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 0602624A *I Weapons and Munitions 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	-	81.447	53.581	41.455	-	41.455	48.825	58.018	57.427	67.124	-	-
H18: *Weapons & Munitions Technologies*	-	20.154	21.749	21.455	-	21.455	20.900	23.620	17.425	19.791	-	-
H19: *Asymmetric & Counter Measure Technologies*	-	12.689	14.924	5.353	-	5.353	4.558	6.401	9.449	11.769	-	-
H1A: *WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE*	-	35.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-
H28: *Warheads/ Energetics Technologies*	-	13.604	16.908	14.647	-	14.647	23.367	27.997	30.553	35.564	-	-

A. Mission Description and Budget Item Justification

This Program Element (PE) investigates, designs and evaluates enabling technologies to develop lethal and nonlethal weapons and munitions with increased performance and the potential for lower weight, reduced size, and improved affordability. Project H18 focuses on weapons and munitions development. Project H19 researches technologies to maintain and enhance the weapons lethality. Project H28 evaluates munition components such as fuzes, power, warheads with tailorable effects, and insensitive munition compliant energetic materials.

Work in this PE is related to, and fully coordinated with, PE 0602303A (Missile Technology), PE 0602105A (Materials Technology), PE 0602618A (Ballistics Technology), PE 0602772A (Advanced Tactical Computer Science and Sensor Technology), PE 0602782A (Command, Control, Communications Technology), and PE 0603004A (Weapons and Munitions Advanced Technology).

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

Work in this PE is primarily performed by the Armament Research, Development, and Engineering Center (ARDEC) at Picatinny Arsenal, NJ, in cooperation with the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD; the Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Belvoir, VA; the Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI; and the Aviation and Missile Research, Development, and Engineering Center (AMRDEC), Huntsville, AL.

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 0602624A / *Weapons and Munitions Technology*		
B. Program Change Summary ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**
Previous President's Budget	83.340	53.581	50.022	-	50.022
Current President's Budget	81.447	53.581	41.455	-	41.455
Total Adjustments	-1.893	0.000	-8.567	-	-8.567
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.893	-			
• Adjustments to Budget Years	0.000	0.000	-8.666	-	-8.666
• Civ Pay Adjustment	0.000	0.000	0.099	-	0.099

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2016	FY 2017
Project: H1A: *WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE*		
Congressional Add: *Program Increase*	35.000	-
Congressional Add Subtotals for Project: H1A	35.000	-
Congressional Add Totals for all Projects	35.000	-

Change Summary Explanation

Fiscal Year (FY) 2018 funding decreased to support higher priority efforts.

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 0602624A / *Weapons and Munitions Technology*	Project (Number/Name) H18 / *Weapons & Munitions Technologies*	

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
H18: *Weapons & Munitions Technologies*	-	20.154	21.749	21.455	-	21.455	20.900	23.620	17.425	19.791	-	-

A. Mission Description and Budget Item Justification

This Project designs, investigates, and evaluates component technologies to enable affordable precision munitions as well as provide increased lethality and performance with reduced logistics and advanced direct/indirect fire capabilities for soldier, ground vehicle and aviation platforms, and for protection of platforms.

Efforts in this Project support the Army Science and Technology Lethality Portfolio.

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 in this Project is performed by the Armament Research, Development, and Engineering Center (ARDEC), at Picatinny Arsenal, NJ (in collaboration with a the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD; the Aviation and Missile Research, Development, and Engineering Center (AMRDEC), Huntsville, AL; and the Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Belvoir, VA.)

