

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

**February 2007**

BUDGET ACTIVITY		PE NUMBER AND TITLE						
<b>1 - Basic research</b>		<b>0601101A - In-House Laboratory Independent Research</b>						
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	21651	19187	19266	19790	19178	19236	19637	20047
91A ILIR-AMC	15392	14103	14113	14636	14033	14036	14323	14616
91C ILIR-MED R&D CMD	3632	3592	3640	3615	3661	3697	3778	3861
91D ILIR-CORPS OF ENGR	1366	1302	1317	1335	1273	1286	1314	1343
91E ILIR-ARI	302	190	196	204	211	217	222	227
91J IN-HOUSE LAB INDEPENDENT RESEARCH - MEDICAL (CA)	959							

**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 Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the DoD Basic Research Plan (BRP). 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 for the Behavioral and Social Sciences (ARI).

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<b><u>B. Program Change Summary</u></b>	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	21236	19402	18416	18824
Current BES/President's Budget (FY 2008/2009)	21651	19187	19266	19790
Total Adjustments	415	-215	850	966
Congressional Program Reductions		-73		
Congressional Rescissions				
Congressional Increases				
Reprogrammings	415	-142		
SBIR/STTR Transfer				
Adjustments to Budget Years			850	966

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<b>BUDGET ACTIVITY</b> <b>1 - Basic research</b>		<b>PE NUMBER AND TITLE</b> <b>0601101A - In-House Laboratory Independent Research</b>					<b>PROJECT</b> <b>91A</b>		
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	
91A ILIR-AMC	15392	14103	14113	14636	14033	14036	14323	14616	

**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 Strategic Planning Guidance, the Department of Defense (DoD) Basic Research Plan (BRP), the Army Science and Technology Master Plan (ASTMP), and the Army Modernization Plan. Work in this project is performed by the Army Materiel Command and the Army Research Institute.

<u>Accomplishments/Planned Program:</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
- Edgewood Chemical Biological Center - In FY06, expanded the biomarkers project to include proteins in multiple tissues, as well as a hair follicle assay. Explored novel genomic signatures of ricinus species, development of vibrio cholerae as a model for hyper-variable mutator strains, and multiplexed protein separation technology. The vibrio study is significant for the detection of genetically engineered pathogens. In addition, the multigenically engineered antibody lines was completed. In FY07, continuing novel approaches to develop a multifunctional biological agent simulant; investigate of methodology to identify and quantify physiological response to toxic agents, investigate advanced genetic analysis methods that might lead to facile detection and identification methods for biological material, soliciting new concepts to address standoff detection of chemical vapors and aerosols; improving decontamination effectiveness against toxic chemical and biological materials with minimal effect on the environment and materials of construction, including sensitive items such as electronics; characterizing protective materials for filters and other materials; and developing and pursuing new concepts for multi-purpose obscurant materials. In FY08 and 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.	1612	1291	1123	1135
- Armaments RDEC - In FY06, conducted basic research in energetics, smart munitions, armament materials, directed energy, and nanomaterials applied to armaments/munitions to achieve higher lethality on target, affordable increase in munitions accuracy, and directed energy target effects. In FY07, conduct research into modeling of semi-metal energetics, new modalities for e-field sensors, classifying 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, 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. In FY09, will continue to 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.	2706	2154	1899	1958
- Tank-automotive RDEC - In FY06 formulated evolutionary computing algorithms for adaptive path planning and navigation for improved autonomous robotic ground vehicles; developed in-situ combustion chamber temperature and pressure sensors to validate high performance engine, thermodynamic combustion models for increased military engine performance and fuel economy. In FY07, develop	1900	1433	1353	1364

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reinforcement learning algorithms and compare performance with bio-inspired robot behaviors for the next generation explosive ordinance disposal (EOD) robots; compute liquid heat pipe (LHP) coefficients for innovative thermal heat transfer mechanisms in electronic equipment thermal management applications. In FY08, will 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 will 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.				
- Natick Soldier Center - In FY06, investigated relationship between electrical and mechanical characteristics of flexible conducting materials in researching e-textiles; confirmed essential features of mathematical representation of permeation kinetics in model foods; examined electronic conduction in novel conducting polymers for use in fibers. In FY07, establish/confirm theoretical foundation for electrical and physical effects in hybrid conductive yarns useful in robust e-textiles; use 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 in solving disparate mathematical problems; examine means for coupling biorecognition elements to polymers with potential to sense food pathogens. In FY08, will 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, utilize morphology control data results to make initial selections of methodology to verify ability to regulate nanoscale characteristics.	1387	1459	1375	1425
- Aviation and Missile RDEC Missile Efforts - In FY06, transitioned high-frequency acoustic sensor technology to the system design of the Inertial Sensor for Target Discrimination (ISTAR) missile demonstration project. Electronically Steered, Phased Array Antennas Utilizing Semi-Conductor Technology has been transitioned to the Phased Arrays for Tactical Seekers applied technology program. Demonstrated high efficiency, white light phosphor for rugged, eye-matched solid state lighting. Implemented a microstrip circuit that produces chaotic VHF oscillations, enabling technology for ultrawide band radar applications. Developed an ultra-wide bandwidth optical limiter based on transparent, metallo-dielectric, photonic band gap structures. Demonstrated an energy-time cryptographic system for secure communication. In FY07, demonstrate solid state single-photon emitter for secure quantum communications. Investigate ultra-wide band shifterless beam steering using these VHF oscillators. Fabricate transparent metal stacks using copper and ZnO, to test for ultra-wide bandwidth optical limiting. Develop 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, will explore wide bandgap semiconductor photodetectors for advanced ultraviolet seekers. Investigate ultra-wide band chaotic arrays in radar applications. Will 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.	2623	3178	2529	2608
- Aviation and Missile RDEC Aviation Efforts - In FY06, developed tightly coupled computational fluid dynamics/computational structural dynamics(CFD/CSD) analysis methods for improved understanding of the link between fundamental 3D unsteady transonic flow physics and aeromechanics issues; developed pressure sensitive paint measurement techniques for interaction aerodynamics research; conducted experimental study on co-axial rotor aerodynamics and benchmark vortex wake flow-field measurements; and conducted experimental study of passive boundary layer flow control for rotor airfoil dynamic stall initiated by trailing edge separation. In FY07, conduct experimental work on the limitations and turbulence modeling issues for advanced airfoil design tools operating near stall; conduct experimental study on high Reynolds number 3D bluff body turbulent boundary layer active separation control for fuselage drag	2525	1414	1832	1966

