ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602105A - MATERIALS TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	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	34423	60102	18614	19029	19400	19673	20066	20518
H7B	Advanced Materials Initiatives (CA)	17252	41487						
H7G	NANOMATERIALS APPLIED RESEARCH	4797	5204	4905	5034	5203	5316	5393	5522
H84	MATERIALS	12374	13411	13709	13995	14197	14357	14673	14996

A. Mission Description and Budget Item Justification: This program element (PE) funds research and evaluation of materials technologies for armor and armaments that will significantly enhance the survivability and lethality of Future Force systems and where feasible, can be exploited to enhance the Current Force. This PE builds on the materials research transitioned from PE 0601102 (Defense Research Sciences) H42 (Materials and Mechanics) project and applies it to specific Army platforms and the individual Soldier. Project H84 is directed toward developing materials technology that contributes to making heavy forces lighter and more deployable and light forces more lethal and survivable. Project H84 provides the technology base required for solving materials-related problems in individual Soldier support equipment, armor, armaments, aircraft, ground and combat vehicles, and combat support. Project H7G funds the collaborative research efforts in nanomaterials technology between the ARL and the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology and the ISN industry partners. The effort is focused specifically on the improvement in individual Soldier protection. Project H7B funds congressional special interests associated with advanced materials for the full range of Army applications. Work in this PE is related to and fully coordinated with efforts in PE 0602618 (Ballistics Technology), PE 0602601 (Combat Vehicle and Automotive Technology), PE 0602782 (Command, Control, Communications Technology), PE 0602786 (Warfighter Technology), PE 0603001 (Warfighter Advanced Technology), PE 0603004 (Weapons and Munitions Advanced Technology), PE 0603005 (Combat Vehicle Advanced Technology), PE 0603008 (Command, Control, Communications Advanced Technology), and PE 0708045 (Manufacturing Technology). 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 in this project is performed by the Army Research laboratory and is intended to transition materials technologies and support the Army materiel efforts at the Armaments Research, Development, and Engineering Center, Picatinny Arsenal, NJ; the Tank and Automotive Research, Development, and Engineering Center, Warren, MI; the Aviation and Missile Research, Development, and Engineering Center, Huntsville, AL; the Natick Soldier Center, Natick, MA; the Edgewood Chemical and Biological Center, Edgewood, MD; and the Communications and Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	35051	18822	19209	19563
Current BES/President's Budget (FY 2008/2009)	34423	60102	18614	19029
Total Adjustments	-628	41280	-595	-534
Congressional Program Reductions		-230		
Congressional Rescissions				
Congressional Increases		41950		
Reprogrammings	-628	-440		
SBIR/STTR Transfer				
Adjustments to Budget Years			-595	-534

Twenty-two FY07 congressional adds totaling $40208 (after adjustment for Undistributed Congressional Adjustments) were added to this PE.

($958) Composites Materials Tech for Future Cbt Systems
($1917) Future Affordable Multi-Utility Materials for FCS
($1581) Materials Joining for Army Weapons Systems
($1246) Precision Polishing of Large Optics
($2876) MEMS Sensors for Rolling Elements Bearings
($3116) Spinel Tactical Armor Manufacturing Production Tec
($2204) Ultrasonic Consolidatn Matrix for Metal Composites
($3835) LRIP LASSO
($2109) Multifunctional, Nanostructured Materials for FCS
($1821) Airfield Matting System Replacement
($288) Con Sys f/Laser Powder Dep Mfg Process
($2252) Cutting Tools for Aerospace Materials
($2492) Erosian Resist Surface Eng for Helo Comp Blades
($1581) FCA Advanced Ballistic technology Program
($479) IED Simulation in Different Soils
($958) Lightweight Transparent Armor for Force Protection
($2588) Munition Shape Charge Control Research
($1917) Nanomanufacturing of Multifunction Sensors
($1294) Production of Turtle Shell Armor for E-SAPI
($1246) Structural Reliability of Smart Mun & Lgtwt Struct
($2492) Thermal Sprays for Polymeric-Based Ballistic Mitig

($958) Thermoplastic Composite Body Armor

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2 - Applied Research	**0602105A - MATERIALS TECHNOLOGY**	**H7G**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H7G	NANOMATERIALS APPLIED RESEARCH	4797	5204	4905	5034	5203	5316	5393	5522