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Novel Propulsion Technology for the Future	3.707	3.388	3.429
Description: This effort explores propellant technologies such as powder coextrusion and grain coatings, while retaining insensitive properties, for employment in gun launch environments as well as directional thrusters including those that deliver a broad spectrum of effects. It also conducts experiments with these propellants to increase the range of artillery and mortar rocket assisted projectiles.			
FY 2016 Accomplishments: Conducted evaluation of extended range 120mm mortar fire in a round designed to double (2x) the range; produced co-extruded gun propellant for direct and indirect fire applications; performed 30mm fires of coated propellant for improved ballistic performance and extended range with lower sensitivity to temperature; increased the burn rate at low temperature and maintained high temp burn rate resulting in more range over the temp spectrum and increased accuracy due to less propellant variation; formulated new materials for extended range artillery applications.			
FY 2017 Plans: Evaluate novel and innovative gun propellant materials for the implementation of three-dimensional (3D) printed charge development; develop next generation charge concepts and prototypes using 3D printing technology for medium caliber up to			

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 0602624A / *Weapons and Munitions Technology*	**Project (Number/Name)** H18 / *Weapons & Munitions Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
large caliber charges for tank, artillery and mortar systems; develop engineering tools to design and model 3D printed charges using the novel materials and novel charge concepts. ***FY 2018 Plans:*** Will optimize formulation and design electrode configurations for electrically controlled energetic materials (ECEM) which could enable extended range and improve precision and temperature compensation; design and develop igniter materials and characterize interaction between coated propellant grains and ignition system in development of a temperature invariant propulsion system; conduct experiments to transform feed stock propellant formulations into spheroidal geometries using advanced processing techniques; mature the die design and formulation developed organically for co-extrusion processing; mature novel propellant formulations and validate models and experiments while investigating increased propellant masses for use in co-developed foam celluloid combustible case; continue to investigate, research, and mature new rocket motor formulations for use in emerging rocket assisted projectiles to determine potential range increases.			
Title: Advanced Weapons Technology ***Description:*** This effort investigates innovative weapon technologies such as recoil energy mitigation, affordable precision, extended range/guided technologies, and advanced propellant for future medium caliber direct fire systems that could provide similar or greater lethality than current systems. ***FY 2016 Accomplishments:*** Investigated innovative weapon technologies that could provide lethality improvements such as nanostructured materials for high strain rate applications and counter unmanned aerial systems (UAS) system analysis; developed weapon technologies that incorporate new materials (e.g. nanotechnology, additive manufacturing); developed weapon, munition and fire control technologies that support advanced forms of engagement, such as collaborative multi-role weapons and munitions. ***FY 2017 Plans:*** Investigate novel weapon technologies that provide lethality improvements in confined, complex, constrained environments; investigate aviation armament technologies that support lighter, more lethal armaments for the family of rotary wing aircrafts. ***FY 2018 Plans:*** Will investigate novel weapon technologies that will allow for heat check techniques of cracks in explosives; conduct experiments to develop cold spray deposition processes for erosion resistant metal coatings.	1.354	1.497	0.824
Title: Extended Range Projectile Technology ***Description:*** This effort develops various methods of low cost extended range technologies for mortar and artillery applications. Projectile lift and surface control technologies will be investigated for survivability and functionality through component level	0.949	-	-

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 0602624A / *Weapons and Munitions Technology*	**Project (Number/Name)** H18 / *Weapons & Munitions Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
research and modeling and simulation. The Warfighter will be able to use these technologies coupled with handheld devices to engage Beyond Line-of-Sight (BLOS) targets and guide the projectile in flight. ***FY 2016 Accomplishments:*** Investigated hybrid (155mm projectile with the incorporation of base fins and lifts/control surfaces) technologies for artillery indirect fire application; designed control surfaces to achieve extended ranges; conducted bench top testing of control actuation mechanisms such as (power sources, motors and canards) capable to maintain structural integrity.			
Title: Affordable Precision Technologies ***Description:*** This effort investigates technologies that provide affordable precision capabilities for projectiles fired into Global Positioning System (GPS) denied environments. ***FY 2016 Accomplishments:*** Completed subsystem evaluation of the optics to include laying out the tactical imager and electronics form factor as well as begin high-g survivability testing of the optics; performed evaluation of the image processing navigation algorithm using the modeling and simulation developed. This effort was conducted in collaboration with AMRDEC through the Aided Target Recognition (ATR) Working Group and with ARL personeel through a technology transition agreement. . ***FY 2017 Plans:*** Validate the algorithm development for the imager based terminal guidance concepts through extensive modeling and simulation efforts; conduct experiments in order to verify the survivability and maturity of the candidate imager technologies in a high G environment. ***FY 2018 Plans:*** Will characterize thoroughly the image navigation component and subsystem technologies across the operational conditions in order to ensure a robust Technology Readiness Level 5 (TRL-5) is achieved for all of the enabling subsystems; a new low Size, Weight, and Power (SWaP) Tactical Grade Gun Hardened Inertial Measurement Unit (IMU) will be demonstrated to a TRL-5.	2.570	2.962	3.015
Title: Enabling Printed Explosives, Power Sources & Electronics for Munitions ***Description:*** This effort designs and evaluates the state-of-the-art in materials printing, direct write, flexible electronics, and conformal systems for the Warfighter. ***FY 2016 Accomplishments:*** Investigated, designed and adopted commercial-off-the-shelf (COTS) hardware to print electronics and energetics for use in munitions and power sources for munitions and other armament applications; established materials and printing techniques to add capabilities to munitions and fuze systems, while reducing the size, weight, and cost of conventional electronics; conducted	0.718	-	-

