

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

**February 2008**

BUDGET ACTIVITY	PE NUMBER AND TITLE						
<b>2 - Applied Research</b>	<b>0602624A - Weapons and Munitions Technology</b>						
COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
Total Program Element (PE) Cost	120794	102681	30576	30384	30455	31224	31517
H18 ARTY & CBT SPT TECH	12591	14500	12164	14457	17084	17631	17692
H19 CLOSE COMBAT WEAPONRY	7316	5421	7276	4495	1985	2029	2074
H1A WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE	82838	65487					
H28 MUNITIONS TECHNOLOGY	18049	17273	11136	11432	11386	11564	11751

**A. Mission Description and Budget Item Justification:** This program element (PE) designs and develops improved weapons and munitions technologies to enable combat overmatch for the Future Force and, where feasible, for Current Force enhancements. Efforts in this PE result in increased system lethality and survivability with the potential for lower weight, reduced size, and improved affordability. Project H28 supports the warhead development efforts for the Kinetic Energy Active Protection System (KEAPS), which develops countermeasures for Active Protection Systems (APS) to enhance survivability for lightly armored vehicles. Projects H18 supports the Common Smart Submunition effort, which designs and develops component technologies for next generation precision kill and target-discriminating submunition that can be used in a variety of delivery systems. Project H18 supports the Fuze and Power for Advanced Munitions efforts, which enables tailorable warhead effects for increased functionality and develops new on-board munition power systems with increased energy/power densities that extend the range and increase the lethality of future munitions. Another major effort in project H18 is the Insensitive Munition (IM) Technologies Initiative, which focuses on reducing unplanned/accidental detonation of munitions. This work is related to and fully coordinated with IM work at the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD, (Program Element (PE)/Project 0602618/H80) and the Aviation and Missile Research, Development, and Engineering Center, Huntsville, AL, (PE 0602303/214). Project H18 also supports Non-Lethal High Powered Microwave (HPM) technology development. Projects H18 and H19 support Multi-mode HPM and Laser Induced Plasma Channel Technology which develops and miniaturizes key directed energy (DE) technologies and subsystems to support DE weaponization with the potential to field leap-ahead capabilities. Projects H18 and H28 develop a scalable warhead yield and propellant technologies for advanced gun launch and thrusters to deliver a broad spectrum of effects ranging from low to high lethality against threat personnel and targets while reducing collateral damage. Project H28 focuses on the design and evaluation of advanced warheads (shaped charge and Explosively Formed Penetrators (EFPs); novel energetics/explosives; and high impetus, low flame temperature propellants to reduce wear on gun tubes. Most products of this PE transition to PE0603004A (Weapons and Munitions Advanced Technology) for maturation and demonstration. Project H1A funds congressional special interest items. The cited work is consistent with the Department of Defense Research and Engineering Strategic Plan, the Army Science and Technology Master Plan, the Army Modernization Strategy, and the Army Posture Statement. Work is primarily performed by the Army Armament Research, Development, and Engineering Center at Picatinny Arsenal, NJ, as well as the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD.

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<u><b>B. Program Change Summary</b></u>	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2008/2009)	118331	40469	30663
Current BES/President's Budget (FY 2009)	120794	102681	30576
Total Adjustments	2463	62212	-87
Congressional Program Reductions		-3708	
Congressional Rescissions			
Congressional Increases		65920	
Reprogrammings	5307		
SBIR/STTR Transfer	-2844		
Adjustments to Budget Years			-87

Twenty-six FY08 congressional adds totaling \$65920 were added to this PE.

