ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602624A - Weapons and Munitions Technology

COST (In Thousands)		FY 2004 Actual	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		76108	102442	37824	36764	36850	36308	34264	35648
H18	ARTY & CBT SPT TECH	14449	20036	13571	14764	10798	11018	10591	11743
H19	CLOSE COMBAT WEAPONRY	6564	6480	7054	8611	12197	11397	11494	11579
H1A	WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE	28293	50474	0	0	0	0	0	0
H28	MUNITIONS TECHNOLOGY	26802	25452	17199	13389	13855	13893	12179	12326

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 Systems (FCS). 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 contain efforts that support the FCS 120mm Line-Of-Sight (LOS)/Beyond-Line-Of-Sight (BLOS) System Advanced Technology Demonstration (ATD). This ATD, which completes in FY05, matures and evaluates armament system components and the associated LOS/BLOS ammunition in direct support of the FCS Mounted Combat System (MCS). Although the ATD is focused on developing a 120mm solution, the technologies pursued are applicable to either a 120mm or 105mm lightweight gun system, whichever becomes the final MCS design. The ATD will mature advanced materials, advanced recoil techniques, and Electrothermal Ignition (ETI) to overcome the challenges of creating a smaller, lighter armament system with lethality equaling or exceeding that of current systems. The Mid-Range Munition (MRM) is being developed to provide the BLOS capability for MCS. Projects H18, H19, and H28 also support the MCS Ammunition System Technologies (MAST) effort focused on developing lighter weight armament components to enhance both the performance and ammunition packaging efficiency of the FCS LOS/BLOS armament system for FCS spiral insertion or MCS upgrade. Additionally, Projects H18, H19 and H28 support Common Smart Submunition, which will develop and demonstrate component technologies for a next generation precision kill and target-discriminating submunition that can be used in a variety of delivery systems. Other major efforts in Project H18 include an Insensitive Munition (IM) Technologies Initiative, focused on reducing unplanned/accidental detonation of munitions; and Enabling Fuze Components for Advanced Munitions, which will develop technologies that reduce munition size and add tailorable effects. Other efforts in H19 include: Agile Target Effects System (ATES), which will employ a non-lethal, Directed Energy (DE) capability to suppress a variety of threats launched close to a platform.; and Common Modular Power Sources, which is developing on-board munition power systems with increased energy/power densities to extend the range and increase lethality of future munitions. Project H1A funds Congressional special interest items. Project H28 focuses on the design and development of advanced warheads (both shaped charge and Explosively Formed Penetrators (EFP)); modeling and analytic codes for thermal analysis; novel energetics/explosives; and high impetus, low flame temperature propellants to reduce wear on gun tubes. 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).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	44666	43385	41160
Current Budget (FY 2006/2007 PB)	102442	37824	36764
Total Adjustments	57776	-5561	-4396
Net of Program/Database Changes			
Congressional Program Reductions	-1702		
Congressional Rescissions			
Congressional Increases	61950		
Reprogrammings			
SBIR/STTR Transfer	-2472		
Adjustments to Budget Years		-5561	-4396

Change Summary Explanation:
FY06 - Funds realigned ($5561K) to higher priority requirements.
FY07 - Funds realigned ($4396K) to higher priority requirements.

Thirty FY05 Congressional adds totaling $61950 were added to this PE.

FY05 Congressional Adds with no R-2A:
Active Coatings Technology, Project H1A ($1918)
Active Coating Technology, Project H1A ($2023)
Advanced Integrated Digital Camera Rifle Scope (ADCRS), Project H1A ($959)
Advanced Technology Lightweight Armament System – Rarefaction Wave Gun, Project H1A ($959)
Amorphous Metal Manufacturing Technology for Military Applications, Project H1A ($959)
Applied Research Integration, Project H1A ($1727)
Applied Research Program for Advanced Materials and Processes for Armament Structures Program, Project H1A ($3836)
Armament Systems Engineering and Integration Initiative (ASEI2), Project H1A

