ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE
1 - Basic research	**0601101A - In-House Laboratory Independent Research**

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		23065	21236	19402	18416	18824	18178	18236
91A	ILIR-AMC	17001	15050	14261	13223	13662	13033	13036
91C	ILIR-MED R&D CMD	4572	3688	3632	3668	3621	3661	3697
91D	ILIR-CORPS OF ENGR	1251	1200	1317	1327	1337	1273	1286
91E	ILIR-ARI	241	312	192	198	204	211	217
91J	IN-HOUSE LAB INDEPENDENT RESEARCH - MEDICAL (CA)	0	986	0	0	0	0	0

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. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2006)	23077	20542	21199
Current BES/President's Budget (FY 2007)	23065	21236	19402
Total Adjustments	-12	694	-1797
Congressional Program Reductions		-92	
Congressional Rescissions		-214	
Congressional Increases		1000	
Reprogrammings	-12		
SBIR/STTR Transfer			
Adjustments to Budget Years			-1797

One FY06 Congressional add totaling $1000 was added to this PE.

FY06 Congressional add with no R-2A (appropriated amount is shown):
($1000) Tesla Human Whole-Body Research MRI

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601101A - In-House Laboratory Independent Research**	**91A**

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
91A ILIR-AMC	17001	15050	14261	13223	13662	13033	13036

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 DoD 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.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
- Edgewood Chemical Biological Center - In FY05, completed work on scale-up production of photonic material bachteriorhodopsin, continued work on multigenic engineering for enhanced antibody production, and conducted principal components analysis of biomarkers for low level chemical agent exposure. The latter effort will establish molecular fingerprints for forensics analysis of agent exposure. In FY06, the biomarkers project will be expanded to include proteins in multiple tissues, as well as a hair follicle assay. Will explore novel genomics 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 will be completed. In FY07, will solicit new and continuing basic research efforts focused on fundamental questions pertaining to CBD and applied biotechnology that address Army requirements.	1879	1612	1262
- Armaments RDEC - In FY05 conducted basic research in new synthetic methodologies for high density, high energy materials, carbon nanotubes as energetic/strengthening materials; acoustic sensors for discrimination of chemical, biological, and high-explosive artillery rounds; E-field sensors and sensor fusion. In FY06, conduct 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 will continue 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.	2826	2706	2198
- Tank-automotive RDEC - In FY05, fabricated and tested real-time four-Stokes parameter optical apparatus for robotic vehicle perception and signature measurement; formulated mathematical models of diesel engine flame propagation in terms of multi-fuel performance parameters; compared theoretical and experimental liquid heat capillary tube thermal transfer performance characteristics for passive, low signature cooling of military electronics; formulated intelligent agent architectures for swarming ground robot behaviors. In FY06 formulate evolutionary computing algorithms for adaptive path planning and navigation; develop in-situ combustion chamber temperature and pressure sensors to validate high performance engine thermodynamic combustion models; solve multi-body equations of motion for forward and inverse ground vehicle dynamic models. In FY07, will develop reinforcement learning algorithms and compare performance with bio-inspired robot behaviors; compute liquid heat pipe (LHP) heat transfer coefficients for ground vehicle environments and compare with NASA zero-gravity spacecraft data; model advanced ground propulsion phenomena in support of Army's Future Combat Systems (FCS) requirements.	1837	1900	1473

- Natick Soldier Center - In FY05, extended model on inactivation of pressure resistant bacterial spores; researched strategies for overcoming claustro-intolerance in warfighters; investigated interaction between movement in complex environments and cognitive processing of information; and examined self-assembled phage based fibers (collaboration with Institute for Collaborative Biotechnologies). In FY06, investigate relationship between electrical and mechanical characteristics of flexible conducting materials; will confirm essential features of mathematical representation of permeation kinetics in model foods; examine electronic conduction in novel conducting polymers for use in fibers. In FY07, will establish/confirm theoretical foundation for electrical and physical effects in hybrid conductive yarns useful in robust e-textiles; will use Lie Group theory and dynamical systems analysis to investigate common characteristics in problems/solutions of interest to Soldier mission; will examine means for coupling biorecognition elements to polymers with potential to sense food pathogens.	1581	1387	1509
- Aviation and Missile RDEC Missile Efforts - In FY05, (1) transitioned transparent metal photonic crystal technology to troops in Iraq for a solar protective film on riot shields, (2) transitioned third order interactions technology for optical limiting in photonic bandgap structures to demonstration of a seeker counter-countermeasure, (3) transitioned hypersonic heatshield research to the Compact Kinetic Energy Missile (CKEM) as the primary thermal protection system, (4) demonstrated real-time 3-D stereoscopic display for use in remotely guided vehicles, and (5) demonstrated materials suitable for multimode seeker domes. In FY06, investigate and demonstrate shifter-less beam steering for a new ultra-wideband radar concept, and demonstrate optical limiting effect in infrared photonic crystal fibers. In addition develop model of self focusing and second harmonic generation for short pulses in negative index materials, and demonstrate nanomachining in optical waveguides for frequency selective devices. In FY07, will demonstrate new concepts in specific focus areas of terahertz pulsed sources, nano technology, complex chaotic systems, quantum computing and photonic bandgap structures for applications in RF devices, sensor protection and other missile systems.	3991	2623	2774
- Aviation and Missile RDEC Aviation Efforts - In FY05, performed research to achieve robust control architecture for UAV missions. Conducted research to measure boundary layer properties in separated-flow regions to construct new turbulence models. Generated new high order dissipation schemes to reduce the spurious vortex dissipation in the OVERFLOW code. In FY 06, analyze the particle image velocimetry (PIV) measured data, and develop new turbulence model based on the PIV measurement of boundary layer properties in separated-flow regions. Generate the background oriented stereo Schleiren technique. In FY07, will generate unstructured grid algorithms for rotorcraft/UAV aerodynamics. Will investigate the modeling and suppression of rotorcraft disturbance response.	2443	2483	2155
- Communications-Electronics RDEC - In FY05, investigated models for fused sensors and improved automatic/aided target recognition algorithms. Identified techniques for practical electrolyte research for Lithium Ion Batteries. Characterized membrane-based oxygen-enriched combustion of liquid hydrocarbon fuels. Investigated an entropy based network architecture for improved communication, conducted basic research into highly efficient small antennas. Investigated the enhancement of electromagnetic signals utilizing surface plasmonic properties. In FY06, complete analysis of ultraviolet-C band muzzle flash intensity and detection range for counter sniper applications. Perform research enabling high bandwidth, high-efficiency small antennas at lower frequencies with reduced co-site interference. Formulate and investigate new high-energy cathode materials for advanced lithium batteries. In FY07, will investigate new radio frequency absorption material for warfighters body-wearable vest. Will explore techniques for more reliable (terahertz band) communication and for improving information encoding in noisy channels. Will investigate polymer and polymer blends with high breakdown voltage characteristics for electrochemical systems. Will investigate the feasibility of using modified Bayesian Belief Networks to express essential knowledge in order to perform selected core data fusion tasks for Level 2 data fusion.	2444	2339	1890
- Peer reviewed proposal efforts- This is a new effort within the ILIR Program beginning in FY 07. Proposal efforts will be selected at the start of each Fiscal Year through competitive applications among the Army laboratories with ILIR funding. It is intended to provide increased quality and responsiveness in exploring new technological concepts in basic research that are highly relevant to Army needs.	0	0	1000