- (\$800) Effects Based Operations Decision Support Services (EBODSS)
- (\$1000) Strategic Technology Development and Integration for the Joint Munitions and Lethality Life Cycle Management Command
- (\$1360) CZT-Based Liquid Explosives Detections Systems
- (\$1400) Long Range Initiator
- (\$1600) Advanced Rarefaction Weapon Engineered System
- (\$1600) Hospital Emergency Planning and Integration (HEPI) Letterkenny Army Depot and Chambersburg Hospital
- (\$1600) Ripsaw Unmanned Ground Vehicle Weaponization
- (\$1600) SLEUTH Tungsten Heavy Ailey Penetrator and Warhead Development
- (\$1840) Research for Army Cannon Systems
- (\$2000) Center for Borane Technology
- (\$2000) Renewable Energy Testing Center
- (\$2400) Armament System Engineering and Integration Initiative (ASEI2)
- (\$2400) Development and Demonstration of Multi-use/Urban Operations Joint Training System at Fort Dix
- (\$2400) Electrolytic Super-Capacitor
- (\$2400) Exploding Foils Initiators with Nanomaterial-based Circuits
- (\$2400) Green Armament / RangeSafe Technology
- (\$2400) Mitigation of Energetics Single Point Failures
- (\$2640) Fatigue Odometer for Vehicle Components and Gun Barrels Project Cannon Systems
- (\$3000) Engineered Surfaces for Weapons Life Extension
- (\$3200) Rapid Response Force Protection System (Remote Weapons Platform)
- (\$3200) Remotely Operated Weapons and Sensor Technology

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BUDGET ACTIVITY

PE NUMBER AND TITLE

**2 - Applied Research**

**0602624A - Weapons and Munitions Technology**

- (\$3280) Army Center of Excellence in Acoustics
- (\$4000) Developmental Mission Integration
- (\$4000) Energetic Formulation and Fabrication
- (\$5600) Advanced Materials & Process for Armament Structures (AMPAS)
- (\$5800) Electroconversion of Energetic Materials

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

**February 2008**

<b>BUDGET ACTIVITY</b> <b>2 - Applied Research</b>		<b>PE NUMBER AND TITLE</b> <b>0602624A - Weapons and Munitions Technology</b>					<b>PROJECT</b> <b>H18</b>	
COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
H18 ARTY & CBT SPT TECH	12591	14500	12164	14457	17084	17631	17692	

**A. Mission Description and Budget Item Justification:** This project conducts applied research on technologies to enable advanced munitions, submunitions, smart munitions, networked fires, fire control, combat support systems, and cannon fires in support of the Future Force and, where feasible, to enhance Current Force capabilities. Improved smart munitions are pursued to enhance Non Line-of-Sight (NLOS) and area denial capabilities. These munitions can be delivered by a wide range of munition/missile systems with significant increases in lethality effectiveness and number of kills per individual munition/missile to reduce logistic burden. Major efforts include: Common Smart Submunition (CSS), which designs and evaluates component technologies for a next generation precision kill and target-discriminating submunition that can be used in a variety of delivery systems; and an Insensitive Munition (IM) Technology initiative, which focuses on identifying, maturing, and applying technologies that will reduce unplanned, accidental, and/or sympathetic detonation of munitions in order to meet IM requirements. The focus of the IM effort conducted within this project is on designing barrier and venting technologies for existing and future gun propulsion systems and developing high energy, IM gun propellants for emerging gun programs. The IM effort also investigates venting mechanisms and IM liner technologies for existing and future explosive projectiles. In addition, it develops predictive models and simulations for IM technologies. Other efforts in this project include: Fuze and Power for Advanced Munitions, which researches and evaluates technologies that reduce munition size and add tailorable effects for advanced munitions; Future Force Gun and Munition Technology, which matures leap-ahead concepts for future armaments, munitions, and energetics and exploits novel nano-structured metal/ceramic materials; High Powered Microwave (HPM) technology for use in non-lethal weapons; the development of propellant technologies for advanced gun launched munitions and thrusters that deliver a broad spectrum of effects ranging from low to high lethality against threat personnel and targets while reducing collateral damage; and Multi-mode HPM and Laser Induced Plasma Channel Technology which develops and miniaturizes key directed energy (DE) technologies and subsystems to support DE weaponization with the potential to field leap-ahead capabilities. Work in project H18 is related to, and fully coordinated with, efforts in projects H19 and H28 (also in program element (PE) 0602624A), PE 0602618A (Ballistics Technology), and projects 232 and L94 in PE 0600304A (Weapons and Munitions Advanced Technology). The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy and the Army Science and Technology Master Plan. This work is performed by the U.S. Army Armament Research, Development, and Engineering Center (ARDEC), at Picatinny, NJ, and the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD.