($4028)
Armaments Systems Information Assurance, Project H1A ($2014)
Army Welding Deployment Initiative, Project H1A ($959)
Deep Digger, Project H1A ($959)
Dynamic Pulse Detonation, Project H1A ($959)
Electroconversion of Energetic Materials, Project H1A ($2397)
Green Armaments Technology Initiative, Project H1A ($3356)
Hazardous Materials Management and Technology Development, Project H1A ($959)
Integrated Emergency Operations Capabilities (IEOC), Project H1A ($1630)
Less than Lethal and Layered Protection Systems, Project H1A ($1918)
Micro-Laminate Ceramic Armor, Project H1A ($1726)
Perimeter Defense Technologies, Project H1A ($2110)
Polymer Cased Ammunition – 5.56mm, Project H1A ($959)
RangeSafe Technology Demonstration Initiative, Project H1A ($2877)
Research Authority Active Coatings Technology (ACT) Program, Project H1A ($959)
Scram-Jet Powered Munitions for Future Combat Systems, Project H1A ($959)
Seamless Data to Display, Project H1A ($3356)
Strategic Materials/Strategic Manufacturing Initiative (SM2i), Project H1A ($2158)

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February 2005

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

COST (In Thousands)		FY 2004 Actual	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	14449	20036	13571	14764	10798	11018	10591	11743

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 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 will be pursued to enhance FCS Non Line of Sight (NLOS) capabilities and area denial capabilities that 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, reducing logistic burden. Specific major efforts include: FCS 120mm LOS/BLOS System ATD, which designs and tests ammunition handling components, muzzle brakes and turret drives for the FCS MCS; MCS Ammunition System Technologies (MAST), which will mature component technologies to enhance capabilities of the FCS MCS munition suite; and Common Smart Submunition (CSS), which will develop component technologies for a next generation precision kill and target-discriminating submunition that can be used in a variety of delivery systems. Beginning in FY05, the project funds an Insensitive Munition (IM) Technology Initiative, which focuses on developing and applying technologies that will reduce unplanned, accidental and/or sympathetic detonation of munitions in order to achieve mandated IM compliance regulations. For gun propulsion systems the focus is on developing barrier and venting technologies for existing and future gun propulsion systems and high energy, IM gun propellants at the sub-scale level for emerging gun programs. For warheads this effort will develop venting and IM liner technologies for existing and future explosive projectiles. In addition, the effort will develop predictive modeling capabilities for IM technologies. Efforts also starting in FY05 are: Enabling Fuze Components for Advanced Munitions, which will research and evaluate technologies that reduce munition size and add tailorable effects for advanced munitions; and Future Force (FF) Gun and Munition Technology, which will develop leap-ahead concepts for FF armaments, munitions and energetics and exploit novel nano-structured metal/ceramic materials. Beginning in FY07, this project will begin researching 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 2004	FY 2005	FY 2006	FY 2007
FCS 120mm LOS/BLOS System ATD: In FY04, completed subsystem tests of ammunition handling components to verify compatibility with combustible case ammunition; completed firing tests at Army Research Laboratory using 20mm surrogate ammunition to validate the design and models for advanced muzzle brake with blast deflector to protect vehicle structure and sensors from firing overpressure; conducted lab tests of prototype gun turret electric drives.	6026	0	0	0
MAST: In FY04, completed initial designs and fabricated improved proximity sensor for LOS Multi-Purpose (LOS-MP) projectile.	1889	0	0	0
Networked Sensors for the Future Force ATD: In FY04, designed low cost, distributed and networked unattended ground sensors.	1341	0	0	0
Lightweight Dismounted Mortar Weapon: In FY04, conducted analysis of material options to assess viable candidates for thermal, dynamic and economical feasibility; fabricated mock-ups for mechanical assessment.	1000	0	0	0
CSS: In FY04, began system design, risk assessment, and trade studies to baseline metrics for hard and soft carrier applications, and determined operational performance of sensor and lethal mechanism design requirements. In FY05, design and build hardened components and test critical subsystems in an air gun; build breadboard sensor and conduct electronics evaluation prior to full function submunition integration; initiate CSS integration model development. In FY06, will miniaturize sensor, electronics and deployment system components into a CSS smaller brassboard suitable for UAV, missile, and projectile applications. In FY07, will design and test a CSS brassboard hardened for gun launch, with advanced explosively formed penetrator warhead, and advanced sensors and electronics in preparation for cable drop test against target array scheduled for early in FY08.	712	6203	5651	2936

