

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)								DATE February 1999																																																									
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602105A Materials Technology																																																													
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost																																																							
Total Program Element (PE) Cost	12319	13012	13849	13825	15549	16404	15084	15828	Continuing	Continuing																																																							
AHM1 Hardened Materials	2811	2980	0	0	0	0	0	0	0	5791																																																							
AH84 Materials	9508	10032	13849	13825	15549	16404	15084	15828	Continuing	Continuing																																																							
<p>A. <u>Mission Description and Budget Item Justification:</u> This program element (PE) provides materials technology for armor and armaments to enable US dominance in future conflicts across a full spectrum of threats in a global context. Project AH84 is directed toward developing materials technology that will make our heavy forces lighter and more deployable, and our light forces more lethal and survivable. Project HM1 focuses on developing the materials technology needed so that future strategic missile interceptors can meet stringent performance demands. Work in this program element has been coordinated with the other military services through the Materials/Processes Area Plan to prevent duplication of effort and to maximize the return on investment. . Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Force XXI.</p>																																																																	
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">B. Program Change Summary</th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> <th style="text-align: center;"><u>FY 2000</u></th> <th style="text-align: center;"><u>FY 2001</u></th> </tr> </thead> <tbody> <tr> <td>Previous President's Budget (FY 1999 PB)</td> <td style="text-align: center;">12415</td> <td style="text-align: center;">10137</td> <td style="text-align: center;">11344</td> <td style="text-align: center;">12513</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">12811</td> <td style="text-align: center;">13137</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>a. Congressional General Reductions</td> <td style="text-align: center;">-396</td> <td style="text-align: center;">-125</td> <td></td> <td></td> </tr> <tr> <td>b. SBIR / STTR</td> <td style="text-align: center;">-72</td> <td></td> <td></td> <td></td> </tr> <tr> <td>c. Omnibus or Other Above Threshold Reductions</td> <td style="text-align: center;">-24</td> <td></td> <td></td> <td></td> </tr> <tr> <td>d. Below Threshold Reprogramming</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>e. Rescissions</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Budget Years Since FY 1999 PB</td> <td></td> <td></td> <td style="text-align: center;">+2505</td> <td style="text-align: center;">+1312</td> </tr> <tr> <td>Current Budget Submit (FY 2000 / 2001 PB)</td> <td style="text-align: center;">12319</td> <td style="text-align: center;">13012</td> <td style="text-align: center;">13849</td> <td style="text-align: center;">13825</td> </tr> </tbody> </table>											B. Program Change Summary	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	Previous President's Budget (FY 1999 PB)	12415	10137	11344	12513	Appropriated Value	12811	13137			Adjustments to Appropriated Value					a. Congressional General Reductions	-396	-125			b. SBIR / STTR	-72				c. Omnibus or Other Above Threshold Reductions	-24				d. Below Threshold Reprogramming					e. Rescissions					Adjustments to Budget Years Since FY 1999 PB			+2505	+1312	Current Budget Submit (FY 2000 / 2001 PB)	12319	13012	13849	13825
B. Program Change Summary	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>																																																													
Previous President's Budget (FY 1999 PB)	12415	10137	11344	12513																																																													
Appropriated Value	12811	13137																																																															
Adjustments to Appropriated Value																																																																	
a. Congressional General Reductions	-396	-125																																																															
b. SBIR / STTR	-72																																																																
c. Omnibus or Other Above Threshold Reductions	-24																																																																
d. Below Threshold Reprogramming																																																																	
e. Rescissions																																																																	
Adjustments to Budget Years Since FY 1999 PB			+2505	+1312																																																													
Current Budget Submit (FY 2000 / 2001 PB)	12319	13012	13849	13825																																																													
<p>Change Summary Explanation: Funding – FY 1999 – Congressional add for Hardened Materials (+3000). FY 2000 (+2271) and FY 2001 (+1348) to support research on compulsator materials and light weight vehicle armor materials.</p>																																																																	

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
--	------------------------------

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602105A Materials Technology	PROJECT AHM1
--	---	------------------------

COST <i>(In Thousands)</i>	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AHM1 Hardened Materials	2811	2980	0	0	0	0	0	0	0	5791

Mission Description and Justification: This is a Congressionally Funded program; not part of the Army's core mission funded program. This project focused on developing the materials technology for critical components meeting the stringent requirements of strategic interceptors. Materials development for the advanced composite shroud (ACS) enables expansion of the battle space for strategic interceptors by allowing systems to be flown at conditions 3 times more stringent than the current state of the art. This technology program was managed by the Army Research Laboratory, Aberdeen Proving Ground, MD, with contractual efforts at Fiber Materials, Incorporated, of Biddeford, ME (prime), and included as subcontractors Crystal Systems, Inc., of Salem, MD, and Lockheed/Martin Corp., of Sunnyvale, CA.

