

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2008

BUDGET ACTIVITY		PE NUMBER AND TITLE					
1 - Basic research		0601101A - In-House Laboratory Independent Research					
COST (In Thousands)	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	18404	21528	19832	19238	19297	19699	20110
91A ILIR-AMC	12866	14022	14673	14086	14090	14378	14672
91C ILIR-MED R&D CMD	3833	3617	3616	3662	3698	3779	3862
91D ILIR-CORPS OF ENGR	1522	1309	1339	1279	1292	1320	1349
91E ILIR-ARI	183	195	204	211	217	222	227
91J IN-HOUSE LAB INDEPENDENT RESEARCH - MEDICAL (CA)		2385					

A. Mission Description and Budget Item Justification: The goal of the Army's In-House Laboratory Independent Research (ILIR) program is to attract and retain top flight science and engineering PhDs to the Army's research organizations. This basic research lays the foundation for future developmental efforts by identifying the fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge. The ILIR program provides a source of competitive funds to Army laboratories to stimulate high quality, innovative research with significant opportunity for payoff in Army warfighting capability. The ILIR program serves as a catalyst for major technology breakthroughs by giving laboratory directors flexibility in implementing novel research ideas and nurturing promising young scientists and engineers. Successful ILIR projects are typically transitioned to start-up projects under basic or applied research mission funding within an organization. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, the Army Science and Technology Master Plan and the Department of Defense Basic Research Plan. Project 91E performed at the Army Research Institute for the Behavioral and Social Sciences (ARI) is focused on research that will develop and validate new techniques in social network analysis as well as training techniques to enhance expertise and adaptability and decrease training time. The work in this program is performed by the Army Materiel Command (AMC), Army Medical Research and Materiel Command (MRMC), the Army Corps of Engineers Engineer Research, and Development Center (ERDC), and the Army Research Institute (ARI).

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<u>B. Program Change Summary</u>	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2008/2009)	19187	19266	19790
Current BES/President's Budget (FY 2009)	18404	21528	19832
Total Adjustments	-783	2262	42
Congressional Program Reductions		-138	
Congressional Rescissions			
Congressional Increases		2400	
Reprogrammings	-363		
SBIR/STTR Transfer	-420		
Adjustments to Budget Years			42
One FY08 congressional adds totaling \$2400 were added to this PE.			
(\$2400) Silicon Carbide Armor Manufacturing Initiative			

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BUDGET ACTIVITY 1 - Basic research		PE NUMBER AND TITLE 0601101A - In-House Laboratory Independent Research					PROJECT 91A	
COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
91A ILIR-AMC	12866	14022	14673	14086	14090	14378	14672	

A. Mission Description and Budget Item Justification: This project provides funding for In-house Laboratory Independent Research (ILIR) in the Army Materiel Command's six Research, Development, and Engineering Centers (RDECs). This basic research lays the foundation for future developmental efforts by identifying the fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, the Army Science and Technology Master Plan and the Department of Defense Basic Research Plan. Work in this project is performed by the Army Materiel Command and the Army Research Institute.