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 0602624A / *Weapons and Munitions Technology*	**Project (Number/Name)** H18 / *Weapons & Munitions Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
experiments to determine applicability of printing techniques for antennas, sensors, electrical components, and other components printed onto windscreens, radomes, munitions, and weapon systems. This effort was conducted in collaboration with CERDEC, AMRDEC and ARL through both an integrated project team and technical working groups.			
Title: Extended Range Indirect Fire Weapon Technology ***Description:*** This effort initially investigates and determines the viability of candidate extended range indirect fire weapon technologies that facilitate light weight armaments with launch velocities resulting in ranges of 70km and beyond with emerging ammunition. Technologies will be applied at the system and sub-system level to address technology gaps. ***FY 2016 Accomplishments:*** Matured the concepts of an extended range armament system; conducted initial verification of models through lab scale prototypes designs and testing; and evaluated the various technology concepts based on the capabilities the integrated system provides. ***FY 2017 Plans:*** Mature and integrate extended range armament component technologies further; continue to validate technology concepts in an integrated environment to assess impacts to current systems; determine technologies that provide weight reduction potential while supporting increased velocities needed for ranges beyond the current capability of self-propelled artillery (M109A7) howitzer. ***FY 2018 Plans:*** Will continue to mature extended range indirect fire component technologies and conduct integrated experiments to validate technologies for use with the M109A7 howitzer system to determine system impacts of the extended range capability as well as investigate the application of these technologies to other indirect fire systems such as the M777A2 and M119A3.	2.197	2.814	2.783
Title: Force Protection Technologies ***Description:*** This effort accelerates the development of disruptive technologies that enable transformational protection capabilities for vital assets, forces and civilian populations, increasing safety, decreasing collateral damage and minimizing fratricide. ***FY 2016 Accomplishments:*** Investigated and designed armament technologies to provide protection to vehicles, facilities, weapons, and personnel; developed precision weapons, munitions and fire control technologies to reduce collateral damage to non-combatants while providing greater standoff distance between incoming threats and vital assets. ***FY 2017 Plans:***	3.374	0.588	-