<b>Accomplishments/Planned Program:</b>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Common Smart Submunition (CSS): In FY07, conducted full up integration of components/subsystems into prototype tactical munition; executed Technology Readiness Level (TRL) tests to evaluate and establish baseline performance in these critical areas: 1) sensors and algorithms (Autonomous Target Recognition - ATR, Simulated Computer Lab runs, Captive Flight Test - CFT); 2) Orientation and Stabilization (O&S) spin/stability performance (helicopter drop/spin tests); and 3) High-G survivability (shock tests, Soft Recovery System [SRS] tests). Evaluated Modeling and Simulation (M&S) analyses for carrier/submunition packaging, dispense, engagement, and effectiveness. Evaluated Electronic Safe and Arm Device (ESAD) to define optimal interface (timing and location) between fuze and ammunition. In FY08, quantify and baseline post-test operational performance metrics as entrance criteria for 2nd System Design Review in Dec 2008; specifically the sensor transmit/receive performance, algorithm/ATR discrimination capability, O&S samara blade performance for both slow and high speed deployments, and High-G survivability of components/sub-systems (sensor module, electronics, Safe and Arm [S&A] module, battery, and O&S module; develop interface for submunition electronics, sensors, and warhead; conduct	2844	3068	

<b>ARMY RDT&amp;E BUDGET ITEM JUSTIFICATION (R2a Exhibit)</b>		<b>February 2008</b>	
<b>BUDGET ACTIVITY</b>	<b>PE NUMBER AND TITLE</b>	<b>PROJECT</b>	
<b>2 - Applied Research</b>	<b>0602624A - Weapons and Munitions Technology</b>	<b>H18</b>	
structural integrity testing and Captive Flight Test (Phase 1) to facilitate development of Form Factored components; evaluate tactical hardware and dynamic environment through modeling and simulation and verification testing. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s) 0602624/H19 and PE/Project 0603004/232.			
IM Technologies Initiatives: In FY07, designed full scale warhead venting; conducted experimental characterization and bullet impact/fragment impact (BI/FI) modeling of Non-Line-of-Sight Launch System (NLOS-LS) warhead; downselected most promising formulations and conducted subscale demonstration of best warhead for ballistic and IM performance. In FY08, show high lethality in a full scale prototype warhead venting and reactive liner design; conduct sympathetic detonation (SD) modeling and experimental characterization of low order behavior. In FY09, will complete SD/BI modeling of NLOS-LS warhead including low order response.	3001	1019	250
Fuze and Power for Advanced Munitions: In FY07, integrated Micro Electro-Mechanical System Safe and Arm Devices (MEMS S&As) and Electronic Safe And Arm Devices (ESADs) with submunition proximity sensors and continued laboratory, flight test of proximity technologies; evaluated integrated system to validate models. In FY08, evaluate performance and safety of ESAD and MEMS sub-assemblies. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.	3292	2911	
Nanotechnologies for FF Armaments and Munitions: In FY07, investigated/characterized nanomaterial based powders for use with low energy initiation (LEI) concepts. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0602624/H28.	424		
High Powered Microwave - Non-Lethal (HPM-NL): In FY07, evaluated a non-explosive HPM payload capable of being fired from a Line-of-Sight (LOS), Non-Line-of-Sight (NLOS), and Beyond-Line-of-Sight (BLOS) platform and cause temporary or permanent electronic disruption with reduced collateral effects; conducted trade studies to establish design parameters; evaluated various HPM source technologies; established target defeat metrics; modeled various launch methods and subsequent performance characteristics. In FY08, model component behavior and fabricate individual components of the system; conduct component experiments for antenna, primer power, pulsed power, and microwave source and in collaboration with Department of Energy, model effects on infrastructure targets; integrate results from infrastructure targets with battlefield effectiveness models; evaluate G-Hardened design of NL munition to address structural integrity in a gun launch environment; model iterative exterior, interior, and terminal ballistics for various delivery methods; perform a design of experiment with the goal of the elimination of temperature dependence on a high power system that focuses energy in a narrow band. In FY09, will commence integration of individual components and will model the integration of the combined system; will perform mechanical High-G design and electrical analyses in tandem to address electrical shielding effectiveness; will commence laboratory effects testing of an integrated laboratory prototype against relevant electronic materiel; will feed battlefield models with results of testing to achieve improved battlefield modeling fidelity.	3030	5745	6932
Novel Propulsion Technology for the Future: In FY08, design and develop advance propulsion and ignition technologies for gun launched munitions; evaluate existing M&S tools for advanced propellants, igniters and thrusters for scalable & adaptive applications; develop and characterize advanced novel propellants for igniter based upon M&S results. In FY09, will fabricate novel igniters and demonstrate them against current baseline igniters; will optimize propulsion technologies at the component level for integration into scalable & adaptive response munitions. Will develop M&S tools for scalable & adaptive propulsion prediction capabilities across the full range of munition applications. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0602624/H28 and PE/Project 0603004/232.		1512	2017
Pulsed Laser technologies: In FY09, laser induced plasma channel (LIPC) modeling and simulation will define the optimum filament geometries for effective energy transmission; laboratory studies will investigate the interaction of various directed energy fields in custom waveguides; verification tests for LIPC plasma channels will provide insight to expected increases in performance in directed energy weapons; development of pulse power and antenna technology needed for a Multi Mode DE System will be performed; a parallel effort in			2965

