ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2004

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602624A - Weapons and Munitions Technology

	COST (In Thousands)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
	Total Program Element (PE) Cost	71917	75266	44666	43385	41160	41508	41348
H18	ARTY & CBT SPT TECH	15973	14322	14603	14114	15208	15317	15605
H19	CLOSE COMBAT WEAPONRY	9560	6622	6821	11385	12160	12262	6486
H1A	WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE	2381	28125	0	0	0	0	0
H28	MUNITIONS TECHNOLOGY	23376	26197	23242	17886	13792	13929	19257
WA2	GREEN ARMAMENTS TECHNOLOGY	5335	0	0	0	0	0	0
WA3	CORROSION MEASUREMENT AND CONTROL	3240	0	0	0	0	0	0
WA4	ARMAMENT SYSTEMS NETWORK IA CENTER	3334	0	0	0	0	0	0
WA5	HOMELAND DEFENSE TECHNOLOGIES	4668	0	0	0	0	0	0
WA6	NANOTECHNOLOGY CONSORTIUM	952	0	0	0	0	0	0
WA7	PUBLIC-PRIVATE PARTNERSHIP, NON-MUNITIONS	1668	0	0	0	0	0	0
WA8	SEAMLESS DATA DISPLAY	1430	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This Program Element (PE) designs and matures improved weapon 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 better affordability, lower weight and reduced size. Projects H18, H19, and H28 support the FCS 120mm Line-Of-Sight (LOS) Beyond-Line-Of-Sight (BLOS) System Advanced Technology Demonstration (ATD). The ATD's objective is to mature and evaluate 120mm LOS and BLOS armament system components and ammunition suite in support of the FCS Increment 1 Mounted Combat System (MCS). This effort will incorporate System Requirements Analysis and establishment of Best Technical Approach (BTA) to support Lead Systems Integrator (LSI) prime contractor detailed MCS design. The ATD will mature advanced materials, advanced recoil techniques, and electrical ignition to overcome the challenges of creating a smaller, lighter armament system with lethality equaling or exceeding that of current systems. Projects H18, H19, and H28 also support the corresponding MCS Ammunition System Technologies to develop lighter weight armament components to enhance both the performance and stowed ammo capabilities of the FCS Increment 1 120mm LOS/BLOS armament system.

Other major efforts in Project H18 include the Objective Non Line Of Sight (NLOS) Mortar Technology program, which provides a 120 mm breech loaded

mortar weapon to meet FCS range and firing rate performance requirements; advanced laser radar/infrared (LADAR/IR) sensor technology to enhance performance of smart munitions; technology advances in acoustic sensors; and the Future Intelligent Munition (FIM) which will provide the FCS Intelligent Munition System (IMS) with an improved munition, which covers a greater area of terrain with fewer munitions and supports remote delivery at tactical and operational ranges using a variety of delivery platforms (i.e., artillery, rocket, missile, vehicular, and mortar). Project H19 will define, mature and evaluate a breadboard/brassboard Agile Target Effects System (ATES) to suppress/defeat close in threats to the FCS. Project H28 focuses on simultaneously increasing lethality and reducing system weight and includes the development of advanced warheads (both shaped charge and explosively formed penetrators); the maturation of modeling and analytic codes for thermal analysis; and high impetus, low flame temperature propellants to reduce wear on gun tubes, which degrades accuracy and increases the system cost. 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). This program element contains no duplication with any effort within the Military Departments. This work is performed by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), at Picatinny Arsenal, New Jersey.

Work in this PE is related to, and fully coordinated with, efforts in PE 0602618A (Ballistics Technology) and PE 0602623A (Joint Service Small Arms Program (JSSAP), and its technologies typically transition to PE 0603004A (Weapons and Munitions Advanced Technology) and PE 0603802A (Weapons and Munitions Advanced Development).

B. Program Change Summary	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2004)	72504	39485	45598
Current Budget (FY 2005 PB)	71917	75266	44666
Total Adjustments	-587	35781	-932
Congressional program reductions		-705	
Congressional rescissions			
Congressional increases		38300	
Reprogrammings	-587	-1814	
SBIR/STTR Transfer			
Adjustments to Budget Years			-932

Significant Change Explanation:
FY04 - Fifteen FY04 Congressional adds totaling $38300 were added to this PE.

FY04 Congressional Adds with no R-2As:
($890) Advanced Materials and Processes for Non-Munition Armament Structures Program, Project H1A: The purpose of this one year Congressional add is to research the use of metal matrix composites, titanium alloys, advanced aluminum alloys, and functionally gradient materials. No additional funding is required to complete this project.