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
IM Technologies Initiatives: In FY04, begin developing tools for predictive technology for insensitive munitions design. In FY05, investigate barrier materials and on-set threshold velocity; select two propellant families and initiate study; develop computer model to analyze venting designs and perform baseline laboratory hardware experiments; model and simulate bullet impact and sympathetic detonation threshold on a selected explosive. In FY06, will select barrier materials for pallet and/or container concepts and test ability to break up and slow down fragment threat; design vent for a selected munition; fabricate propellants and evaluate through sub-scale testing; apply venting design to laboratory hardware and evaluate effectiveness in a lab; perform optimization of detonation threshold modeling for bullet impact and sympathetic detonation. In FY07, will fabricate and test selected pallet and vented container with munition; downselect propellants and conduct sub-scale testing; apply thermal modeling and venting to full scale prototype design and experimental verification; use M&S tools to design an effective barrier against sympathetic detonation.	300	1850	2150	3100
Future Intelligent Munition: In FY04, conducted system/subsystem simulations and determine best technical approach; conducted analysis to determine the on-board detector requirements of the munition in the context of the sensor technology proposed for the Intelligent Munition System and FCS.	712	0	0	0
Enabling Fuze Components for Advanced Munitions: In FY05, begin the design and modeling of large caliber Micro-Electro Mechanical Systems (MEMS) Safe and Arm (S&A) components, multipoint Electronic Safe & Arm Device (ESAD) components and proximity and safety sensors. In FY06, will conduct laboratory evaluation of MEMS S&A components, ESADs and safety sensors designs. In FY07, will integrate MEMS S&As and ESADs with sensors and continue laboratory evaluation verify models.	0	3050	3490	3400
Future Force Gun and Munition Technology: In FY05, conduct investigations of lighter weight armament systems and extended range more lethal munitions; model induction plasma process for producing nano-aluminum. In FY06, will develop most promising technology solutions for system application; verify ability to achieve 1 kg/hr deposition rate for nano-aluminum particles. In FY07, will refine and demonstrate process design concept for nano-ceramic materials.	0	3030	1419	416
Future Force Breaching in Military Operations in Urban Terrain. In FY06 will mature the breaching system to reduce the minimum safe distance from 300 m. to 100 m. which improves safety and reduces the effort to complete a wall breaching mission during urban operation. In FY07, will conduct hand emplaced demonstration against spectrum of wall targets.	0	0	861	953

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
High Power Microwave (HPM) - Non Lethal: In FY07 will develop a non-explosive HPM projectile capable of being fired from a NLOS platform to provide an area of mission kill effect against electronic materiel that ranges from persistent upset to permanent damage; will initiate and complete tradestudy to establish total system design parameters; initiate payload development with HPM source; design antennae consistent with system parameters.	0	0	0	3959
Acoustic Counter Battery System: This one year Congressional add matured and integrated a passive acoustic sensing system designed to detect and locate hostile artillery and mortar fires and provided targeting information to fire direction centers. No additional funding is required to complete this effort	2469	0	0	0
Acoustic Counter Battery System: This one year Congressional Add adapted the demonstrated capability of the permanently fixed site concept to a portable, scalable and reconfigurable package. No additional funding is required to complete this effort.	0	2516	0	0
Army Center of Excellence in Acoustics: In FY05, this Congressional add conducts innovative research and development in acoustic technology with academic & commercial partners to support a wide spectrum of army requirements ranging from rapid fielding iniatiatives to accelerating technology insertion into major programs; e.g., FCS and Intelligent Munitions System.	0	3387	0	0
Totals	14449	20036	13571	14764

