ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602624A - Weapons and Munitions Technology**

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		103533	125267	35344	33361	33918	33346	33957
H18	ARTY & CBT SPT TECH	19996	13377	13519	10451	10275	10742	11213
H19	CLOSE COMBAT WEAPONRY	5151	6954	7937	8866	9557	10255	10244
H1A	WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE	52944	87982	0	0	0	0	0
H28	MUNITIONS TECHNOLOGY	25442	16954	13888	14044	14086	12349	12500

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 with a focus on meeting requirements of the Future Combat System (FCS) 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. Projects H18, H19, and H28 support the Mounted Combat System (MCS) and Abrams Ammunition System Technologies (MAAST) effort, which is focused on maturing an improved ammunition suite to meet FCS requirements and reduce the logistics burden for the MCS and M1A2. The Mid-Range Munition (MRM), a focused effort under MAAST, provides the Beyond-Line-Of-Sight (BLOS) capability for MCS. Also, Projects H18, H19 and H28 support 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. Additionally, Projects H18, H19 and H28 support the Fuze and Power for Advanced Munitions efforts, which in tandem enable tailorable warhead effects for increased functionality and also designs and evaluates new on-board munition power systems with increased energy/power densities in order to extend the range and increase the lethality of future munitions. A major effort in Project H18 is the Insensitive Munition (IM) Technologies Initiative, which is focused on reducing unplanned/accidental detonation of munitions. Project H1A funds Congressional special interest items. Project H28 focuses on the design and evaluation of advanced warheads (shaped charge and Explosively Formed Penetrators (EFPs)); modeling and analytic codes for thermal analysis; novel energetics/explosives; and high impetus, low flame temperature propellants to reduce wear on gun tubes. Most products of this program generally transition to PE 0603004A (Weapons and Munitions Advanced Technology) for maturation and demonstration. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and the Defense Technology Area Plan (DTAP). Work is primarily performed by the Army Armaments Research, Development and Engineering Center at Picatinny Arsenal, NJ.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2006)	102442	37824	36764
Current BES/President's Budget (FY 2007)	103533	125267	35344
Total Adjustments	1091	87443	-1420
Congressional Program Reductions		-549	
Congressional Rescissions		-1263	
Congressional Increases		89255	
Reprogrammings	1091		
SBIR/STTR Transfer			
Adjustments to Budget Years			-1420

Thirty-five FY06 Congressional adds totaling $89255 were added to this PE.

FY06 Congressional adds with no R-2A (appropriated amount is shown):
($1700) Acoustic Counter Battery System (ACBS)
($1750) Active Coatings Technology (ACT)
($1800) Advanced Materials and Nanotechnology for Ammunition
($6400) Advanced Materials and Processes for Armament Structure (AMPAS)
($2000) Advance Technology Lightweight Armament System - Rarefaction Wave Gun
($1700) Alloy-Tungsten for Armor Piercing Ammunition
($2800) Armament Systems Engineering - ASEI2
($1400) Armaments Systems Info Assurance
($2000) Armor and Structures Transformation Initiative (ASTI) - Steel to Titanium
($5400) Army Center of Excellence in Acoustics
($1400) Army Syst Engineering and Integration
($1400) Center for Integrated Security Logistics
($2800) Developmental Mission Integration
($3000) Dynamic Pulse Detonation
($1400) Effects Planning and Course of Action Tool (EPCAT)
($3750) Electroconversion of Energetic Materials
($3500) Engineered Surfaces for Weapons Systems Life Extension
($2400) Fatigue Odometer for Vehicle Components and Gun Barrels Project
($2800) Green Armaments/Rangesafe
($5100) Integrated Emergency Operations Capabilities