($1965) Applied Research Integration, Project H1A: The purpose of this one year Congressional add is to investigate new conventional and advanced energy weapons systems. No additional funds are required to complete this project.

($3652) Armaments Information Assurance, Project H1A: The purpose of this one year Congressional add is to develop a homeland defense network for reporting and disseminating from unattended sensors for "situational awareness." No additional funds are required to complete this project.

($3933) Army Welding Technology Development Initiative, Project H1A: The purpose of this one year Congressional add is to design, develop and implement a management system to ensure the introduction of critical materials joining technologies to Army defense contractors, suppliers, and depots for armament system needs. No additional funds are required to complete this project.

($4589) Green Armaments Technology, Project H1A: The purpose of this one year Congressional add is to fund research in green armaments technology at Picatinny Arsenal. No additional funds are required to complete this project.

($2622) Homeland Defense Technologies, Project H1A: The purpose of this one year Congressional add is to establish a multi-acre site that will serve as a dual use Armament Development and Homeland Security/Defense Research and Training area. No additional funds are required to complete this project.

($3278) RangeSafe Technology Demonstration Initiative, Project H1A: The purpose of this one year Congressional add is to develop and evaluate technologies for remediation of Army firing ranges. No additional funds are required to complete this project.

($1311) Seamless Data to Display, Project H1A: The purpose of this one year Congressional add is to conduct research in data display technologies for weapons systems. No additional funds are required to complete this project.

($3651) Smart Coating Material Program, Project H1A: The purpose of this one year Congressional add is to conduct research in the next generation of coatings for Army materiel through the use of nanotechnology. No additional funds are required to complete this project.

($1311) Titanium Extraction Mining and Process Engineering Research (TEMPER), Project H1A: The purpose of this one year Congressional add is to

identify and develop new extraction and mining technologies that will significantly reduce the cost of titanium for Army systems. No additional funds are required to complete this project.

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February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H18	ARTY & CBT SPT TECH	15973	14322	14603	14114	15208	15317	15605

A. Mission Description and Budget Item Justification: This project focuses on applied research of technologies for 120mm LOS BLOS cannon, mortar weapon, smart munitions, fire control and combat support systems in support of FCS increment 1 and the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. Specific efforts include FCS 120mm LOS BLOS System Advanced Technology Demonstration (ATD); Objective Non Line Of Sight (NLOS) Mortar Technology; Advanced Sensors for Smart Munitions; and Advanced Acoustic/Seismic Systems. Efforts beginning in FY04 include: MCS Ammunition System Technologies (MAST); Common Smart Submunition; Lightweight Dismounted Mortar Weapon; and Future Intelligent Munition. MAST will mature technologies to enhance the capabilities of FCS Increment 1 120mm LOS/BLOS munition suite for the MCS through spiral technology insertion. LOS/BLOS/NLOS Gun Enhancements development includes utilization of lightweight materials and advanced recoil mitigation technologies to enhance or create more lethal, lightweight armaments. Advanced acoustic sensors will be investigated for providing non-line of sight target cueing for a variety of weapons platforms. Technologies for reducing artillery target location error, for providing real time targeting data to fire direction centers and enhancing functionality of sensor inter-networking are being matured to support information dominance strategies for FCS. Improved smart munitions will be pursued for FCS NLOS 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. 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 Arsenal, New Jersey and the Army Research Laboratory at Aberdeen Proving Ground, Maryland.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
Objective NLOS Mortar Technology: In FY03, completed kinematics analysis on selected configuration; established the hardware design of the breech loaded, recoiling mortar. At the end of FY 03, designs and models generated were transitioned to support the maturation and demonstration effort under PE0603004A.	3771	0	0
Advanced Sensors for Smart Munitions: In FY03, fabricated smart sensor component hardware and performed captive flight test; concluded sensor suite packaging analysis for smart munitions. This effort will transition to the Common Smart Submunition Program for use in the work described in PE0603004A	1790	0	0
Networked Sensors for the Future Force ATD: In FY03, evaluated acoustic sensor system to accurately locate artillery and mortar fires to cue AN/TPQ-36/37 (Fire Finder Radars); implemented the ground target classifier and target counting algorithm for integration into a real-time, high fidelity system. In FY04, develop low cost, distributed and networked unattended ground sensors.	1989	1316	0

