0.213	-	-0.213

Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Army	Date: February 2015
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 2014	FY 2015
Project: NA5: *Advanced Weapons Components (CA)*		
Congressional Add: *Directed energy/thermal management program increase*	-	10.000
Congressional Add Subtotals for Project: NA5	-	10.000
Congressional Add Totals for all Projects	-	10.000

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army			Date: February 2015
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 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
042: *High Energy Laser Technology*	-	25.310	28.513	29.428	-	29.428	28.803	22.774	21.346	30.378	-	-

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 lasers 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 analysis 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 U.S. 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 2014	FY 2015	FY 2016
Title: Solid State Laser (SSL) Effects	7.719	5.792	5.426
Description: This effort provides the underlying data required to support system engineering designs, lethality analysis, and modeling and simulation (M&S) tools for laser weapon systems. This effort includes the operation of the Solid State Laser Testbed (SSLT), a 100kW class laser testbed located at the HELSTF for conducting SSL effects experiments in an open air environment.			
FY 2014 Accomplishments: Returned SSLT laser and clean room to fully operational standards to complete transfer of SSLT operations and maintenance responsibility to White Sands Missile Range (WSMR) HELSTF; continued static and dynamic experiments to investigate performance of the SSLT against mortars and unmanned aerial platforms and used data collected to refine and validate M&S codes.			
FY 2015 Plans: Upgrade SSLT lethality data collection capability to collect better represented lethality data to improve lethality models and better predict integrated high energy laser demonstration performance; use lethality data to improve laser weapon system			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
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 2014	FY 2015	FY 2016
battle management capability against Rockets, Artillery, and Mortar (RAM) and Unmanned Aerial System (UAS) targets; begin collecting lethality data on targets to support planning for the upcoming High Energy Laser Mobile Demonstrator (HEL MD) 50kW class demonstration, modeling, and effects simulation analysis; continue validation and analysis of atmospheric effects on the propagation of a 1.06 micron SSL. ***FY 2016 Plans:*** Will conclude SSLT lethality data collection effort on representative RAM and basic UAS targets; conduct field performance validation, analyze data, and provide lethality data for the HEL MD 50kW class demonstration; develop plan and schedule, and procure targets for follow-on threats to include cruise missiles and advanced UAS threats; and analyze data and provide results from validation of 1.06 micron laser propagation models.			
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 ground platforms. This work is done in collaboration with the HEL JTO and other Services. ***FY 2014 Accomplishments:*** Demonstrated performance of refractive, light weight beam director and used data to update and validate models for component maturity; completed development of the aperture sharing element of the light weight beam director and demonstrated the jitter performance and track stability required for a mobile HEL weapon system; began the integration of an Adaptive Optics (AO) system that will allow for improved beam propagation. ***FY 2015 Plans:*** Begin joint advanced beam control effort with other services and the HEL JTO to develop beam control component technology that is capable of meeting desired performance requirements; continue development of an All Weather Tracker with the goal to be able to track RAM and UAS targets in adverse weather to augment the tracking and aim point maintenance of a High Energy Laser Weapon System; complete analysis and subscale experiments using segmented mirrors to demonstrate improved ability to correct wavefront errors in a high energy laser. ***FY 2016 Plans:*** Will validate performance of an advanced, tactical, light-weight beam director during representative tactical laser engagements; validate advanced tracking concepts and atmospheric beam compensation at the SSLT in representative tactical laser engagements; continue development of All-Weather Tracker technologies, to include algorithms and component hardware,; complete analysis and subscale experiments using segmented mirrors to validate improved ability to correct wavefront errors in a HEL; begin development of a breadboard All-Weather Tracker that integrates algorithms and the sensor sub-system that will be	1.225	4.066	3.283