($2100) Less than Lethal and Scalable Protection
($2000) Micro-Laminate Ceramic Armor
($2100) Micro/Nano Systems Technology Research
($2200) Nanoparticle Development for Energetic Materials and Protective Systems
($3500) Non-nuclear Earth Penetrator Operational Prototype
($1400) Perimeter Defense Technologies
($1000) Polymer Cased 5.56mm Small Arms Ammunition
($2800) Precision Manufacturing Initiative
($2100) Remotely Operated Weapon/Sensor Technology
($3500) Seamless Data Display (SDD)
($3200) SLEUTH Tungsten Heavy Alloy Penetrator and Warhead Development
($5655) Titanium Extraction Mining and Process Engineering Technology
($1000) Toxin Guard Research
($1000) Transition Laser Engineered Net Shaping Technology
($1200) Ultra Wide Band Sensors

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February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602624A - Weapons and Munitions Technology**	**H18**

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H18	ARTY & CBT SPT TECH	19996	13377	13519	10451	10275	10742	11213

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, cannon fires, and mortar fires in support of Future Combat System (FCS), the Future Force and, where feasible, to enhance Current Force capabilities. Technology challenges include reducing artillery target location errors, providing real time targeting data to fire direction centers, and enhancing functionality of sensor inter-networking to support information dominance strategies for FCS. Improved smart munitions are pursued to enhance FCS Non Line-of-Sight (NLOS) capabilities and area denial capabilities. They 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. For gun propulsion systems, the focus of the IM effort is on designing barrier and venting technologies for existing and future gun propulsion systems and developing high energy, IM gun propellants at the sub-scale level for emerging gun programs. For warheads, this effort investigates venting mechanisms and IM liner technologies for existing and future explosive projectiles. In addition, the effort 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; and 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. In FY07, this project also researches high power microwave technology for use as non-lethal weapons. The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and the Defense Technology Area Plan (DTAP). 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.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
Common Smart Submunition (CSS): In FY05, conducted a lethality effectiveness study, which determined sizing requirements for an Explosively Formed Penetrator (EFP); evaluated options for sensors to meet discrimination performance requirements and considered a variety of launchers by participating in Joint Service working groups; designed components and evaluated performance of the CSS electronics, sensor, signal processing, and other critical sub-systems. In FY06, fabricate hardened breadboard electronic components; conduct tower field experiment and high-g Soft Recovery System (SRS) experiment; develop CSS models for analyzing packaging and integration issues; miniaturize and develop packaging architecture for CSS electronics; and build components/sub-systems into a system small enough for Umanned Aerial Vehicle, missile and/or projectile applications. In FY07, will integrate components into subsystems and evaluate sensor performance, discrimination algorithms and high-g shock and survivability; evaluate warhead penetration performance and effectiveness for smaller-diameter EFP liner.	6203	5567	2936
IM Technologies Initiatives: In FY05, began developing computer models to analyze venting designs and performed experiments with baseline laboratory hardware; modeled effects of bullet and fragment impacts as well as sympathetic detonation; fabricated and evaluated new venting designs on the propelling charge container; assessed potential barrier materials to be evaluated with baseline ammunition; fabricated and characterized new propellants. In FY06, demonstrate venting designs in the laboratory and use data to build venting model;	1850	2119	3100