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

COST (In Thousands)		FY 2004 Actual	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	6564	6480	7054	8611	12197	11397	11494	11579

A. Mission Description and Budget Item Justification: This project focuses on applied research and technology for maneuver and fire support cannon armament systems in support of 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 with more accurate delivery, significantly reduced logistics footprint and reduced life cycle costs for ground combat platforms. This project provides opportunities for longer range, more accurate and more lethal cannon systems for armored vehicles, to include enabling technologies to support FCS. Both hardware and analytical tools will be refined and used to assess performance, identify problem areas and formulate solutions. Principal efforts support the FCS 120mm LOS/BLOS System ATD, which completes in FY05 and MCS Ammunition System Technologies (MAST) by the design and development of a FCS ammunition suite for rapid extended range defeat of high-value targets out to 8km+; modeling and simulation of advanced armament systems; cannon design technologies including recoil mitigation techniques for use of large caliber cannons on lightweight vehicles; novel chamber configuration; and advanced barrel coating technology to provide extended barrel life for tank, artillery and FCS cannon systems. This project will mature advanced multi-mode fuzing technologies, extended range munitions and alternative mechanisms to defeat advanced armor systems. The Agile Target Effects System (ATES) effort evaluates a breadboard/brassboard that delivers a synergistic combination of Directed Energy (DE) technologies to suppress/defeat close in threats. Rheostatic Pulsed Energy Weapons System (RPEWS) will refine the design of a DE weapon system exploiting advances in pulsed power supplies. The Urban Warfighter Technology effort will design and develop technologies to address the soldiers needs for operations in urban terrain. Common Modular Power Sources for 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. In FY07 Non-Lethal Payloads for Personnel Suppression and Vehicle Area Denial will begin to address the technical challenges associated with surpressing or denying access to designated areas. 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 2004	FY 2005	FY 2006	FY 2007
FCS 120mm LOS/BLOS System ATD: In FY04, completed composite cell design and vibration testing for hull ammunition storage; evaluated ability of advanced Kinetic Energy (KE) munition to defeat future heavy armor target.	2711	0	0	0
MAST: In FY04, completed initial designs and initiated fabrication of LOS-Multi-Purpose (LOS-MP) projectile.	500	0	0	0
Agile Target Effects System (ATES): In FY04, integrated selected DE sources into brassboard; determined effectiveness of agile source against representative target(s).	3353	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Rheostatic Pulsed Energy Weapons System - In FY05, conduct target effects/material interaction tests using selected agile DE source technology. In FY06, will continue target effects/material interaction tests, and initiate a baseline integrated system design. In FY07, will finalize the integrated system design based on results of the target effects/material tests; begin acquisition of the long lead hardware/components for the objective system; and design High-Powered Microwave countermeasures.	0	1441	2644	4571
Urban Warfighter Technology: Investigate technologies for mounted and dismounted warfighters in an urban situation including cabability to deliver stand-off lethality and defeat of counter-lethality.	0	3156	0	0
Common Modular Power Source for Munitions: In FY05, initiate design and testing of advanced energy systems based on thermal and liquid reserve batteries with lower volumes, new electrolytes, and higher power densities; and perform modeling of advanced thermal battery technology. In FY06, will conduct laboratory evaluation and initial testing of preliminary designs on new thermal and liquid reserve batteries.	0	1313	2000	0
Common Smart Submunition Warhead: In FY05, assemble component warhead technologies (i.e. Novel Energetics, Multiple Effects, and Gen II EFP) for a breadboard warhead design.	0	570	0	0
Non-Lethal Payloads for Personnel Suppression and Vehicle Area Denial: In FY06, will conduct analysis to determine appropriate material for nano-particle payload to achieve desired effects; will conduct packaging studies; will conduct dissemination test and initial health and environmental assessment. In FY07, will verify effectiveness of area denial round to disable vehicle target; and optimize nanoparticle material and conduct performance evaluations in relevant environments.	0	0	2410	4040
Totals	6564	6480	7054	8611