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<b>2 - Applied Research</b>	<b>0602624A - Weapons and Munitions Technology</b>	<b>H18</b>	
reducing the size and footprint of existing Solid State HPM sources will also be conducted. A down selection will be made based on technology maturity and will be packaged into a lightweight portable counter-IED system demonstrator. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0602624/H19 and PE/Project 0603004/232.			
Small Business Innovative Research/Small Business Technology Transfer Programs		245	
<b>Total</b>		12591	14500

12164

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COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
H19 CLOSE COMBAT WEAPONRY	7316	5421	7276	4495	1985	2029	2074	

**A. Mission Description and Budget Item Justification:** This project focuses on conducting applied research and designing technologies for maneuver and fire support cannon armament systems in support of the Future Force and, where feasible, to enhance Current Force capabilities. The project develops enabling technologies that result in significantly greater lethality at longer ranges with more accurate delivery, significantly reduced logistics footprint, and reduced life cycle costs for ground combat platforms. Both hardware and analytical tools (software) are refined and used to assess performance, identify problem areas and formulate solutions. This project develops components for advanced multi-mode fuzes and directed energy weapons and munitions. Efforts include Countermine/threat neutralization which exploits Laser Induced Plasma Channel (LIPC) to defeat surface laid and buried mines and other threats; Non-Lethal Payloads for Personnel Suppression, which enables personnel suppression and area denial at BLOS ranges; Near Autonomous Unmanned Systems effort, which designs and evaluates a remote weapon station optimized for high-reliability on an unmanned vehicle; Multi-mode High Powered Microwave (HPM) and Laser Induced Plasma Channel (LIPC) Technology which develops and miniaturizes key directed energy (DE) technologies, conducts system engineering designs, and evaluates power and energy demands required for weaponizing LIPC onto a hybrid platform. Ground Based Munitions Technologies which begins in FY09 optimizes smart ground based munitions for the urban and complex fight. Work in project H19 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 0600304A (Weapons and Munitions Advanced Technology). The cited work is consistent with the Department of Defense Research and Engineering Strategic Plan, the Army Science and Technology Master Plan, the Army Modernization Strategy, and the Army Posture Statement. This work is performed by the U.S. Army Armament Research, Development, and Engineering Center (ARDEC), at Picatinny, NJ, and the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD.