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 0602624A / *Weapons and Munitions Technology*	**Project (Number/Name)** H18 / *Weapons & Munitions Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Investigate and develop armament technologies capable of providing non-kinetic, High-Powered /Radio Frequency Directed Energy, lethal effects against Unmanned Aerial systems, precision Rocket, Artillery, Mortar and other potential threats.			
Title: Long Range Gun Technology Development ***Description:*** This effort investigates and develops candidate extended range artillery weapon system and projectile technologies that increase the range up to 2x with increased precision. Resulting component technologies will be evaluated and matured in the fully coordinated effort of the same name in PE/Project 0603004A/232. ***FY 2016 Accomplishments:*** This effort was conducted in concert with the Extended Range Indirect Fire Weapon Technology effort mentioned above. These new technologies were applied to light weight common armament, advanced micro-common fire control, novel post launch propulsion methods, and advanced projectile lifting surfaces. ***FY 2017 Plans:*** This effort is being conducted in concert with the Extended Range Indirect Fire Weapon Technology effort; determine weight reduction of common 155mm armament concepts integrated with advanced micro-common fire control concepts to achieve extended range for demonstration mentioned in PE/Project 0603004A/232; validate post launch propulsion methods for next generation extended range munitions and determines range extension gains achieved by post launch lifting surfaces. ***FY 2018 Plans:*** This effort will be conducted in concert with the Extended Range Indirect Fire Weapon Technology effort to determine weight reduction of common 155mm armament concepts integrated with advanced micro-common fire control concepts to achieve extended range for demonstration mentioned in PE/Project 0603004A/232; validate post launch propulsion methods for next generation extended range munitions and determine range extension gains that could be achieved by new designs of post launch projectile lifting surfaces.	3.363	2.500	1.500
Title: Fuze and Power Technologies for Munitions ***Description:*** This effort investigates and designs innovative fuze and power technologies for enhanced environment and target sensing/classification, warhead initiation schemes and advanced fuze setting to provide enhanced lethality combined effects on targets and advanced initiation schemes for the next generation munitions. ***FY 2016 Accomplishments:*** Explored robust airburst fuze technology concepts for increased accuracy in multi-purpose rounds; developed microscale sensor concepts and devices for enhanced environment sensing and for arming and warhead initiation in which all the energetic components are out-of-line; investigated alternative fuze setting methodologies to more efficiently transfer and store power and data to smart indirect fire projectiles; investigated multi-point initiation concepts applicable for Insensitive Munitions	1.922	2.000	2.080

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 0602624A / *Weapons and Munitions Technology*	**Project (Number/Name)** H18 / *Weapons & Munitions Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
applications; investigated innovative munitions power source candidate technologies for medium and large caliber munitions. These technologies supported the Joint Munitions Program Technical Coordinating Group (TCG – 5 and TCG-10) and the Joint Fuze Technology Program (JFTP). ***FY 2017 Plans:*** Continue to design and develop robust airburst fuze technology concepts for increased accuracy in multi-purpose rounds; mature micro-scale sensor components and devices for enhanced environment sensing and for arming and warhead initiation in which all the energetic components are both in and out-of-line; validate alternative fuze setting methodologies to more efficiently transfer and store power and data to smart indirect fire projectiles; mature multi-point initiation components applicable to Insensitive Munitions; validate innovative munitions power source technologies for medium and large caliber munitions. These technologies will continue to support the Joint Munitions Program Technical Coordinating Group (TCG – 5 and TCG-10) and the JFTP. ***FY 2018 Plans:*** Will continue to mature advanced sensor components and devices; mature advanced initiation systems applicable to insensitive munitions; mature and validate advanced power technologies for medium and large caliber munitions; and mature airburst fuzing technologies for reduced range error in medium caliber fuzing. These technologies will continue to support the Joint Munitions Program TCG – 5 and TCG-10 and the JFTP.			
Title: Cluster Munitions Replacement Acceleration ***Description:*** This effort will design and develop the critical components that will aid in the maturation of a materiel solution designed to replace 155mm dual purpose improved conventional munition (DPICM) artillery. The components will include the design, development and component testing of fuzing, warhead and stabilization technologies. ***FY 2017 Plans:*** Effort investigates high reliability DPICM technologies, design and develop high reliability fuzing architectures in a small, self-contained form factor; assign component space allocation including investigation of fuze component level technologies, stabilizer design and development and mature warheads. Continue to develop advanced unitary warhead designs and to further design and establish warhead initiation requirements and compatibility with existing artillery fuze designs. Develop and mature critical components leveraging lessons learned from prior cluster munition replacement component testing. ***FY 2018 Plans:*** Will investigate and mature fuze initiation train design; research and develop novel designs of arming, warhead and stabilization architectures; conduct lab experiments for critical components to validate reliability and functionality claims; fund research looking at the effectiveness of materiel solutions for various concepts.	-	6.000	7.000
Title: Programmable Intelligent Collaborative Engagement Munition	-	-	0.824