FY 1998 Accomplishments:

- 2811 - Developed and prepared the advanced composite shroud for full-scale sled test at Holloman Air Force Base to verify the separation dynamics at flight conditions.
- Total 2811

FY 1999 Planned Program:

- 2902 - Conduct two flight tests of the ARL composite shroud, for Advanced Interceptor Technology (AIT) configuration
 - Characterize failure modes for single crystal sapphire
 - Conduct initial characterization studies of single resin system for shroud/heat shield
 - 78 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
- Total 2980

FY 2000 Planned Program: Project not funded in 2000

FY 2001 Planned Program: Project not funded in 2001

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602105A Materials Technology				PROJECT AH84		
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH84 Materials	9508	10032	13849	13825	15549	16404	15084	15828	Continuing	Continuing
<p>Mission Description and Justification: This project provides the technical foundation for materials technology in metals, ceramics, polymers, and composites essential for their optimum application to future Army systems. It also 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. 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. Areas of study in these developments are in characterization, to include high strain rate characterization, processing, and fabrication of these materials. Additional efforts provide materials solutions for improved performance, durability, and cost reduction in Army unique systems. The work is conducted at the Army Research Laboratory, Aberdeen Proving Ground, MD and Hampton, VA 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 Research, Development and Engineering Center, Huntsville, AL; the Natick Research, Development and Engineering Center, Natick, MA; and the Missile Research, Development and Engineering Center, Huntsville, AL.</p> <p>FY 1998 Accomplishments:</p> <ul style="list-style-type: none"> • 2670 - Provided component ferroelectric material for full scale phase shift antenna. Licensed ferroelectric formulation patents. - Developed refractory metal based warhead liner materials using novel processing techniques. - Applied novel, inexpensive processes to produce refractory metal coatings to increase the performance of large caliber direct and indirect fire platforms. • 6230 - Produced transparent armor material in a prototype configuration for individual soldier protection. - Provided modeling and simulation codes as guidelines to improving the ballistic resistance of ultra lightweight armor material. - Evaluated novel processing methods for improved chemical resistance of polymers/elastomers for chemical/biological agent protection of Army and materiel systems. - Developed integral composite structures that combine structural capabilities and ballistic performance without collateral damage. - Developed novel armor plate and ballistically tolerant metallic materials using laser processing. - Enhanced laser ultrasonic inspection technology to detect and characterize flaws in ground and air vehicles; flight tested the mission intensity counter to improve the intensity versus component damage rate model; and advanced active suspension control technology by incorporating brake induced vibration data. • 608 - Developed microwave Non-Destructive Evaluation methods for multi-layered armor/composite structures; applied laser ultrasonic inspection system to flaw detection and characterization; validated a smart structures model for elastic coefficients; flight tested the Mission Intensity Counter; developed a non-linear structural dynamic model of NASA Langley's advanced piezoelectric 'smart' material (Thunder); and investigated brake induced vibration effects on active suspension control. <p>Total 9508</p>										
Project AH84		Page 3 of 5 Pages				Exhibit R-2A (PE 0602105A)				