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
Future Intelligent Munition: In FY04, conduct system/subsystem simulations and determine best technical approach; conduct 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. In FY05, will begin design of ground detector, air seeker and propulsion mechanism hardware along with associated electronics and algorithms.	0	855	3268
FCS 120mm LOS BLOS System: In FY03, completed detailed design of ETC propulsion and turreted armament system; conducted gun testing of cartridge case and seals with ETC ignition and kinetic energy (KE) composite sabot; continued laboratory demos of shaped charge (SC) and explosively formed penetrator (EFP) warheads. Conducted maneuverability analysis and preliminary guidance and control design for laboratory testing. In FY04, complete system integration laboratory demo of fire control functionality; complete functional demos (TRL6) of launcher and autoloader prototypes; conduct turret manufacturing/integration; conduct Guide-To-Hit test of MRM with single mode seeker. Conduct High-g tests of multi-mode sensor components for MRM.	4045	5882	0
LOS/BLOS/NLOS Armament System Technologies: In FY05, will initiate and complete light weight armament component optimization and design; will complete modeling, analysis, and design of fully automated ammunition handling resupply module for main gun and secondary armament dual feed with reduced logistics tail; will develop fire control techniques for improved accuracy through in-flight communication at extended ranges and improved gun pointing	0	0	8364
MCS Ammunition System Technologies (MAST): In FY04, complete initial designs and fabricate improved proximity sensor for LOS Multi-Purpose (MP) projectile.	0	1850	0
Common Smart Submunition: In FY04, begin system design, risk assessment, and trade studies to baseline metrics for hard and soft carrier applications, and operational performance of sensor and lethal mechanism design requirements. In FY05, will design and build critical subsystems for breadboard sensor and electronics evaluation prior to full function submunition integration.	0	854	2971
Lightweight Dismounted Mortar Weapon: In FY04, conduct analysis of material options to assess viable candidates for thermal, dynamic and economical feasibility; fabrication of mock-ups will be conducted for mechanical assessment. Beginning in FY2005, this effort continues in PE0603004A.	0	984	0
Nanotechnology for Smart Munitions: This one year Congressional add matured nanoparticle materials and transducer devices for integration into smart munitions. No additional funding is required to complete this project.	1347	0	0
Smart Coatings: This one year Congressional add completed maturation of coatings for Army materiel that are self-healing and have advanced attributes such as providing camouflage. No additional funding is required to complete this project.	1684	0	0

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
Applied Research Integration: This one year Congressional add investigated new armament and fire control technologies to increase lethality for lighter Army systems in the future. Technologies explored include warheads, fire control, fuzing, smart munitions/algorithms, directed energy, etc. No additional funding is required to complete this project.	1347	0	0
Acoustic Counter Battery System: The purpose of this one year Congressional add is to continue development of a passive acoustic sensing system to detect and locate hostile artillery fires and to provide targeting data to fire direction centers. No additional funding is required to complete this project.	0	2350	0
Small Business Innovative Research/Small Business Technology Transfer Programs	0	231	0
Totals	15973	14322	14603

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February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H19	CLOSE COMBAT WEAPONRY	9560	6622	6821	11385	12160	12262	6486