optimize container venting design; assess potential barrier materials; fabricate and evaluate second iteration of propellants. In FY07, will select most promising venting design and conduct demonstration to assess IM performance; will demonstrate IM model performance using bullet and fragment impact on the NLOS-LS; conduct live bullet and fragment test on NLOS-LS to verify model results; will conduct MIL-STD-2105C IM tests with optimized vented container and barrier materials; will conduct subscale demonstration of improved propellant for ballistic and IM performance.			
Fuze and Power for Advanced Munitions: In FY05, completed the design and modeling of large caliber Micro-Electro Mechanical Systems (MEMS) Safe and Arm (S&A) device components; fabricated multipoint Electronic Safe & Arm Device (ESAD) components and baselined proximity and impact sensor designs. In FY06, conduct laboratory evaluation, and refine design for MEMS S&A components, ESADs and safety sensor designs. In FY07, will integrate MEMS S&As and ESADs with sensors and continue laboratory evaluation of integrated system to validate models.	3050	3439	3400
Future Force Advanced Weaponry and Munitions: In FY05, investigated lighter weight armament systems for the FCS family of ground vehicles and investigated use of nano-materials in fabrication of lighter weapons and munitions. In FY06, identify most promising technology solutions for light weapons and munitions applications; verify, through experimentation, ability to achieve 1 kg/hr deposition rate for nano-aluminum. Investigate wall-breaching technologies that may reduce the minimum safe distance from 300 meters to 100 meters; characterize baseline sensor designs for survivability versus performance and perform gun launch experiments to demonstrate survivability of individual component technologies. Begin development of multi-mode integrated g-hardened sensor packages. Conduct system engineering and tradeoff analysis to identify the best technical approach to provide a remote armament capability for Armed Robotic Vehicle; begin design and analysis of the ammunition handling system, the weapon mount, and control system. In FY07, will refine and demonstrate process design concept for nano-ceramic materials for lighter weight armament systems. Investigate a non-explosive HPM projectile capable of being fired from a NLOS platform and that can cause temporary or permanent electronic disruption; will conduct trade study to establish design parameters; will begin design and evaluation of a HPM source; will design HPM radiator consistent with system parameters. These efforts are coordinated with related efforts in PE/Projects 060624/H19 and H28.	2990	2252	4083
Acoustic Counter Battery System: In FY05, this one year Congressional add conducted a study to evaluate reducing the size, weight and power required for the current vehicle mounted system to transition it to a man-portable ground based system and/or a soldier wearable system. No additional funding is required to complete this effort.	2516	0	0
Army Center of Excellence in Acoustics: In FY05, this one year Congressional add conducted research and maturation of acoustic technology with academic and commercial partners to support a wide spectrum of Army efforts ranging from rapid fielding initiatives to accelerating technology insertion into major programs. No additional funding is required to complete this effort.	3387	0	0
Total	19996	13377	13519

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602624A - Weapons and Munitions Technology**	**H19**

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H19	CLOSE COMBAT WEAPONRY	5151	6954	7937	8866	9557	10255	10244

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 Future Combat System (FCS), the Future Force and, where feasible, to enhance Current Force capabilities. The project conducts research in technologies that will 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 matures advanced multi-mode fuzing components, extended range munitions and alternative mechanisms to defeat advanced armor systems. Fuze and Power for Advanced Munitions refines advanced on-board munition power systems with increased energy/power densities, increased mission time, improved temperature performance and reduced volume and weight for a variety of applications. Countermine/IED Neutralization exploits Laser Induced Plasma Channel (LIPC) to defeat Improvised Explosive Devices (IEDs) and mines. The Armed Robotic Vehicle (ARV) effort designs and evaluates a remote weapon station optimized for high-reliability on an unmanned vehicle. The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and the Defense Technology Area Plan (DTAP). 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.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
Non-Lethal Payloads for Personnel Suppression : In FY06, conduct laboratory and field testing to determine concentration levels of suppression payload to achieve desired effects against personnel; conduct system flight demonstration; conduct dissemination test and initial health and environmental assessment. In FY07, will verify effectiveness of personnel suppression round to deliver NL payload to area target; and will conduct system performance evaluations in relevant environments.	0	1987	2582
Countermine/IED Neutralization & Urban Warfare: In FY05, investigated performance of technologies for mounted and dismounted warfighters in an urban situation including a capability to deliver stand-off lethality and defeat enemy active protection systems. In FY06, conduct modeling & simulation to increase channel length of laser filamentation for LGE; evaluate different Directed Energy waveform types for effective defeat of Improvised Explosive Devices (IEDs) and Mines; conduct laser filamentation testing to determine laser parameters required for integration with high voltage energy or other Directed Energy (DE) waveforms. In FY07, will begin brass board integration of laser with DE system(s) to demonstrate LGE technology; will conduct laboratory testing to verify laser integration parameters and will perform low level target effects testing for countermine/counter IED.	1830	3000	2852
Warfighter Technology for Future Operations: In FY05, assembled component warhead technologies (i.e., Novel Energetics and Combined Effects Warhead) for a breadboard design. Conducted target effects/material interaction tests using selected agile DE source technology; performed initial studies into benefits of integrating high voltage or other Directed Energy (DE) waveforms with Laser Guided Energy (LGE); identified hardware upgrades to laboratory laser to improve experiments with LGE; transitioned information/results to Precision Mine Neutralization & Location ATO to investigate the LGE for countermine/counter IED applications. Also in FY05, began design and evaluation of advanced energy systems based on thermal and liquid reserve batteries with lower volumes, new electrolytes and higher power densities; performed modeling of advanced thermal battery technology. In FY06, conduct laboratory evaluation and initial testing of preliminary designs on new thermal and liquid reserve batteries and hybrid systems as power sources for	3321	1967	711