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602105A Materials Technology	PROJECT AH84
<p>FY 1999 Planned Program:</p> <ul style="list-style-type: none"> • 6562 - Determine enhanced ballistic performance and dynamic response of ultra-lightweight armor materials. <ul style="list-style-type: none"> - Demonstrate advanced polymeric/barrier materials that offer improved performance and durability in Army chemical defense applications. - Elucidate processing/microstructure/property relationships of nanostructured polymers and nano-reinforced ceramic materials for improved survivability in Army systems. - Develop computer models that determine the structural as well as ballistic performance of complex composite material systems for application to the family of future lightweight combat vehicles. - Optimize process for fabricating ballistically resistant hybrid laminate. - Develop rapid prototyping of ballistically tolerant novel components via laser processing. - Quantify ballistic enhancement in integral ceramic/composite armor. - Characterize and elucidate processing and microstructural relationships to produce novel metallics, ceramics and intermetallic microstructures for engineering lightweight structural armor materials • 2813 - Characterize, in simulated gun firings, the enhanced erosion resistance of advanced coating systems designed to significantly increase gun barrel lifetime. <ul style="list-style-type: none"> - Demonstrate improved ferroelectric ceramic processing using double doping to deduce losses and increase tunability for significantly reducing the cost and weight of future antenna systems. - Fabricate prototype refractory metal shaped charged liners and examine their processibility. - Develop processing techniques for fabrication of nano-materials to replace depleted uranium in penetrators. • 642 - Investigate fatigue, flaw detection, and material characterization of thick composite structures; and correlate analytical model of smart material 'Thunder' with dynamic test results. <ul style="list-style-type: none"> - Develop advanced non-destructive evaluation (NDE) methodology for improved structural analysis and flaw/damage detection in composites; incorporate dynamic data into smart materials model; test active suspension system control for ground vehicles. • 15 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs <p>Total 10032</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 3190 - Develop atomic scale, physical-based models of propellant gas interactions with the gun bore surface to predict the durability of the bore surface for a variety of coatings systems and propellants. <ul style="list-style-type: none"> - Demonstrate dielectric materials for miniature smart munition antenna sections to enable extended range and improved accuracy for both direct and indirect fire weaponry. - Fabricate prototype refractory metal explosively formed projectile liners and determine their processibility. • 7310 - Develop life prediction models for Army materiel based on accelerated weathering, cyclic corrosion testing, and real-world exposure studies that will significantly reduce logistical costs for Army systems. 		
Project AH84	Page 4 of 5 Pages	Exhibit R-2A (PE 0602105A)

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602105A Materials Technology	PROJECT AH84
<p>FY 2000 Planned Program: (continued)</p> <ul style="list-style-type: none"> - Quantify and optimize sensor arrays to assess ballistic damage, environmental degradation and potential chemical/biological agent threats. - Fabricate and evaluate new mass-efficient means to improve the ballistic resistance of ceramics by integrating them with organic-matrix composites to enable improved lightweight combat vehicles. - Determine the microstructural influences of metallic-intermetallic-ceramic components on the performance of current composite armor designs • 739 - Conduct microwave NDE measurement and analyses for large composite structures; develop more portable and field usable laser ultrasonic inspection technique; demonstrate a portable, integrated 3D imaging technique for improved inspection of complex structures; and evaluate 'MONGREL', an advanced off-road, high-speed wheeled testbed, for structural dynamics research. • 1185 - Determine critical materials technologies essential for the successful demonstration of pulsed power machines for AAN. • 1425 - Determine high strain-rate behavior and failure criteria of layered and functionally graded ceramics, metals and anisotropic composites to develop constitutive models to abet the rational design of materials for high-performance, integrated, multifunctional armors <p>Total 13849</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 8197 - Demonstrate reduced-cost, appropriate-quality processing technology for lightweight combat vehicles that feature the integrated armor structure technologies available. - Develop procedures for producing bulk materials with nano-scaled microstructures for protection from extreme environments. - Model and engineer candidate multi-phase functionally graded microstructure for penetration resistance and minimal collateral damage in future lightweight combat vehicles. - Integrate multifunctional sensor arrays to assess ballistic damage, environmental degradation and potential chemical/biological agent threats. • 3484 - Produce a full scale section of a large caliber gun tube coated with an enhanced erosion resistant refractory metal coating applied by high velocity spray techniques. - Demonstrate thin film phase shifter materials with properties comparable to bulk materials for significantly reducing the cost and weight of future antenna systems. - Characterize relevant material properties of previously developed refractory metal warhead liners and optimize processing parameters for greater reliability and performance. • 796 - Evaluate prototype microwave NDE hardware using TACOM-provided composite test components; complete laser ultrasonic inspection technology development and checkout; and investigate control algorithms for the "MONGREL" active suspension. • 1348 - Validate penetration and structural simulations to enable material design for future multifunctional, high-performance armor/structure solutions to counter medium-caliber and residual (post APS) large-caliber threats to AAN combat vehicles." <p>Total 13825</p>		
Project AH84	Page 5 of 5 Pages	Exhibit R-2A (PE 0602105A)

THIS PAGE INTENTIONALLY LEFT BLANK