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 and the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The project conducts research in technologies that will result in significantly greater lethality with more accurate delivery, significantly reducing logistics footprint while reducing life cycle costs for ground and air 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. Principal efforts support the ammunition suite for the FCS for rapid extended range defeat of high value targets out to 8km+, expanding the maneuver commander's battle area 7-fold. This project funds modeling and simulation of advanced armament systems leading to application for FCS. Cannon design technologies include: recoil mitigation techniques for use of large caliber cannons on lightweight (less than 20 ton) vehicles and a novel chamber configuration, leading to overall compact armament system configurations. Advanced barrel coating technology, utilizing cylindrical magnetron sputtering (CMS) of refractory alloys, is being pursued to provide extended barrel life for tanks, artillery and FCS cannon systems, with potential to provide an environmentally friendly process as a future replacement for electro-deposition of chrome plating. This project will mature advanced multi-mode fuzing technologies including some lower cost, self-destruct technologies for submunitions that could reduce unexploded ordnance on the battlefield and provide low cost electronic safe and arm devices for single and future multi-mode warheads. The project also matures extended range munitions and alternative mechanisms to defeat advanced armor systems. Both hardware and analytical tools will be matured and used to assess system performance, identify problem areas and formulate solutions. This project matures and evaluates a breadboard/brassboard Agile Target Effects System (ATES) that delivers a synergistic combination of directed energies to suppress/defeat close in threats to the FCS. The project also matures advanced on-board munition power systems with increased energy and power densities, increased mission time, improved temperature performance and reduced volume and weight for the Objective Force. 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 Arsenal, New Jersey and the Army Research Laboratory at Aberdeen Proving Ground, Maryland.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
FCS 120mm LOS BLOS System: In FY03, completed test firing of 105 swing chamber gun system, formulated design of lightweight 120mm cannon, autoloader, fire control, advanced propulsion and turreted armament system; conducted initial system component demonstration; conducted high-G tests of beyond line of sight (BLOS) projectile sensor components; optimized multimode warheads in prototype projectile designs. In FY04, evaluate Advanced KE with novel penetrator by firing against future heavy armor target.	6048	2633	0
MCS Ammunition System Technologies (MAST): In FY04 complete initial designs and initiate fabrication of LOS-MP projectile.	0	548	0
LOS/BLOS/NLOS Armament System technologies: In FY05, will conduct dynamic modeling and analysis of FCS Increment 1 armament system to determine methods of increasing gun elevation capability through the reduction in recoil swept volume enabled through advanced propellant venting. Develop candidate concepts for propellant venting, fabricate and demonstrate most promising concepts to assess integration impacts and validate recoil reductions predicted in models.	0	0	3995
Agile Target Effects (ATE): In FY03, identified Agile Target Effects laser and microwave sources and determined reduction of energy source power required to defeat selected targets due to synergistic effects; developed enhanced dazzler energetic material using nano-particles. In FY04, integrate selected directed energy sources into brassboard ATE weapon system and determine effectiveness and benefit of synergy against representative target(s). In FY05, will complete detailed concept design of ATE system; will conduct feasibility demonstrations of major ATE components with reduced size/weight/power and will continue ATE effects investigations on selected targets to refine/enhance system design requirements.	3512	3386	1460
Common/Modular Power Source for Munitions: In FY05, will design configuration and testing of advanced energy systems with higher power densities, including concepts for alternate/hybrid systems, and will perform modeling of advanced thermal battery technology.	0	0	1366
Small Business Innovative Research/Small Business Technology Transfer Programs	0	55	0
Totals	9560	6622	6821

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H28	MUNITIONS TECHNOLOGY	23376	26197	23242	17886	13792	13929	19257

A. Mission Description and Budget Item Justification: This program advances the state of the art for enabling technologies supporting the FCS and the Future Force and, where feasible, exploits opportunities 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, both shaped charge (SC) and explosively formed penetrators (EFP); high energy explosives; large-caliber gun propellants with barrel wear reducing additives; insensitive munitions (IM); energetics; advanced materials/processes for warheads; and techniques/processes to address material corrosion. Novel warhead architectures, new initiation techniques and advanced material technologies are being applied to produce smaller, lighter, more effective, multi-role warheads having 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 threat 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 Initiation (ETI), offer increased muzzle kinetic energy, precision ignition and unmatched repeatability. The integrated propellant and explosive insensitive munitions program will increase the battlefield survivability of land combat systems and enhance overall safety at manufacturing plants, storage depots, and during air and sea transport. Efforts under this project support the FCS 120mm LOS BLOS System ATD and MAST, which mature and evaluate a lightweight, multi-role armament and ammunitions system. Analysis and maturation of Multiple-EFP warheads also supports the Army's Full Spectrum Active Protection System (APS) research and development, performed by the Tank Automotive Research Development and Engineering Center (TARDEC) under Program Element (PE) 0603005A. 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 Arsenal, New Jersey and the Army Research Laboratory at Aberdeen Proving Ground, Maryland.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
FCS 120mm LOS BLOS System ATD: In FY03, used small-scale (pilot) process to prove feasibility of an environmentally friendly process for a selected explosive formulation. Delivered 200 pounds of the candidate high-energy and high blast, insensitive explosive formulations for testing in FCS warheads; tailored selected multi-purpose SC and EFP warhead designs for fabrication in the optimum FCS munition configuration. In FY04, fabricate, characterize and assemble FCS propellant charges for full-up firing demo of ETI propulsion capability; conduct warhead demo of MRM warhead.	8681	8741	0
MCS Ammunition System Technologies (MAST): In FY04, complete initial propulsion and warhead designs, fabricate and conduct initial warhead laboratory tests of Line Of Sight-Multi Purpose (LOS-MP) munition. In FY05, will complete warhead demonstrations of LOS MP for airburst capability; will optimize Electronic Safe & Arm (ESA) subsystem of multi-effects warhead; will complete design of advanced propulsion providing precision ignition and hot performance across entire temperature range.	0	1747	9002
Full Spectrum Active Protection (FSAP)/Integrated Survivability: In FY03, successfully evaluated lethality of active protection system (APS) warhead designs to defeat kinetic energy (KE) penetrators, anti-tank guided missiles (ATGMs) and rocket propelled grenades (RPGs); successfully evaluated initial tactical warhead design for FSAP counter-munition. In FY04, integrate APS warhead into counter-munition; optimize warhead design with system fuzing. In FY05, will conduct dynamic testing of optimized APS warhead integrated into counter-munition. This task is complementary to and fully coordinated with work accomplished in PE0602601A and supports demonstration of APS, conducted under PE0603005A.	1500	1776	2060
Novel Energetic Materials for the Future Force: In FY03, evaluated nanometals and nanoalloys for advanced gun propellant and explosive formulations; matured new processing technologies for nanomaterials. In FY04, characterize candidate energetic materials and assess energetic system concepts exploiting managed energy release for advanced gun propellant and explosive formulations. In FY05, will define matrix of energetic materials technologies for advance gun propulsion and advanced explosives for warhead applications.	3000	2920	3800
Hardened Combined Effects Penetrator Warhead Technology: In FY04, conduct hardened shaped charge warhead modeling/design evaluation and initial baseline hardware experimentation including armor penetration, MOUT targets and baseline fragmentation. In FY05, will determine bash-through loads for key targets; will mature hardening techniques and hardened designs of the penetrator; will evaluate candidate multi-purpose energetic materials including energetics structural integrity.	0	973	4706
Multiple Effects Warhead Technology: In FY04, mature and evaluate a revolutionary Gen II EFP warhead concept for FCS smart munitions. An EFP, 1-3 caliber long, will be designed and evaluated. In FY05, will optimize Gen II design with aerostable tail configuration and demonstrate enhanced penetration capability at standoff greater than 50 meters.	0	1564	3197