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
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 2014	FY 2015	FY 2016
compatible with the HEL MD; develop data fusion algorithms and high frame rate image processing hardware and software; and develop adverse weather testing methods and equipment.			
Title: High Efficiency Laser Development	15.157	16.965	19.102
Description: This effort develops component technologies that increase SSL wall-plug efficiencies, which will lead to reductions in size and weight for multiple subsystems that greatly improve the ability to integrate SSL systems into mobile Army weapon platforms. This work is done in collaboration with the HEL JTO and other Services. Selected laser design will be fabricated and integrated with the High Energy Laser Mobile Demonstrator (HEL MD) developed in 0603004A, Project L96. ***FY 2014 Accomplishments:*** Completed environmental testing on fiber laser subcomponents to support the rugged 50kW efficient laser critical design and conducted subscale experiments and analysis to ensure it will be compatible with the HEL MD ruggedness, reliability, and affordability factors; completed high efficient laser component design requirements and risk reduction testing of the rugged fiber laser amplifier, fiber array holder, and the Multi-Layer Dielectric (MLD) grating and holder; completed the rugged fiber laser component development and began the purchase of long lead items for laser fabrication, such as high efficient laser diode pumps, efficient high power ytterbium doped fibers, and laser control electronics; and completed the design and fabrication of the rugged, high power beam combination optical element. ***FY 2015 Plans:*** Complete critical design review on efficient high power rugged laser for future integration into HEL MD; purchase long lead items, including the multi-dielectric grating, 112 channel fiber array holder, polarization-maintaining high power fibers, fiber coupled pump diodes, fiber isolators and pump combiner, and narrow line-width seed sources; complete design and spectral beam combiner component risk reduction experiments to support scaling up to 100kW; begin initial subcomponent integration; conduct improved laser thermal management risk reduction experiments and verify performance of two-phase cooling approach to improve magazine depth; complete fabrication of one double-density Fiber Laser Module (FLM) and two additional fiber laser modules to support the manufacture readiness review; complete maintenance concept plan for the high power rugged laser line replaceable units. ***FY 2016 Plans:*** Will complete laser subcomponent fabrication and integration; complete fabrication of 28 double density high power fiber laser modules (>2kW each); demonstrate maintenance concept plan in the laboratory with the laser line replaceable units; complete the laboratory performance validation of the rugged, high efficiency laser to at least the ~50kW power level; begin preparation of laser for integration, develop detailed integration plan for laser subsystem integration into the HEL MD and complete all the interface			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
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 2014	FY 2015	FY 2016
specifications; validate performance of a laser system integrated refrigerant cooling subsystem meeting runtime and duty cycle performance requirements; and complete assessment of efficient laser power scaling to >100kW.			
Title: HEL Research and Development and Concepts Analysis Laboratories ***Description:*** This effort focuses on developing in-house expertise through SSL assessments and starting in FY15, other SMDC/ ARSTRAT technical core competencies, including air and missile defense, responsive space, and small satellites. ***FY 2014 Accomplishments:*** Completed the analysis of an Adaptive Optics (AO) system and transitioned the hardware and algorithms to the light weight beam director effort for integrated tactical performance assessments; began performance demonstrations using hardware and algorithms for correcting laser propagation in deep turbulence; began development of an all weather tracker that is compatible with a laser weapon system. ***FY 2015 Plans:*** Complete Adaptive Optics (AO) performance demonstrations of advanced AO algorithms for transition to the HEL MD AO system; purchase pump diodes and scaled electric/Radio Frequency discharge sources and begin diode pump gas laser scaling experiments; develop models of space environment effects on small spacecraft; perform orbital assessments of nanosatellite spacecraft and constellation concepts; and investigate concepts in support of space, missile, rocket, and mortar defense. ***FY 2016 Plans:*** Will complete preliminary design and conduct experiments to verify Xenon laser design is scalable for potential next generation electric laser compactness, efficiency, and thermal management properties; begin algorithm development and establish an experimental testbed for non-beacon-based 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; characterize AO performance limits during horizontal beam propagation in a relevant environment; investigate radar enhancements to HEL MD fire control loop; refine models of space environmental effects on small satellites; and investigate small satellite propulsion and control designs for acquisition and tracking.	1.209	1.690	1.617
Accomplishments/Planned Programs Subtotals	25.310	28.513	29.428

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602307A / *Advanced Weapons Technology*	**Project (Number/Name)** 042 / *High Energy Laser Technology*

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army			Date: February 2015
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 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
NA5: *Advanced Weapons Components (CA)*	-	-	10.000	-	-	-	-	-	-	-	-	-

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 2014	FY 2015
Congressional Add: Directed energy/thermal management program increase	-	10.000
FY 2015 Plans: Directed energy/thermal management program increase		
Congressional Adds Subtotals	-	10.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A