ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602105A - MATERIALS 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		48274	35051	18822	19209	19563	19850	20123
H7B	Advanced Materials Initiatives (CA)	33250	17743	0	0	0	0	0
H7G	NANOMATERIALS APPLIED RESEARCH	4553	4934	5262	5393	5543	5653	5766
H84	MATERIALS	10471	12374	13560	13816	14020	14197	14357

A. Mission Description and Budget Item Justification: This program element (PE) researches and evaluates materials technologies for armor and armaments that will significantly enhance the survivability and lethality of Future Combat Systems (FCS) and Future Force systems and, where feasible, can be exploited to enhance Current Force capabilities. The PE builds on the materials research transitioned from PE 0601102 (Defense Research Sciences) H42 (Materials and Mechanics) and applies it to specific Army platforms and the individual soldier. Project H84 is directed toward developing materials technology that contributes to making our heavy forces lighter and more deployable, and our light forces more lethal and survivable. It 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 for Technology, MA 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 (ARL) is intended to transition materials technologies and support the Army materiel efforts at the Armaments Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ; the Tank and Automotive Research, Development and Engineering Center (TARDEC), Warren, MI; the Aviation and Missile Research, Development and Engineering Center (AMRDEC), 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), Fort Monmouth, NJ.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2006)	50788	17559	18236
Current BES/President's Budget (FY 2007)	48274	35051	18822
Total Adjustments	-2514	17492	586
Congressional Program Reductions		-154	
Congressional Rescissions		-354	
Congressional Increases		18000	
Reprogrammings	-2514		
SBIR/STTR Transfer			
Adjustments to Budget Years			586

Ten FY06 Congressional adds totaling $18000 were added to this PE.

FY06 Congressional adds with no R-2A (appropriated amount is shown):
($1000) Advanced Ceramic Armor High Mobility Combat Vehicles
($1000) Advanced Lightweight Composite Armor Materials for Ballistic Impact and Blast Protection
($1500) Advanced Materials for Mine Detection and Blast Mitigation
($1500) Composite Materials Technology for Future Combat System
($3000) Future Affordable Multi-Utility Materials for Future Army Combat
($1400) Lightweight Blast Containment Vessel Development
($2200) LRIP LASSO
($2000) MEMS Sensors for Rolling Bearings
($2400) Multifunctional, Nanostructured Materials for FCS
($2000) Tactical Armor Manufacturing

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602105A - MATERIALS TECHNOLOGY**	**H7G**

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H7G	NANOMATERIALS APPLIED RESEARCH	4553	4934	5262	5393	5543	5653	5766

A. Mission Description and Budget Item Justification: This project integrates 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 a collaborative research effort in nanomaterials technology between the Army Research Laboratory (ARL), the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology and the ISN's 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 2005	FY 2006	FY 2007
- 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 fabrication into woven materials) to enable revolutionary Future Force Warrior protection capabilities. Coordinated research program conducted internally, by ARL, externally by ISN industry partners, and through collaboration with ARL and ISN industry partners. In FY05, devised protective materials concepts that could be incorporated into multifunctional capabilities (e.g., ballistic, blast and fire/flame protection) with reduced weight within a single integrated system. Exploited selected processing methodology to fabricate prototype nanomaterials-based, functionally integrated specimens for evaluation with improved survivability and lethality. In FY06, will investigate materials technologies and incorporate into flexible multi-material assemblies and determine performance of newly developed materials systems. In FY07, will mature multi-functional materials concepts to include addressing scalable processing and fabrication methods.	4553	4934	5262
Total	4553	4934	5262

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H84 MATERIALS	10471	12374	13560	13816	14020	14197	14357

A. Mission Description and Budget Item Justification: The goal of this project is to provide the technical foundation for materials technology in metals, ceramics, polymers, and composites that are essential for lethal and survivable Future Combat Systems (FCS), Future Force Warrior (FFW) and other Future Force platforms. 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 materials and structures 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, mechanics, 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 the 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 FCS and FFW. The work is conducted by the Army Research Laboratory (ARL), 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 (ARDEC), Picatinny Arsenal, NJ; the Tank and Automotive Research, Development and Engineering Center (TARDEC), Warren, MI; the Aviation and Missile Research, Development and Engineering Center (AMRDEC), 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). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
- 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 FCS, Current and Future Force Platforms and Ground Tactical Vehicles. In FY05, validated enhanced structural armor, metallics, and ceramics to enable advanced armor technology formulation; and validated computational methodologies for design of blast and impact-resistant multifunctional composite structures critical to improving the survivability of Current and Future Force platforms. In FY06, the validated computational models will be used to design and fabricate multi-material assemblies to achieve optimized multi-spectral properties. In FY07, will evaluate these multi-functional assemblies against ballistic, mine blast and other emerging threats.	4199	4160	4808
- Optimize lightweight armor materials and defeat mechanisms against emerging threats to enable affordable design of future multifunctional ballistic protective systems for the Future Warrior. Provide quantitative scientific basis for modeling and simulation that result in new lethal mechanisms/protection schemes for the individual warfighter. In FY05, devised new physics-based simulation capability to model the effects of ballistic, blast, or shock impact and stab incidence on the warfighter; investigated novel armor materials and processing techniques to devise concepts for soldier extremities protection. In FY06, will exercise initial simulation codes against known threats and current protection schemes and refine models as required; will incorporate lightweight armor materials and novel defeat mechanisms into concepts to improve Soldier extremity protection. In FY07, will validate simulation and design tools for individual	2251	2398	2564

warfighter protection and lethality applications and transition promising protection/lethality concepts to development community.			
- 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 Future Force lethality. In FY05, validated full-pressure (65ksi) ceramic barrel section in 25mm, and produced sub scale penetrators from emerging amorphous metals and unique alloys. In FY06, will characterize full scale penetrators and provide alloy/penetrator manufacturing process diagrams for production and transition to industrial partners; will investigate behavior of metal matrix composites subjected to tensile load over the range of operational temperatures typical for cannons. In FY07, will mature processes and techniques for fabricating ultra-fine grain materials that result in penetrators with improved strength and stiffness; will identify and prove out a process for application of an erosion-resistant appliqué on a lightweight composite cylinder to enable future lightweight armaments.	3521	3398	3640
- 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 FCS and Future Force platforms. In FY05, transitioned a low loss Barium Strontium Titanate (BST) based thin film material to CERDEC's industry partner (Agile Materials and Technology, Inc) for use in next generation phase shifting devices that will have higher tunability and hence will be smaller and less costly and more aptly integrated into structures and equipment carried or worn by soldiers. In FY06, will establish life testing methodologies to evaluate reliability of thin film-based structures. In FY07, will investigate novel materials concepts to increase the temperature stability of active thin film materials.	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 H7G. In FY06, will devise nanomaterial concepts to produce lightweight transparent structural materials systems; will mature processing methods to produce nanometallic materials; will validate nanomaterial enhancements to improve structural and impact properties of polymer composite materials; will devise nanomaterial additives for use in military coatings system improvements; and will mature unique experimental and numerical methods to characterize the mechanical response of nanomaterials. In FY07, will mature design capabilities for advanced nanomaterials and validate scalable processing methods; will investigate effects of nanoengineering on the mechanical and physical properties of composite materials; will quantify effects of nanomaterial modified coating systems on materials performance; will modify and mature improved physics-based nanomaterials property models.	0	1918	2048
Total	10471	12374	13560