<u>Accomplishments/Planned Program:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Edgewood Chemical Biological Center: In FY07, continued novel approaches to develop a multifunctional biological agent simulant; investigated methodology to identify and quantify physiological response to toxic agents, investigated advanced genetic analysis methods that might lead to facile detection and identification methods for biological material, solicited new concepts to address standoff detection of chemical vapors and aerosols; improved decontamination effectiveness against toxic chemical and biological materials with minimal effect on the environment and materials of construction, including sensitive items such as electronics; characterized protective materials for filters and other materials; and developed and pursued new concepts for multi-purpose obscurant materials. In FY08 solicit new concepts for basic research efforts with broad applicability to point and stand-off detection and identification of chemical vapors and biological aerosols, targeted decontamination, protection, information technology, and obscuration sciences. In FY09, will solicit new concepts for basic research efforts with broad applicability to point and stand-off detection and identification of chemical vapors and biological aerosols, targeted decontamination, protection, information technology, and obscuration sciences.	1244	1050	1058
Armaments RDEC: In FY07, conducted research into modeling of semi-metal energetics, new modalities for e-field sensors, classified mortar variants using acoustic sensors, SiC/carbon nanotube composites, new nitration methods for high density high energy materials to achieve increased lethality, accuracy, survivability, and volume reduction for the armament systems/munitions. In FY08, conduct basic research into optical properties of black silicon, fatigue suppression in nanotube composites, detonation theory and modeling development for semi-metal energetic material, bolometric infrared detector based on freestanding single-walled carbon nanotube network, surface enhanced raman spectroscopy of energetic materials on nanostructured substrates, development of shortwave/medium wave/longwave anomaly algorithms for hyperspectral sensors; new nitration methods for high density, high energy materials, sniper detection via multi-mode sensor fusion, and novel synthesis routes of graphine. In FY09, will conduct basic research for developing new explosives and smaller warheads for increased lethality and volume reduction, lighter and stronger materials for guns, algorithms for future intelligent munitions using various sensors, and area denial technologies.	2075	1856	1871
Tank-automotive RDEC: In FY07, developed reinforcement learning algorithms and compared performance with bio-inspired robot behaviors for the next generation explosive ordinance disposal (EOD) robots; modeled bio-mimetic composite structure and demonstrated higher performance than current Army composite structures; developed an experimental apparatus and the associated processing techniques for high speed Stokes parameter imaging to support signature countermeasure and robotic vehicle perception applications. In	1380	1325	1334

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<p>FY08, investigate experimental engine exploration of JP-8 ignition behavior and flame for high performance military engine combustion; new design methodologies for thick section composites using multiple failure theories for improved light-weight material reliability, and develop spectral fractal geometry and linear/non-linear filtering for real time dynamic simulation of Army tactical and combat vehicles. In FY09, will record real-time polarization images for robotic vehicle terrain perception and signature countermeasure applications; will investigate ultra-wide band (UWB) radar development for localizing mobile robots in battlefield scenarios, and explore fuzzy logic clustering algorithms for robotic vehicle stereovision range perception in difficult urban terrain environments.</p>				
<p>Natick Soldier Center: In FY07, established/confirmed theoretical foundation for electrical and physical effects in hybrid conductive yarns useful in robust e-textiles; used Lie Group theory and dynamical systems analysis to investigate common characteristics in problems/solutions of interest to Soldier mission to provide a mathematical framework to help solve disparate mathematical problems; and examined means for coupling biorecognition elements to polymers with potential to sense food pathogens. In FY08, investigate novel means for controlling nanoscale characteristics through precise morphology control, with potential to impact textiles used in Soldier ensemble, flexible wall shelters, and parachutes. In FY09, will utilize morphology control data results to make initial selections of methodology to verify ability to regulate nanoscale characteristics, will identify nanomaterials (metal or dielectrics) and will develop preliminary design for nanorectenna array for converting visible/near-infrared light to direct current for photonic applications and derive a fundamental understanding of how immobilization influences the antimicrobial peptide mechanisms of lytic behavior for Soldier protection against pathogens.</p>	1406	1458	1470	
<p>Aviation and Missile RDEC Missile Efforts: In FY07, demonstrated solid state single-photon emitter for secure quantum communications. Investigated ultra-wide band shifterless beam steering using these VHF oscillators. Fabricated transparent metal stacks using copper and ZnO, to test for ultra-wide bandwidth optical limiting. Developed a "quantum seal" protocol for quantum communication, which allows detection of eavesdroppers after message is received and complete the security analysis against eavesdropping on energy-time cryptographic system. In FY08, explore wide bandgap semiconductor photodetectors for advanced ultraviolet seekers. Investigate ultra-wide band chaotic arrays in radar applications. Fabricate transparent metal stacks for applications to negative refraction and sub-wavelength resolution. In FY09, will develop THz spectroscopic imager for non-destructive testing and stand-off agent detection. Will demonstrate operation of a quantum sensor, for application to sensing electric, magnetic, or microwave fields.</p>	3090	2472	2492	
<p>Aviation and Missile RDEC Aviation Efforts: In FY07, conducted experimental work on the limitations and turbulence modeling issues for advanced airfoil design tools operating near stall; conducted experimental study on high Reynolds number 3D bluff body turbulent boundary layer active separation control for fuselage drag reduction; conducted experimental study of passive boundary layer flow control for rotor airfoil dynamic stall initiated by leading edge shock-induced separation. In FY08, conduct experimental aerodynamics study on adaptive shape changes (morphing) under airfoil dynamic stall conditions; continue study on high Reynolds number 3D bluff body turbulent boundary layer active separation control with a focus on turbulence measurements; develop and validate adjunct airfoil optimization methods for unsteady flow conditions. In FY09, will develop and demonstrate modeling and simulation (M & S) tools for performance, loads and vibratory loads correlation on an active rotor application using wind tunnel validation data; will develop improved turbulence models for rotorcraft CFD M & S tools; will assess improved M & S tools on heavy lift interaction aerodynamics validation data; and will investigate closed-loop active flow control for heavy lift tandem fuselage lateral stability.</p>	1414	1791	1805	
<p>Communications-Electronics RDEC: In FY07, conducted basic research in the areas of network science and security for mobile networks; investigated polymer and polymer blends with high breakdown voltage characteristics for electrochemical systems; continued analysis of new piezoelectric materials for precision resonator applications; continued to investigate thermal substrate matching for large area material interfaces for next generation of imaging sensors. In FY08, investigate fundamental principles needed to enable efficient upgrade of distributed software; investigate a new family of high energy electrochemical materials for advanced batteries; investigate methods of</p>	1816	1639	1652	