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 0602624A / *Weapons and Munitions Technology*	**Project (Number/Name)** H18 / *Weapons & Munitions Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Description: This effort develops, matures and integrates a gun hardened suite of components (software, sensors, navigation and communications) that enable the application of distributed, cooperative and collaborative tactics for munitions. ***FY 2018 Plans:*** Will develop collaborative algorithms, which will include a set of tools like target assignment based on probability of kill scoring, target assignment with must hit priority where total probability of kill priority is applied after must hit criteria are achieved, and 3D pattern goals with arrival time objectives.			
Accomplishments/Planned Programs Subtotals	20.154	21.749	21.455

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 0602624A / *Weapons and Munitions Technology*	Project (Number/Name) H19 / *Asymmetric & Counter Measure Technologies*	

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
H19: *Asymmetric & Counter Measure Technologies*	-	12.689	14.924	5.353	-	5.353	4.558	6.401	9.449	11.769	-	-

A. Mission Description and Budget Item Justification

This Project designs and develops technologies to support asymmetric countermeasures such as radio frequency and ultra-short pulse directed energy and efforts to maintain the lethality and overmatch of United States (US) weapons against current and future threat systems. Work in this Project is related to, and fully coordinated with, efforts in Projects H18 and H28 (also in Program Element (PE) 0602624A), PE 0602618A (Ballistics Technology), and projects 232 and L94 in PE 0603004A (Weapons and Munitions Advanced Technology).

Efforts in this Project support the Army Science and Technology Lethality Portfolio.

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.

This work is performed by the Armament Research, Development, and Engineering Center (ARDEC), at Picatinny Arsenal, NJ, and the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Novel Battlefield Effectors	1.684	2.359	-
Description: This effort investigates unique weapon and munitions enabling technologies to achieve tunable effects on targets and that are capable of providing a full range of effects from non-lethal to highly lethal via a single weapon or munition. ***FY 2016 Accomplishments:*** Investigated the most promising effector technologies such as Hostile Fire Detection, Mortar Blast Attenuation, and Counter-Counter Measure. Technologies were ready for transition to advanced development. Investigated size, weight, power and cost benefits of these technologies in new applications; explored the use of disruptive technologies that could be applied to current and future precision guided direct and indirect fired munitions. ***FY 2017 Plans:*** Investigate novel technologies capable of improving ammunition development and demilitarization throughout the life cycle; provide counter-countermeasure technologies for advanced development; explore the use of disruptive technologies that can be applied to current and future munitions and armament systems.			
Title: Counter-Countermeasure (CCM) Technologies for Weapons and Munitions	1.388	1.463	1.309

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 0602624A / *Weapons and Munitions Technology*	**Project (Number/Name)** H19 / *Asymmetric & Counter Measure Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Description: This effort investigates guidance signal reduction, inertial measurement unit, and antenna design technologies to enable continued effectiveness of US weapon systems against enemy countermeasures including Active Protection Systems (APS), Global Positioning System (GPS) jamming, and active seeker jamming. ***FY 2016 Accomplishments:*** Conducted experimentation of CCM technologies for gun launched munition components in a relevant laboratory environment. ***FY 2017 Plans:*** Validate high power antenna array concept designs that offer size, weight, and power (SWaP) reduction; investigate scalability of novel technologies for various potential applications such as vehicle stopping, counter electronics and counter Unmanned Aeriel Systems (UAS); continue to design and develop innovative technologies for compact solid state high power radio frequency sources. ***FY 2018 Plans:*** Will mature technologies providing active counter-countermeasures against radio frequency (RF) threats; develop advanced materials for passive protection and structural enhancements; conduct designs of experiments to isolate key variables for design enhancements; integrate technologies for performance characterization against simulated threats.			
Title: Enhanced Fire Control for Indirect Fires ***Description:*** This effort evaluates the applicability and integration of state-of-the-art acquisition and engagement technologies for data and image processing, weapon orientation sensors and methodologies to enhance fire control capability, and therefore weapon effectiveness, at various ranges and under battlefield conditions. Investigates components and architectures that will reduce size, weight, power and cost (SWaP-C), and increase commonality and operation across direct and indirect fire control systems. ***FY 2016 Accomplishments:*** Evaluated and integrated acquisition and engagement technologies which supported extended range indirect fire systems such as: extended range tracking and sizing capabilities, advanced sensors, hardware prototyping and firmware coding technologies for use in GPS-denied environments; navigation and pointing technologies/compensation techniques; conventional munition accuracy and reduced navigational burden for smart munitions technologies; communication techniques for in-flight interface/ control with smart munitions; investigated miniaturized and multifunctional electronic components to reduce SWaP-C, and increased commonality of hardware, software and operation across indirect fire systems; performed architecture trade-off analyses that allowed for efficient, real-time fusion of information and data. ***FY 2017 Plans:***	1.921	2.000	2.044