A. Mission Description and Budget Item Justification: This project funds the integration of government and industry scientific capabilities on research to advance innovative nanomaterials technologies and exploit breakthroughs in nanomaterials basic research toward improving Future Force Warrior survivability, lethality, and sustainability. This project funds collaborative research in nanomaterials technology between the Army Research Laboratory (ARL), the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology, and the ISN industry partners. The research is focused on nanomaterials and includes the development of models to facilitate the exploration of concepts for improving individual Soldier protection. Nanomaterial research holds promise in providing the capability to tailor the mechanical and thermal response of materials to enable desired performance improvements specific to the application of interest. 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 in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Devise and validate improved, physics-based, materials property models, and concepts for multifunctional, lightweight, and responsive hierarchical material technologies, and exploit breakthroughs in nanomaterials and multifunctional fiber processing technologies (e.g., scale-up of processes and fabricate into woven materials) to enable revolutionary Future Force Warrior protection capabilities. Coordinated research program conducted internally by ARL and externally through a collaborative effort with ISN and ISN industry partners. In FY06, investigated materials technologies to incorporate multi-material assemblies for multifunctional performance; devised nanoscale additives for protective coatings and inks; advanced materials concepts to enable photonic band gap fibers to be used in explosive detection systems; and scaled up fiber modifications for enhanced protection. In FY07, mature multi-functional materials concepts to include addressing scalable processing and fabrication methods; improve nanomaterials ingredients for sensor applications; and quantify performance of nanoengineered composite fabrics. In FY08, will research technologies to enable multifunctional designs utilizing multiple nanomaterial constituents. In FY09, will validate performance enhancements enabled through insertion of nanomaterials constituents in scalable processes.	4797	5081	4905	5034
Small Business Innovative Research/Small Business Technology Transfer Programs		123		
Total	4797	5204	4905	5034

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602105A - MATERIALS TECHNOLOGY**	**H84**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H84 MATERIALS	12374	13411	13709	13995	14197	14357	14673	14996

A. Mission Description and Budget Item Justification: This project provides the technical foundation for materials technology in metals, ceramics, polymers, and composites that are essential for lethal and survivable Future Force Systems, Future Force Warrior (FFW), and where feasible, can be exploited to enhance Current Force capabilities. In order to meet the challenge of Army transformation, new systems must be significantly lighter, more deployable, and more sustainable. Achieving such systems requires new material and structural solutions that offer significant weight reduction with improved performance, durability, and cost reduction for application to individual Soldier support equipment, armor, armaments, aircraft, ground combat vehicles, and combat support equipment. This project will address these needs through: nanomaterials research across the spectrum of applications to improve performance; improved, physics-based, material, mechanical, and structural models; high strain rate material characterization techniques; non-destructive inspection/evaluation technologies; new high strength/temperature materials and coatings; and advanced fabrication/processing methodologies. Applied research efforts are focused in armor/armament materials, as well as lightweight structural materials and materials affording protection against chemical, biological, or directed energy threats. Overarching goals of this material research are to provide optimized lightweight armor structures, improved affordable processing methods, and the development of modeling and simulation tools to facilitate future design efforts in support of FFW and other Future Force systems. The work is conducted by the Army Research Laboratory, at its Aberdeen Proving Ground, MD, and Hampton, VA, locations, and provides required technologies for advanced development programs at the Armaments Research, Development, and Engineering Center, Picatinny Arsenal, NJ; the Tank and Automotive Research, Development, and Engineering Center, Warren, MI; the Aviation and Missile Research, Development, and Engineering Center, Huntsville, AL; the Natick Soldier Center, Natick, MA; the Edgewood Chemical and Biological Center, Edgewood, MD; and the Communications and Electronics Research, Development, and Engineering Center (CERDEC), Ft. Monmouth, NJ. 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).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Optimize lightweight armor materials/structures, processing methodology, and modeling and simulation tools to enable formulation of lightweight, frontal, and structural armors that will revolutionize the survivability of Current and Future Force platforms and tactical vehicles. In FY06, validated computational models were used to design and fabricate multi-material assemblies to achieve optimized multi-functional properties. In FY07, evaluate these multi-material assemblies against ballistic, mine blast, and other emerging threats. In FY08, will devise processing capabilities to fabricate multi-layer and hybrid materials; will prove ballistic multi-hit capability while maintaining single hit performance; will show capability to fabricate constant-radius, curved, transparent ceramic plates, and apply advanced polishing techniques. In FY09, will evaluate transparent armors and multi-layer/hybrid materials options against current and emerging threats; will provide computational models and simulations of lightweight air supported structures that allow for improved planning, and reduce the number of prototypes needed to develop new lightweight highly mobile medical tent systems.	3819	4015	4394	4467
Optimize lightweight armor materials and defeat mechanisms against emerging threats to enable affordable design of future multifunctional ballistic protective systems for the Future Force Warrior. Provide quantitative scientific basis for modeling and simulation that result in new lethal mechanisms/protection schemes for the individual warfighter. In FY06, exercised initial simulation codes against known threats and current protection schemes and refined models; incorporated lightweight armor materials and novel defeat mechanisms into concepts to improve Soldier extremity protection. In FY07, validate simulation and design tools for individual warfighter protection	2500	2550	2650	2730