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enhancing heat and mass transfer within micro-reactors. In FY09, will identify basic principles to automatically extract knowledge from text that continuously changes its vocabulary over time; will continue to investigate the phenomenology involving large scale network behavior and implications on security and antenna design, and will investigate the behavioral phenomenology of free space sensors to determine how they respond to environmental stimuli.			
Peer reviewed proposal efforts: Proposal efforts will be selected near the start of each fiscal year through competitive applications among the Army laboratories with ILIR funding. Selections are based on an outside independent peer review of the proposals. The intent to provide increased quality and responsiveness in exploring in basic research new technological concepts that are highly relevant to Army needs. This funding will also enhance recruitment, development, and retention of outstanding scientists and engineers engaged in high quality basic research for the Army which will bring a constant flow of new knowledge to our laboratories. In FY08, solicit new and continuing basic research efforts focused on fundamental questions in science that relate to U.S. Army requirements such as network science. In FY09, will continue to solicit new basic research efforts aimed at developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Army problems.	441	2152	2991
Small Business Innovative Research/Small Business Technology Transfer Programs		279	
Total	12866	14022	14673

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BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601101A - In-House Laboratory Independent Research					PROJECT 91C	
COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
91C ILIR-MED R&D CMD	3833	3617	3616	3662	3698	3779	3862

A. Mission Description and Budget Item Justification: This project addresses investigator-driven medical and force protection basic research initiatives performed at the six U.S. Army Medical Research and Materiel Command laboratories. Research areas address countermeasures against infectious diseases, defense against environmental extremes and operational hazards to health, and mechanisms of combat trauma and innovative treatment and surgical procedures. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, the Army Science and Technology Master Plan and the Department of Defense Basic Research Plan. Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD; U.S. Army Medical Research Institute of Chemical Defense (USAMRICD), Aberdeen Proving Ground, MD; U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), Fort Detrick, MD; U.S. Army Institute of Environmental Medicine (USARIEM), Natick, MA; U.S. Army Institute of Surgical Research (USAISR), Fort Sam Houston, TX; and U.S. Aeromedical Research Laboratory (USAARL), Fort Rucker, AL.