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Further mature extended range tracking and miniaturization of components for use in GPS-denied environments as well as further mature navigation and pointing technologies/compensation components; validate improved conventional munition accuracy and communication techniques for in-flight interface/control with smart munitions. ***FY 2018 Plans:*** Will mature extended range tracking, in flight communications and miniaturization of components for use in GPS-denied environments as well as navigation and pointing technologies/compensation components; validate improved conventional munition accuracy and develop common graphical user interfaces for fire control systems to allow for cross platform use and enable multi-role functionality.			
Title: High Powered Radio Frequency ***Description:*** This effort in High Power RF technology focuses on addressing the SWaP-C of High Power RF systems and their components so as to allow tactically useful systems. ***FY 2016 Accomplishments:*** Investigated high dielectric constant composites (nano-dielectrics) to achieve the desired size reduction of the high power antenna array to include validation; designed, fabricated and evaluated transistor technologies, such as laterally diffused metal oxide semiconductor (LDMOS) field-effect transistors, for highly efficient solid state transmitter applications. ***FY 2017 Plans:*** Validate antenna array at high power and prove SWaP reduction; investigate scalability of nano-dielectric technology to alternate frequency ranges for various potential applications such as vehicle stopping, counter electronics, counter UAS, etc.; continue design and development of innovative technologies for compact solid state high power radio frequency sources, leveraging advances in gallium nitride switches, nano-dielectrics, and/or efficient transistors.	1.927	2.002	-
Title: Terrain Shaping Munition Technologies ***Description:*** This effort develops an improved munition capability, remote delivery, and man-in-the-loop control technologies that will allow the warfighter to maintain dominance in the battlefield by denying adversaries access to an area of operations. ***FY 2016 Accomplishments:*** Investigated munition technologies including: large area coverage anti-personnel and dual mode warhead designs, directed energy vehicle defeat effects for low hazard protection of area denial munitions, and munition configurations; and investigated different designs of tamper deterrence and anti-tamper technologies such as obscuration and non-lethal technologies. ***FY 2017 Plans:***	1.921	2.000	2.000

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 0602624A / *Weapons and Munitions Technology*	**Project (Number/Name)** H19 / *Asymmetric & Counter Measure Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Investigate and develop new methods for generation of very high voltages via chemical, capacitive and explosive means, production of pulse/waveform against targets, and delivery of energies into targets by direct injection or remotely. ***FY 2018 Plans:*** Will validate munition architectures across delivery ranges against safety, reliability, and performance requirements; conduct experiments of large area coverage anti-personnel effects; investigate and confirm design with use of new dielectric and de-poling materials and conduct experimentations to validate different configurations and field layouts capable of handling high voltages in very compact form factor; collect validation data for effects study to identify output requirement and design tuning; conduct study on delivery mechanisms; and provide data for improving performances.			
Title: Small Arms Fire Control ***Description:*** This effort focuses on providing the soldier a set of small arms capabilities to increase the accuracy at extended ranges, probability of hit, improve time of engagement, and enhance situational awareness. By achieving these objectives, the soldier will be able to improve their operational effectiveness in reduced time. ***FY 2016 Accomplishments:*** Investigated advanced materials and technologies that optimize small arms fire control architecture at a reduced weight; developed and assessed advanced small arms technologies for improved target handoff; evaluated technologies that detect and provide threat indicators and potential targets; investigated technologies that recognize/classify and identify targets, aid in accurately aiming the weapon for effective firing and allow the soldier to assess conditions after firing for potential reengagement. ***FY 2017 Plans:*** Investigate technologies to increase probability of hit, including ballistic corrections for advanced sensor data including down-range wind sensing, target tracking and handoff at the individual-weapon platform, and moving target aim correction.	3.848	4.200	-
Title: Indirect Fire Aiming Techniques ***Description:*** This effort supports future integrated aiming technologies for indirect fires with enhanced capabilities and a simplified user interface while reducing size, weight and power. ***FY 2017 Plans:*** Investigate various innovative technologies to provide high fidelity location and orientation coordinates for use in indirect-fire applications; analyze technologies that can both provide these capabilities and reduce size, weight and power consumption for the next generation of fire control systems.	-	0.900	-
Accomplishments/Planned Programs Subtotals	12.689	14.924	5.353