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H28	MUNITIONS TECHNOLOGY	26802	25452	17199	13389	13855	13893	12179	12326

A. Mission Description and Budget Item Justification: This project advances the state of the art for enabling technologies supporting the FCS and 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. The project funds maturation of 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 initiation techniques and advanced material technologies are being applied to produce smaller, lighter, more effective, multi-role warheads with advanced warhead liners to defeat existing and projected targets more efficiently. Aerostable EFP designs will be investigated to enable target defeat from greater standoff range to counter adversaries' Active Protection Systems. High-energy, high-density explosives are being matured to increase lethality and optimize design performance. New improved energetic materials provide numerous transition opportunities for weapon system upgrades and FCS. High-impetus propellant formulations, optimized for Electrothermal Chemical Ignition (ETI), offer increased muzzle kinetic energy, precision ignition and repeatability. Efforts under this project support the FCS 120mm LOS/BLOS System ATD completing in FY05, Medium Range Munition (MRM) and Mounted Combat System (MCS) Armament System Technology (MAST), all of which contribute to providing a lightweight armament and ammunition system for FCS MCS. MAST will increase MRM's range and improve performance against various (multiple) targets. Other major efforts in this project include Novel Energetic Materials for the Future Force, which will develop advanced energetic materials with the ability to control energy release for precision munition and counter-munition applications; Hardened Combined Effects Penetrator Warhead Technology, which will provide overmatch lethality using a single warhead capable of defeating armor, bunkers, personnel and Unmanned Air Vehicles. Multiple-EFP Warheads Technology focuses on analysis and maturation of EFP munitions supporting the Army's research and development of vehicle-mounted Active Protection Systems (APSs) and other applications. Future Force (FF) Guns, Munitions and Armor designs and evaluates technologies for a lightweight, single stage wall breaching system that can create Soldier size entry hole in a spectrum of urban walls in 1/3 of the time currently required; develops extended range munitions for 120mm mortar application; and develops 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 in support of the Integrated Survivability ATD managed by the Tank Automotive Research, Development and Engineering Center (TARDEC) under Program Element (PE) 0603005A (Combat Vehicle and Advanced Automotive Technology).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
FCS 120mm LOS/BLOS System ATD: In FY04, completed fabrication and integration onto the lightweight 120mm cannon of a complete ETI system, including a compact pulsed power supply; completed testing to verify predicted performance of improved shaped charge warhead in a configuration suited for the MRM round.	9000	0	0	0
MAST: In FY04, completed initial propulsion and warhead designs; and fabricated and conducted initial warhead laboratory tests of Line-Of-Sight Multi-Purpose (LOS-MP) munition. In FY05, complete warhead testing and evaluation of LOS-MP for airburst capability, concrete wall penetration and anti-armor performance; optimize Electronic Safe & Arm (ESA) subsystem of multi-effects warhead; complete analysis of LOS-MP performance for selection of final design configuration; and complete design of advanced propulsion providing precision ignition and hot performance across entire temperature range. In FY06, will complete initial design and integration of Counter APS and Dynamic Retargeting Capabilities for Enhanced MRM and conduct full-up integrated system test and evaluation.	1795	9342	3431	0
Novel Energetic Materials for the Future Force: In FY04, characterized candidate energetic materials and assessed energetic system concepts exploiting managed energy release for advanced gun propellant and explosive formulations. In FY05, define matrix of energetic materials technologies for advanced gun propulsion and advanced explosives for warhead applications; experimentally assess the potential benefits of energy managed materials (high tailorability) 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; downselect the enabling energetic materials. In FY07, bound the performance characteristics, e.g., pressure & 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 tocurrent systems with conventional energetics.	3000	3946	6100	6800