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<b>1 - Basic research</b>	<b>0601101A - In-House Laboratory Independent Research</b>			<b>91A</b>
reduction; conduct experimental study of passive boundary layer flow control for rotor airfoil dynamic stall initiated by leading edge shock-induced separation. In FY08, will conduct experimental aerodynamics study on adaptive shape changes (morphing) under airfoil dynamic stall conditions; will continue study on high Reynolds number 3D bluff body turbulent boundary layer active separation control with a focus on turbulence measurements; will 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.				
- Communications-Electronics RDEC - In FY06, completed analysis of ultraviolet-C band muzzle flash intensity and detection range for counter sniper applications. Performed research enabling high bandwidth, high-efficiency small antennas at lower frequencies with reduced co-site interference. Formulated and investigated new high-energy cathode materials for advanced lithium batteries. In FY07, conduct basic research in the areas of network science and security for mobile networks; investigate polymer and polymer blends with high breakdown voltage characteristics for electrochemical systems; continue analysis of new piezoelectric materials for precision resonator applications; continue to investigate thermal substrate matching for large area material interfaces for next generation of imaging sensors. In FY08, will investigate fundamental principles needed to enable efficient upgrade of distributed software; will investigate a new family of high energy electrochemical materials for advanced batteries; will investigate methods of 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.	2639	1885	1677	1754
- 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, will 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.		1000	2325	2426
Small Business Innovative Research/Small Business Technology Transfer Programs		289		
<b>Total</b>	<b>15392</b>	<b>14103</b>	<b>14113</b>	<b>14636</b>

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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
91C ILIR-MED R&D CMD	3632	3592	3640	3615	3661	3697	3778	3861

**A. Mission Description and Budget Item Justification:** This project addresses medical and force protection 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 Strategic Planning Guidance, the DoD Basic Research Plan (BRP), the Army Science and Technology Master Plan (ASTMP), and the Army Modernization 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 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
In FY06 used High Performance Computing to conduct "virtual" screening of compounds originally designed for antimalarial drug research to determine if any might have broader applicability to biodefense research. Used nanoparticles to increase immune response to vaccination using a mouse animal model. Applied molecular sequencing technology to determine how the chemical agent "sulfur mustard" causes injury. The results of this research will identify new ways to treat sulfur mustard human casualties. Researched the fundamental mechanisms causing characteristic "head tilting" behavior in aircrew and unexpectedly discovered that it is independent of visual stimuli; this finding could have a significant effect on the design of future helmet-mounted displays. In FY07 and future years (FY08-09), the program will continue to 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.	3632	3493	3262	3250
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, will 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.			378	365
Small Business Innovative Research/Small Business Technology Transfer Programs		99		
<b>Total</b>	<b>3632</b>	<b>3592</b>	<b>3640</b>	<b>3615</b>

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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	
91D ILIR-CORPS OF ENGR	1366	1302	1317	1335	1273	1286	1314	1343	

**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 Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

<u>Accomplishments/Planned Program:</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Battlespace Environment/Military Engineering/Environmental Quality and Installations: In FY06, investigated radar signal reflectance to remotely map soil moisture and strength for mobility and landing site assessments for aircraft. Investigated innovative acoustic processing methods that allow Soldiers to locate targets in urban areas. In FY07, investigate environmentally responsive hydrogels for innovative applications in environmental monitoring, engineering, and nanomaterials synthesis. Study and validate a discrete element model for simulating the mechanical properties of dry soil. In FY08, will investigate nanoparticle and molecular dynamics for chemical and biological networked sensing and will assess infrasound ability to characterize infrastructure. In FY09, will research factors influencing partitioning and ecological risk of military unique nanomaterials in the environment.	1366	1276	1173	1193
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, will 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.			144	142
Small Business Innovative Research/Small Business Technology Transfer Programs		26		
<b>Total</b>	<b>1366</b>	<b>1302</b>	<b>1317</b>	<b>1335</b>