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
Common/Modular Power Source for Munitions: In FY05, will begin design configuration and testing of advanced energy systems with higher power densities, including concepts for alternate/hybrid systems, and will perform modeling of advanced thermal battery technology.	0	0	477
Generation 2 Warhead Development (X-caliber) Explosively Formed Penetrator (EFP): In FY03, this Congressional add supported the design iterations of a Gen-2 warhead (x-caliber) EFP to achieve a greater than 1.5 caliber penetrator. In FY04, the Congressional add will support the design iterations to achieve an Aerostable Gen-2 (x-caliber) EFP hitting targets at greater than 50 meters. No additional funds are required to complete this project.	1340	1984	0
Tandem Explosively Formed Penetrator Warhead Systems: In FY04, the purpose of this one year Congressional add is to develop warhead technology to enable a next generation LOS/NLOS missile and projectile system that can guide to hit for high probability of kill. No additional funds are required to complete this project.	0	945	0
Liquidmetal Alloy-Tungsten (LA-T) Armor Piercing Ammunition: The purpose of this Congressional add is to investigate the properties and performance of liquid metal tungsten alloy penetrators. In FY03, optimized the bulk-density and mechanical properties of amorphous tungsten-alloy penetrator material for greater launch survivability and penetration performance while upgrading the manufacturing process to produce larger scale parts for possible 30mm GAU-8 applications. In FY04, the purpose of this add is to optimize the manufacturing process for long-term producibility and production-readiness while altering the penetrator material for Long-Rod Armor Piercing Applications. No additional funds are required to complete this project.	4068	1489	0
Single Crystal Tungsten Alloy Penetrators: This Congressional add investigates the potential of single crystal tungsten as a viable candidate material to replace depleted uranium for use as kinetic energy penetrators. In FY03, developed a chemical vapor deposition process to manufacture oriented single crystal tungsten billets for ballistic evaluations. In FY04, the purpose of this add is to perform surface engineering processes on sub-scale penetrator rods to eliminate parasitic in-flight fracturing and enhance the ballistic performance of the oriented single crystal tungsten penetrator rods fabricated by the chemical vapor deposition process. No additional funds are required to complete this project.	2872	1417	0
Modular Artillery Charge System (MACS) High Zone Development: The purpose of this one year Congressional add is to develop hybrid propellant for the M232. No additional funds are required to complete this project.	0	1984	0
M795, Extended Range, High Explosive Baseburner Projectile: In FY03, this one year Congressional add supported the maturation of a M795 extended range high explosive projectile. No additional funds are required to complete this project.	1915	0	0

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
Small Business Innovative Research/Small Business Technology Transfer Programs	0	657	0
Totals	23376	26197	23242