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Hardened Combined Effects Penetrator Warhead Technology: In FY04, conducted hardened shaped charge warhead modeling/design evaluation and initial baseline hardware experimentation including armor penetration, urban targets and baseline fragmentation. In FY05, determine the critical impact parameters associated with penetration of targets such as masonry and reinforced concrete walls; mature hardening techniques and hardened designs of the penetrator; and evaluate candidate multi-purpose energetic materials including energetics structural integrity. In FY06, will 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 will refine and optimize designs accordingly; and repeat in-process testing to confirm performance of optimized warhead against selected targets.	1000	4883	5734	4250
Multiple EFP Warhead Technology: In FY04, integrated APS EFP warhead into counter-munition; optimized warhead design with system fuzing; refined and evaluated a revolutionary single liner EFP warhead concept for FCS smart munitions; designed and evaluated a 1.5 to 2 caliber long EFP. In FY05, conduct dynamic testing of optimized APS warhead integrated into counter-munition.	4452	2136	0	0
Common Smart Submunition: In FY05, analyze and test breadboard warhead design to validate significant increase in armor penetration over existing designs. In FY06, will improve EFP warhead aerostability and hit accuracy.	0	1443	671	0
Common/Modular Power Source for Munitions: In FY05, conduct laboratory evaluation and initial testing of preliminary designs; initiate producibility studies. In FY06, will evaluate performance of hybrid system.	0	500	310	0
Future Force Guns, Munitions and Armor: In FY05, conduct computer modeling and simulations of candidate wall breaching designs for MOUT; complete preliminary prototype hardware design. In FY06 will design the prototype breaching system, that is 20% lighter system than current approaches, to create solder size entry holes in reinforced concrete walls in 2 minutes (currently 6 minutes is required to complete mission). In FY07, will mature the breaching system to create entry holes in double reinforced concrete wall with a single operation.; will conduct investigations for improved lethality at extended ranges for precision mortars; will initate lab scale processing method for Boron carbide nano-ceramic materials for lightweight composite/armor; and will conduct an analysis to determine the optimal approach for a Counter Lethality System vs. rockets, artillery and mortars; including trades for tracking systems, fire control solutions and munitions for engaging the incoming threat; will create models for the subsystems.	0	122	953	2339
Generation 2 Warhead Development, Explosively Formed Penetrator (EFP): In FY04, this Congressional add conducted tests to determine aerostability of an EFP out to 50 meters against an armor target. In FY05, this Congressional add demonstrates the ability to defeat a surrogate complex armor target and improved hit accuracies at 50 m. No additional funding is required to complete this effort.	2025	1059	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Liquidmetal Alloy-Tungsten Alloy Penetrator: In FY04, developed a higher density amorphous alloy with the intent of increasing the end-item bulk density of the completed/infiltrated penetrator core intermetallic compounds, and degree of infiltration that ultimately effected the overall quality of the end item.	1095	0	0	0
Liquidmetal Alloy-Tungsten Alloy Penetrator: This one year Congressional add optimizes the metallurgical and physical geometry of the tungsten preform, as well as its internal open porosity to influence terminal ballistic performance. No additional funding is required to complete this effort.	0	2021	0	0
Tandem EFP Warhead Systems: This one year Congressional add completed a study on optimizing function and interface of EFP warheads in the Tandem EFP Warhead System. No additional funding is required to complete this effort.	964	0	0	0
Modular Artillery Charge System (MACS) High Zone Development: This one year Congressional add accepted four lots of hybrid propellant for ballistics performance evaluation. No additional funding is required to complete this effort.	2025	0	0	0
Single Crystal Tungsten Alloy Penetrators: This one year Congressional add investigated performance of subscale single crystal tungsten penetrator rods fabricated by chemical vapor deposition process. No additional funding is required to complete this effort.	1446	0	0	0
Totals	26802	25452	17199	13389