current and future munitions. In FY07, will integrate component technologies for dynamic warhead tests using novel energetics in the combined effects warhead design. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s): 0602624/H18 and H28.			
Armed Robotic Vehicles (ARV): In FY07, will fabricate and assemble breadboard components including the ammo handling system; will conduct laboratory experiments to prove out the basic concept; will continue design and checkout of the control system; will define and validate the interfaces with the ARV through experimentation. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s): 0602624/H18 and H28.	0	0	1792
Total	5151	6954	7937

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February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602624A - Weapons and Munitions Technology**	**H28**

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H28	MUNITIONS TECHNOLOGY	25442	16954	13888	14044	14086	12349	12500

A. Mission Description and Budget Item Justification: This project advances the state of the art for enabling munitions technologies supporting the Future Combat System (FCS), 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 by funding efforts that design and evaluate warheads, multipurpose blast/fragmentation/shaped charge and Explosively Formed Penetrators (EFPs), high energy explosives, large-caliber gun propellants with barrel wear-reducing additives, energetics, and advanced materials/processes for warheads. 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 matured to increase lethality and optimize performance. New improved energetic materials provide numerous transition opportunities for weapon system upgrades and FCS. High-impetus propellant formulations, when coupled with technologies such as electrothermal chemical ignition, offer increased muzzle kinetic energy, precision ignition and repeatability. Efforts under this project support the FCS 120mm Line-of-Sight/Beyond Line-of-Sight (LOS/BLOS) System Advanced Technology Demonstration (completed in FY05) and the Medium Range Munition (MRM), which contribute to providing a lightweight armament and ammunition system for FCS Mounted Combat System (MCS). The MCS and Abrams Armament System Technology (MAAST) continues the work of designing FCS munitions, including an Enhanced MRM, a Line- of-Sight Multi-Purpose (LOS-MP) munition, an Enhanced Kinetic Energy munition. The MAAST effort increases MRM's range and improves performance against various (multiple) targets. Other major efforts in this project include: Novel Energetic Materials for the Future Force, which matures advanced energetic materials with the ability to control energy release for precision munition and counter-munition applications; Hardened Combined Effects Penetrator Warhead Technology, which provides overmatch lethality using a single warhead capable of defeating armor, bunkers, personnel and Unmanned Air Vehicles; Fuze and Power for Advanced Munitions which proposes alternate/hybrid systems and advanced thermal battery for ruggedizing through lab test and evaluation; and multiple-EFP Warheads Technology, which focuses on analysis and maturation of EFP munitions supporting the Army's research and development of vehicle-mounted APSs and other applications. The Common Smart Submunition effort in this project is coordinated with and complementary to the work performed in H19 and is focused on warhead performance. The Future Force Guns, Munitions and Armor effort designs and evaluates technologies for a lightweight, single stage wall breaching system that can create a Soldier-size entry hole in a spectrum of urban walls in 1/3 of the time currently required; matures extended range munitions for 120mm mortar application; and matures nanomaterials for lightweight composite armor applications. Efforts under this project are consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and the Defense Technology Area Plan (DTAP). 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 in support of the Tank Automotive Research, Development and Engineering Center (TARDEC) under Program Element (PE) 0603005A (Combat Vehicle and Advanced Automotive Technology).