and lethality applications and transition promising first generation protection/lethality concepts to development community. In FY08, will show simulation capability for multiple density target with complex projectile failures; will incorporate low density surrogate and multi-density range targets into assessment methodology. In FY09, will increase fidelity of simulation capability and transition second generation protection/lethality concepts to development community for the Future Force Warrior.				
Design, validate, and optimize advanced materials (ceramic, composite, polymers, lightweight, and high-strength metals) and processing techniques for smaller but more lethal penetrators/warheads and affordable, lightweight high performance armaments for revolutionary weapons effectiveness in urban and irregular operations. In FY06, characterized full scale penetrators and provided alloy/penetrator manufacturing process diagrams for production and transitioned to industrial partners; investigated behavior of metal matrix composites subjected to tensile load over the range of operational temperatures typical for cannons. In FY07, mature processes and techniques for fabricating ultra-fine grain materials that result in penetrators with improved strength and stiffness; identify and demonstrate a process for application of an erosion-resistant appliqué on a lightweight composite cylinder to enable future lightweight armaments. In FY08, will explore micro-mechanics effects of blast and impact shock on prospective warhead and projectile materials; will examine methods for controlled fragmentation of projectile body materials; will fabricate long metal matrix composite (MMC) sections with advanced liner material and will perform full scale experimental validation of MMC tube. In FY09, will design material system to provide the desired multi-functional capability to enhance damage on relevant targets and conduct benchmark experiments with that material system.	3555	4334	4165	4298
Design and optimize electro-ceramic materials and processing techniques for integration by CERDEC into advanced antennas that will enable affordable, reliable command, control, communications (C3) information for Current and Future Force platforms. In FY06, established life testing methodologies to evaluate reliability of thin film-based structures. In FY07, investigate novel material concepts to increase the temperature stability of active thin film materials. In FY08, will design and prove a materials reactor to grow thin films for tunable devices; will characterize microstructural, interfacial, and surface properties of the films grown. In FY09, will devise unique growth process science to achieve compositionally graded perovskite oxide thin film materials and will integrate the material into a specialized device structure.	500	500	500	500
Mature and scale-up nanomaterials processes, fabrication, characterization, and performance measures to enable revolutionary concepts for Future Force lethality and survivability beyond those addressed for individual Soldier protection in Project H7G. In FY06, devised nanomaterial concepts to produce lightweight transparent structural materials systems; matured processing methods to produce nanometallic materials; validated nanomaterial enhancements to improve structural and impact properties of polymer composite materials; devised nanomaterial additives for use in military coatings system improvements; and matured unique experimental and numerical methods to characterize the mechanical response of nanomaterials. In FY07, advance design capabilities for advanced nanomaterials and validate scalable processing methods; investigate effects of nanoengineering on the mechanical and physical properties of composite materials; quantify effects of nanomaterial modified coating systems on materials performance; modify and mature improved physics-based nanomaterials property models. In FY08, will perform parametric processing studies of advanced nanomaterial compositions; will apply modeling results to the maturation of reactive materials; will assess and validate performance of nanoengineered composite materials for survivability and lethality applications. In FY09, will scale-up the process methodology for fabricating fully-dense boron carbide plates; will perform microstructural and mechanical property characterization; will determine ballistic behavior of promising Al-based nano-micro composites.	2000	2000	2000	2000
Small Business Innovative Research/Small Business Technology Transfer Programs		12		
Total	12374	13411	13709	13995