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 0602624A / *Weapons and Munitions Technology*	**Project (Number/Name)** H19 / *Asymmetric & Counter Measure Technologies*

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 0602624A / *Weapons and Munitions Technology*				Project (Number/Name) H1A / *WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE*			
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**
H1A: *WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE*	-	35.000	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 for Weapons and Munitions Technology applied research.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017
Congressional Add: Program Increase	35.000	-
FY 2016 Accomplishments: Program increase for weapons and munitions technology research.		
Congressional Adds Subtotals	35.000	-

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 0602624A / *Weapons and Munitions Technology*	Project (Number/Name) H28 / *Warheads/ Energetics Technologies*	

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
H28: *Warheads/ Energetics Technologies*	-	13.604	16.908	14.647	-	14.647	23.367	27.997	30.553	35.564	-	-

A. Mission Description and Budget Item Justification

This Project investigates and designs enabling warhead and energetic technologies such as novel warhead architectures, new propellant techniques, and high-density explosives to produce smaller, lighter, more effective, multi-role warheads, flare and pyrotechnic countermeasures, and novel approaches for ammunition demilitarization and combat in complex environments.

Efforts in this Project support the Army Science and Technology Lethality Portfolio.

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.

This work is performed by the Army Armament Research, Development, and Engineering Center (ARDEC), at Picatinny Arsenal, NJ in collaboration with the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD; and the Aviation and Missile Research, Development, and Engineering Center (AMRDEC), Huntsville, AL.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Scalable Warhead Technology	5.699	5.931	5.250
Description: This effort designs scalable and adaptive explosives and reactive materials technology for either gun or missile-launched weapons and munitions that can deliver a broad spectrum of effects with reduced collateral damage. In addition, this effort will facilitate the design and development of improved area clearance technologies.			
FY 2016 Accomplishments: Designed and developed multi-functional warheads for multi-role missions that include Counter-Rocket, Artillery, and Missile(C-RAM), Counter-Unmanned Aircraft Systems(C-UAS) and anti-vehicle/personnel. Designed and tested brass board designs for shaped charge, explosively formed penetrator (EFP) and blast fragmentation with targeted lethality; determined, through modeling and simulation, the applicability of tunable/tailorable effects for adaptable warheads for future artillery, mortars and medium caliber munitions.			
FY 2017 Plans: Design and test brass board designs for shaped charge, EFP and blast fragmentation with targeted lethality; determine tunable/ tailorable effects for adaptable warheads through modeling and simulation. After successful testing at the component level, apply			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
designs to warhead subsystem for validation. In addition, investigate novel concepts of area clearance capabilities with focus on the advancement of new warheads, line charge materials and fills while reducing collateral damage and maintaining or increasing effectiveness on target. ***FY 2018 Plans:*** Will mature warheads to higher levels of technology readiness through the iterative design and development process and will validate previous work in modeling and simulation. Among these are novel designs that can enable multi-role munitions (e.g. C-RAM, C-UAS) such as shaped charge (SC) and multi explosively formed penetrators (MEFP's) to be developed to address emerging threats. In addition, further designs in controlled and scalable blast fragmentation will be pursued to concentrate lethality while reducing collateral damage. Will continue the design process to provide lethality solutions to cluster munition replacements as well as continue maturing novel area clearance concepts; validate component technologies in a relevant environment.			
Title: Explosives Research ***Description:*** This effort develops high energy/high performance, multi-purpose insensitive munitions (IM) explosives. ***FY 2016 Accomplishments:*** Investigated single step nano-enhanced explosive munitions with greatly reduced shock sensitivities; validated lethality and fragmentation concepts; investigated scale up high pressure synthesis chemistry of disruptive energetic materials; validated high efficiency explosive concepts in munition systems. This effort was conducted in collaboration with ARL through both the integrated project team and technical working groups. ***FY 2017 Plans:*** Investigate synthesis and formulation of advanced energetic materials for low sensitivity and higher performance applications; advance and develop the use of meso-scale reactive flow models to further understand energetics performance as well as energetics sensitivity as it relates to initiation behavior to unplanned stimuli; research materials and processes to enable energetic inks and energetic powder deposition for application to additive three-dimensional (3D) printed energetic parts and devices; investigate the advancement of developing novel nano-energetic formulations to provide substantially less shock sensitivity than current formulations; research synthesis and processing of new materials using novel techniques such as Advanced Flow Reactors (AFR) technology for processing energetic materials in a timely, safe and efficient manner; further research and validate tailored energy release technology for demonstration of electrical on/off energetic capabilities and chemistry-based variable warhead fragmentation; investigate unique disruptive and scalable technologies in collaboration with ARL. ***FY 2018 Plans:*** Will conduct research to investigate a new class of energetic materials, amorphous energetics, capable of on-demand activation for improved sensitivity and performance; will investigate the synthesis of energetic materials tailored to additive manufacturing	4.926	7.877	6.349