<u>Accomplishments/Planned Program:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
In FY07 the program funded innovative in-house basic research proposals that focus on research to explore treatments and countermeasures against militarily relevant infectious diseases; defense against environmental extremes and operational hazards to health; and mechanisms of combat trauma and innovative treatment and surgical procedures. In FY08 and FY09, the program fund innovative in-house basic research proposals that focus on research to explore treatments and countermeasures against militarily relevant infectious diseases; defense against environmental extremes and operational hazards to health; and mechanisms of combat trauma and innovative treatment and surgical procedures these efforts including research areas such as the use of inactivated bacteria as novel vaccine delivery platforms; induction of enhanced environmental stress tolerance through innovative protein therapies; studies exploring the basic mechanisms underlying the beneficial effects of blood plasma in treatment of severe hemorrhagic shock; and efforts to study the relationships between clotting and inflammation and their relationships to acute respiratory distress syndrome and multi-organ failure.	3833	3166	3251
Peer reviewed proposal efforts: Proposal efforts will be selected near the start of each fiscal year through competitive applications among the Army laboratories with ILIR funding. Selections are based on an outside independent peer review of the proposals. The intent to provide increased quality, responsiveness, and innovation in exploring basic research of new technological concepts that are highly relevant to Army needs. This funding will also enhance recruitment, development, and retention of outstanding scientists and engineers engaged in high quality basic research for the Army by providing unique and stimulating research opportunities. In FY08, solicit new and continuing basic research efforts focused on fundamental questions in medical science that relate to U.S. Army requirements including increased emphasis on network science. In FY09, will continue to solicit new basic research efforts aimed at developing and maintaining a cadre of active basic research scientists who can initiate new research as well as extend results from worldwide research and apply them to Army problems.		352	365
Small Business Innovative Research/Small Business Technology Transfer Programs		99	
Total	3833	3617	3616

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BUDGET ACTIVITY 1 - Basic research		PE NUMBER AND TITLE 0601101A - In-House Laboratory Independent Research					PROJECT 91D	
COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
91D ILIR-CORPS OF ENGR	1522	1309	1339	1279	1292	1320	1349	

A. Mission Description and Budget Item Justification: The objective of this basic research project is to support In-House Laboratory Independent Research (ILIR) in the areas of battlespace environments, military engineering, and environmental quality/installations. Past and current ILIR efforts have had, and are having, significant impacts on technology development efforts supporting the Army transformation to the Future Force. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, the Army Science and Technology Master Plan and the Department of Defense Basic Research Plan. The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, executes the project work.

<u>Accomplishments/Planned Program:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Geospatial Research and Engineering/Military Engineering/Environmental Quality and Installations: In FY07, investigated environmentally responsive hydrogels for innovative applications in environmental monitoring, engineering, and nanomaterials synthesis. Studied and validated a discrete element model for simulating the mechanical properties of dry soil. Efforts included research designed to provide for improved understanding of biomimetic material that is suitable for incorporation into micro or nano-sensory devices specific for hazardous biological or chemical detection. Accomplishments in this area have resulted in the application for two patents for Novel Fluorescent Protein Markers. In FY08, investigate nanoparticle and molecular dynamics for chemical and biological networked sensing and assess infrasound ability to characterize infrastructure. In FY09, will research factors influencing partitioning and ecological risk of military unique nanomaterials in the environment.	1273	1167	1176
Peer reviewed proposal efforts: Proposal efforts will be selected near the start of each fiscal year through competitive applications among the Army laboratories with ILIR funding. Selections are based on an outside independent peer review of the proposals. The intent to provide increased quality and responsiveness in exploring in basic research new technological concepts that are highly relevant to Army needs. This funding will also enhance recruitment, development, and retention of outstanding scientists and engineers engaged in high quality basic research for the Army which will bring a constant flow of new knowledge to our laboratories. In FY08, solicit new and continuing basic research efforts focused on fundamental questions in science that relate to U.S. Army requirements such as network science. In FY09, will continue to solicit new basic research efforts aimed at developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Army problems.	249	118	163
Small Business Innovative Research/Small Business Technology Transfer Programs		24	
Total	1522	1309	1339