This funding will also enhance recruitment, development, and retention of outstanding scientists and engineers engaged in high quality basic research for the Army.			
Total	17001	15050	14261

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601101A - In-House Laboratory Independent Research**	**91C**

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
91C ILIR-MED R&D CMD	4572	3688	3632	3668	3621	3661	3697

A. Mission Description and Budget Item Justification: This project addresses medical and force protection research initiatives at the six U.S. Army Medical Research and Materiel Command laboratories: the U.S. Army Aeromedical Research Laboratory (USAARL), the U.S. Army Institute of Surgical Research (USAISR), the U.S. Army Research Institute of Environmental Medicine (USARIEM), the U.S. Army Medical Research Institute of Chemical Defense (USAMRICD), the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), and the Walter Reed Army Institute of Research (WRAIR). 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 WRAIR, Silver Spring, MD; USAMRICD, Aberdeen Proving Ground, MD; USAMRIID, Fort Detrick, MD; USARIEM, Natick, MA; USAISR, Fort Sam Houston, TX; and USAARL Fort Rucker, AL.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
In FY05, discovered that phytase (an enzyme found in plants) increased bioavailability of zinc in plant-derived foods, which may be an important strategy to reduce the prevalence of marginal zinc deficiency in Soldiers, which contributes to neurocognitive deficits and decreased resistance to disease. Acquired software for the analysis of gene expression data derived from rodent microarrays and reanalyzed previously acquired data to validate program's methods of analysis. Determined effects of hazardous noise on human vestibular (an oval cavity in the ear) function. Prepared germination-inhibiting antibodies to Bacillus anthracis. In FY06, investigate mineral metabolism and bone biology using an atomic force microscope equipped with a custom built cell; investigate fundamental autonomic neural oscillations and blood pressure control mechanisms in humans; research novel infectious disease and bio/chem threat treatments, diagnostics, and delivery systems; determine if insertional mutagenesis (induction of genetic mutation) into Ebola virus minigenome leader and trailer regions disrupts replication; and adapt a mouse model of hemorrhagic shock for evaluation of the effects of C-reactive protein on inflammatory gene expression, complement activation, and tissue injury in hemorrhage and resuscitation. In FY07, will research novel infectious disease threat treatments, diagnostics, and delivery systems; will research novel medical treatments, diagnostics, and countermeasures to chemical and biological warfare threat agents; will conduct basic research/studies to enhance the health and performance of Soldiers in operational and training environments, and research novel state-of-the-art trauma, burn, critical care, and combat casualty care medical solutions from self-aid through definitive care across the full spectrum of military operations.	4572	3688	3632
Total	4572	3688	3632

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1 - Basic research	**0601101A - In-House Laboratory Independent Research**	**91D**

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
91D ILIR-CORPS OF ENGR	1251	1200	1317	1327	1337	1273	1286

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 DoD Basic Research Plan (BRP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, executes the project work.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
Battlespace Environment/Military Engineering/Environmental Quality and Installations - In FY05, developed a theoretical physical model for the effect of temperature and particle size on soil hydraulic properties to correctly simulate the ground state and interpret mobility within the battlespace environment. Conducted research on soil electromagnetic models to be incorporated into state-of-ground models supporting terrain reasoning and awareness. In FY06, investigate radar signal reflectance to remotely map soil moisture and strength for mobility and landing site assessments for aircraft. Investigate innovative acoustic processing methods that will allow soldiers to locate targets in urban areas. In FY07, will investigate environmentally responsive hydrogels for innovative applications in environmental monitoring, engineering, and nanomaterials synthesis. Will study and validate a discrete element model for simulating the mechanical properties of dry soil.	1251	1200	1317
Total	1251	1200	1317