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
applications; design explosives charges with integrated electronics; model next-generation gun-propulsion charge design concepts achievable as a result of additive manufacturing capabilities; conduct research with advanced processing methods to synthesize energetic materials in safer, more efficient and environmentally-conscious manners.			
Title: Tunable Pyrotechnics ***Description:*** This effort develops smoke and flare countermeasure for passive protection for ground and air combat platforms, and hand held signals for illumination and signaling. These capabilities will increase warfighter and aircraft survivability. ***FY 2016 Accomplishments:*** Refined dazzler countermeasure (CM) formulations along with additional flight testing. Refined dazzler modeling and simulation (M&S) algorithms as well; cloud countermeasure undergoing final prototype design formulation in full up system level demonstrations on aircraft; updated M&S algorithms for cloud countermeasure; tested advanced countermeasure initial formulations and flare concepts against hardware in the loop threat seekers; developed digital M&S algorithms. ***FY 2017 Plans:*** Finalize formulation and prototype design for dazzler CM for night time solution; perform M & S studies to evaluate if requirements can be met; produce scaled-up quantities for cloud countermeasure for two different flare formulations; conduct flight tests and evaluate effectiveness; transition cloud CM to Engineering Manufacturing Development (EMD) phase; down select from initial formulations of advanced seeker counter-measures (ASCM) and design prototypes for further maturation and demonstration. ***FY 2018 Plans:*** Will integrate and test designs for dazzler CM for both night time and day time solutions; refine M&S for reliability to evaluate if requirements can be met; produce scaled-up quantities for cloud countermeasure for down selected flare formulations; investigate and verify effectiveness of formulations; mature formulations of ASCM to obtain effectiveness data; validate cloud CM to Technology Readiness Level 5 (TRL-5).	2.979	3.100	2.048
Title: Novel Demilitarization Technologies ***Description:*** This effort develops smoke and flare countermeasure for passive protection for ground and air combat platforms, and hand held signals for illumination and signaling. These capabilities will increase warfighter and aircraft survivability ***FY 2018 Plans:*** Will investigate contained release agents for weapons demilitarization; design demilitarization-ready ammunition using embedded agents that will modify explosives on-demand and will render munitions safe and unusable for military purposes.	-	-	1.000
Accomplishments/Planned Programs Subtotals	13.604	16.908	14.647

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C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A