<b><u>Accomplishments/Planned Program:</u></b>	<b><u>FY 2007</u></b>	<b><u>FY 2008</u></b>	<b><u>FY 2009</u></b>
Non-Lethal Payloads for Personnel Suppression: In FY07, verified effectiveness of the NL payload and its dissemination technique at the target area via a system flight test demonstration in relevant environments.	1725		
Mine Neutralization: In FY07, integrated brass board laser with directed energy (DE) system(s) to develop laser guided energy (LGE) technology; conducted laboratory testing to verify laser integration parameters and perform low level target effects testing for countermine. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.	3144		
Common Smart Submunition: In FY07, integrated component technologies (Multiple Explosively Formed and Single Explosively Formed Projectiles) and conducted dynamic warhead tests using novel energetics in the combined effects warhead design; completed Airborne Test Bed (ATB) modification and fabrication enabling sensor/sublet suspension from helicopter and cabling of electronics wiring harness for Captive Flight Tests (CFTs) and Captive Carry Tests (CCTs); rapid downloading of test data for playback/goodness check hardware and processes were analyzed, decided, and incorporated into test program; completed tower testing for sensor development; began developing Form Factored electronics; conducted warhead testing for Single Explosively Formed Penetrator (SEFP) with favorable results; continued to develop Multiple EFP through iterative testing process. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s): 0602624/H18 and 0603004/232.	695		
Near Autonomous Unmanned Systems (NAUS): This effort addresses the safe weapon operations and self security risk areas of NAUS.	1752	1911	1989

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<b>2 - Applied Research</b>	<b>0602624A - Weapons and Munitions Technology</b>	<b>H19</b>	
In FY07, completed detailed design of concept; fabricated and assembled breadboard components including the active magazine and weapon mechanism; conducted laboratory experiments to validate simulations and models of the robotic weapon and ammo handling subsystems; designed and developed system architecture and emulator. In FY08, fabricate prototype robotic weapon and ammo handling system; conduct laboratory evaluations to assess interface and functionality of subsystems; and, simulate functionality via hardware in the loop emulation. In FY09, will fabricate and integrate critical sub-systems; will conduct baseline system level tests. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s): 0602601/H91; 0602618/H03; 0602120; and, 0603005/515.			
Pulsed Laser Technologies: In FY08, develop and miniaturize key directed energy (DE) technologies and subsystems to support DE Weaponization with the potential to field leap-ahead capabilities in effectiveness and suitability; perform target vulnerability analysis based on target modeling and follow on live-fire validation testing against simulated targets to demonstrate effectiveness; develop compact and frequency agile sources to reduce overall system footprint and volume as well increase effectiveness and tactical suitability. In FY09, will characterize and optimize high voltage and radio frequency sources to produce multiple target effects; will characterize and optimize RF sources to determine buried or surface threat susceptibility. Efforts described here are coordinated and complimentary to related efforts in PE/Projects 0602624/H18 and 0603004/232.		3395	2063
Ground Based Munitions Technologies: In FY09, will evaluate urban technologies for ground based munitions for use with the Intelligent Munitions System (IMS) (PE 654808/D016); will optimize a set of sensor suites for the urban environment and will evaluate merging sensor modalities; will evaluate target engagement approaches from a ground based munition that can engage both personnel and light vehicles while minimizing collateral damage. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.			3224
Small Business Innovative Research/Small Business Technology Transfer Programs		115	
<b>Total</b>		<b>7316</b>	<b>5421</b>
			<b>7276</b>