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
MAAST: In FY05, completed warhead performance tests and evaluation of Line of Sight-Multi Purpose (LOS-MP) munition for airburst capability, concrete wall penetration and anti-armor performance; optimized Electronic Safe & Arm (ESA) subsystem of multi-effects warhead; completed analysis of LOS-MP performance for selection of final design configuration; completed design of advanced propulsion providing precision ignition and hot performance across entire temperature range. In FY06, mature advanced propulsion charge for LOS-MP and mature a robust combustible cartridge case design; statically test MRM multi-mode warhead designs and complete initial	9342	3382	0

design and integration of counter APS for MRM.			
Novel Energetic Materials for the Future Force: In FY05, defined matrix of energetic materials technologies for advanced gun propulsion and advanced explosives for warhead applications; experimentally assessed the potential benefits of energy-managed materials by generating the appropriate comparative experimental data. In FY06, select a system application for demonstration of novel energetic material (gun propulsion/rocket/multi-purpose warhead); verify the predicted performance and multi-purpose benefit based on additional laboratory experiments and simulations as well as subscale and/or test scaled units and select the enabling energetic materials. In FY07, will bound the pressure and temperature characteristics of the gun propellant and new energetic material for warheads through testing and modeling of selected gun propulsion/multi-purpose warhead; will conduct analysis to determine performance/surivability characteristics compared to current systems with conventional energetics; will conduct experiments with best-performing energetic materials in selected systems or subassemblies.	3946	6014	6800
Hardened Combined Effects Penetrator Warhead and Explosively Formed Penetrator (EFP)Technology: In FY05, determined the critical impact parameters associated with penetration of targets such as masonry and reinforced concrete walls; investigated hardening techniques and hardened designs of the penetrator and evaluated candidate multi-purpose energetic materials including energetics structural integrity. Conducted dynamic testing of optimized APS warhead against Kinetic Energy and High Explosive Anti-Tank rounds. In FY06, incorporate enhanced blast explosives and advanced fragmentation designs into hardened shaped charge warheads and conduct in-process testing. In FY07, will evaluate test results and refine and optimize warhead designs accordingly and repeat in-process testing to confirm performance of optimized warhead against selected targets.	7019	5652	4250
Generation 2 Warhead Development, Explosively Formed Penetrator (EFP): In FY05, this one-year Congressional add investigated a warhead design to defeat a surrogate complex armor target; explored improved hit accuracies at 50 meters; and evaluated performance. No additional funding is required to complete this effort.	1059	0	0
Liquidmetal Alloy-Tungsten Alloy Penetrator: In FY05, this one year Congressional add evaluated variations in physical geometry of a tungsten alloy to determine the performance enhancement; investigated manufacturing processes. No additional funding is required to complete this effort.	2021	0	0
Extended Area Protection & Survival (EAPS): In FY07, will analyze and model advanced warhead and fuze designs; and will design, fabricate and test against static targets.	0	0	1326
Warfighter Munitions Technology: In FY05, analyzed breadboard submunition warhead design that showed significant increase in armor penetration over existing designs. Conducted laboratory evaluation and initial testing of munition power source preliminary designs. Also in FY05, investigated light weight materials for application to armament systems. In FY06, improve aerostability and hit accuracy of EFP warhead. Evaluate performance and investigate producibility of a hybrid munition power. Also in FY06, develop most promising lightweight solutions for system specific applications. In FY07, will investigate ways to improve precision mortars with respect to increasing lethality at extended ranges; and will conduct an analysis to determine the optimal approach for defeating incoming threats (rockets, artillery and mortars) including trade-offs for tracking systems, fire control software, and munitions for engaging the incoming threat; will create models for these subsystems. Also in FY07, will experiment with baseline designs of grenade launched sensors to ensure survivability of acoustic and electro-optic sensors when subjected to gun launch environment; will investigate hardening processes; will begin designing a multi-modal sensor suite for a 40mm grenade application.	2055	1906	1512
Total	25442	16954	13888