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<b>BUDGET ACTIVITY</b> <b>2 - Applied Research</b>		<b>PE NUMBER AND TITLE</b> <b>0602624A - Weapons and Munitions Technology</b>					<b>PROJECT</b> <b>H28</b>	
COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
H28      MUNITIONS TECHNOLOGY	18049	17273	11136	11432	11386	11564	11751	

**A. Mission Description and Budget Item Justification:** This project advances the state of the art for enabling munitions technologies supporting the Future Force and, where feasible, to enhance Current Force capabilities. The project focuses on achieving increased lethality using smaller and lighter weapon systems with smaller and lighter armaments. Novel warhead architectures, new propellant techniques, and advanced material technologies are applied to produce smaller, lighter, more effective, multi-role warheads with advanced warhead liners to more efficiently defeat existing and projected targets. High-energy, high-density explosives are designed to increase lethality and optimize munition performance. New improved energetic materials provide increased lethality and offer numerous transition opportunities for weapon system upgrades. High-impetus propellant formulations, when coupled with technologies such as electrothermal chemical ignition, offer increased muzzle kinetic energy, precision ignition, and repeatability. This project funds the Novel Energetic Materials for the Future Force effort which matures advanced energetic materials with the ability to control energy release for precision munition and counter-munition applications and the Hardened Combined Effects Penetrator Warhead Technology effort which provides overmatch lethality using a single warhead capable of defeating armor, bunkers, personnel, and Unmanned Air Vehicles (UAVs). The Future Force Guns and Munition Technology effort designs and evaluates technologies for lighter weight 120mm gun components, lightweight nano-materials for UAVs, and the Common Smart Submunition effort which is coordinated with and complementary to the work performed in H19 and is focused on warhead performance. Other efforts include the development of warhead and fuze safe and arm technology necessary for the Kinetic Energy Active Protection System (KEAPS) countermeasure development; Extended Area Protection and Survivability, which demonstrates the use of command-guided medium caliber projectiles for the interception and destruction of incoming rockets, artillery, and mortar rounds; and G-Hardened Sensor Technology for Munitions, which develops ground sensors hardened to resist the forces of gun-launch and ground impact. This project also supports the development of scalable and adaptive explosives and reactive materials technology for weapon and munitions either gun or missile launched that deliver a broad spectrum of effects with reduced collateral damage and develops capabilities to detect/locate hostile shooters before a shot is fired. Work in project H28 is related to, and fully coordinated with, efforts in projects H18 and H19 (also in program element (PE) 0602624A), PE 0602618A (Ballistics Technology), and projects 232 and L94 in PE 0600304A (Weapons and Munitions Advanced Technology). The cited work is consistent with the Department of Defense Research and Engineering Strategic Plan, the Army Science and Technology Master Plan, the Army Modernization Strategy, and the Army Posture Statement. This work is performed by the U.S. Army Armament Research, Development, and Engineering Center (ARDEC), at Picatinny, NJ, and the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD. The APS countermunition efforts are developed and collaborated with the Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI, PE 0603005A and the Aviation and Missile Research, Development, and Engineering Center (AMRDEC), Huntsville, AL, PE 060313A.

<b><u>Accomplishments/Planned Program:</u></b>	<b><u>FY 2007</u></b>	<b><u>FY 2008</u></b>	<b><u>FY 2009</u></b>
Novel Energetic Materials for the Future Force: In FY07, bounded the pressure and temperature characteristics of the novel energetic materials for warheads through additional testing and modeling of selected multi-purpose warhead designs; conducted analysis to determine performance/survivability characteristics compared to current systems with conventional energetics; conducted experiments with best-performing energetic materials in multipurpose warheads.	6581		
Hardened Combined Effects Penetrator Warhead Technology: In FY07, evaluated test results and then refined and optimized warhead designs accordingly; repeated in-process testing and confirmed performance of optimized warheads; performed advanced hardening	4114	4170	

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design, advanced fragmentation/multipurpose energetic, and unitary hardened shaped charge ERA defeat test investigations. In FY08, test and evaluate optimized blast fragmentation, optimize warhead penetration, and blast/frag penetrator warheads against a broad target set including armor, personnel, material, and fortified structures.. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.				
Future Force Gun and Munition Technology (Lightweight Armaments Enhancement Program-LAEP): In FY07, completed testing of LAEP gun components to TRL 6; successfully executed firing test which included blast overpressure and target impact dispersion tests. Nanotechnologies for Future Force Armaments and Munitions: In FY08, conduct advanced concept investigations for direct write technologies (including lab demonstrations). (Direct Write Technologies involves placing a thin line of explosive (i.e., writing) onto a surface or chip for the purposes of reducing the size and weight of an explosive train/detonator.) In FY09, will integrate the best candidate technologies from the FY08 investigation into actual UAV Systems; will investigate integration of developed direct write technologies into actual armaments systems and subsystems. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s): 0602624/H18 and H19, and PE/Project 0603004/232.	361	1244	3020	
Kinetic Energy Active Protection System (KEAPS): In FY07, baselined blast warhead design through modeling & simulation (M&S) and verification tests; evaluated warhead performance in near tactical configuration; completed breadboard fuze safe & arm (S&A) design and initial testing; generated initial interface control documentation between warhead/fuze S&A device and countermeasure. In FY08, refine warhead/fuze S&A interfaces with countermeasure; evaluate critical warhead parameters in near tactical environments; evaluate integrated warhead and fuze S&A interface through testing; evaluate integrated fuze S&A and countermeasure performance in near tactical environments. In FY09, will finalize warhead/fuze S&A interfaces with KEAPS interceptor; will evaluate near tactical warhead and fuze S&A through M&S and verification testing against all classes of threats; will evaluate integrated warhead, fuze S&A and countermeasure performance in near tactical environment. Efforts described here are coordinated and complimentary to related efforts in PE/Project 063004/232 and are developed and collaborated with efforts in PE/Project 063005/221 and 063313/550.	4606	6810	3575	
Extended Area Protection and Survivability (EAPS): In FY07, analyzed and modeled advanced warhead and fuze designs; fabricated and tested against static targets. In FY08, evaluate the effectiveness of a lethality round (the standard projectile envelope configured for an advanced warhead technology kill mechanism), and a course correction round (the standard projectile envelope containing course correction technology for increased accuracy); as the basis for the final decision on the integration of the EAPS projectile. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232 and 0603313.	1284	2918		
G-Hardened Sensors Technology for Munitions: In FY07, continued experimentation (begun in FY06 in 602624/H18) and baselined designs to ensure survivability of the more fragile sensor modalities such as acoustic and electro-optical; hardened sensor elements to withstand impact during deployment; categorized integrated sensor packages and began design and integration of a multi-modal sensor suite into a 40mm grenade form factor. In FY08, conduct lab experiments and demonstrate survivability of individual and integrated component technologies in > 20kG environments based on metrics developed earlier; develop architecture for networking sensors from different G-hardened nodes for target localization; conduct fabrication of hardware and demonstrate ruggedness of sensors through testing conducted with air gun experimentation; perform initial demonstration of miniaturized highly-integrated components imbedded in munitions to include 40mm grenades. In FY09, will refine integrated design approach and G-hardened packaging; will demonstrate survivability of individual and integrated component technologies in > 30kG and demonstrate (through live fire of munitions) the remote deployment of fully integrated prototypes packaged into mortars and 40mm grenades; will implement architecture for distributed, low complexity, and power efficient decentralized network fusion of multiple G-hardened nodes for target localization.	1103	1787	1601	
Scaleable Warhead Technology: In FY09, will conduct modeling and simulation studies of warhead concepts for evaluation of scaleable			2940	

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baseline performance against multiple target set configurations. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.			
Small Business Innovative Research/Small Business Technology Transfer Programs		344	
<b>Total</b>		<b>18049</b>	<b>17273</b>
			<b>11136</b>