ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2004

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601101A - In-House Laboratory Independent Research

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost		20255	23914	23971	25052	25302	25841	16925
91A	ILIR-AMC	15187	18615	18197	19017	19163	19597	10571
91C	ILIR-MED R&D CMD	3594	3829	4058	4243	4315	4390	4466
91D	ILIR-CORPS OF ENGR	1181	1470	1414	1476	1502	1527	1556
91E	ILIR-ARI	293	0	302	316	322	327	332

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 technical directors 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 work in this program is performed by the Army Materiel Command, Army Medical Research and Materiel Command, the Army Corps of Engineers Engineer Research and Development Center and the Army Research Institute. 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).

B. Program Change Summary	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2004)	20608	24121	24256
Current Budget (FY 2005 PB)	20255	23914	23971
Total Adjustments	-353	-207	-285
Congressional program reductions		-207	
Congressional rescissions			
Congressional increases			
Reprogrammings	-353		
SBIR/STTR Transfer			
Adjustments to Budget Years			-285

Projects with no R-2A:

(FY03: $293; FY05: $302) Army Research Institute, Project 91E: The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) provides the Army's basic research in personnel, training, and leader development to ensure that the human component of warfighting keeps pace with the equipment, weapons, and systems changes envisioned for transformation to the Future Force. In FY03/FY04, focused on the ability of people to detect and react to changes in the digital environment, and evaluated theories of situational judgment tests. In FY05, focus on conditional reasoning and performance in the context of decision-making.

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COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
91A	ILIR-AMC	15187	18615	18197	19017	19163	19597	10571

A. Mission Description and Budget Item Justification: This project provides funding for ILIR research in the Army Materiel Command's six Research, Development and Engineering Centers (RDECs) and the Army Research Institute. 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 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 Materiel Command and the Army Research Institute.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- Aviation and Missile RDEC Missile Efforts - In FY03, transitioned secure communications link based on chaotic waveform to Unmanned Ground Vehicle Project Office. Transitioned advanced Computational Fluid Dynamics models and designs into future hypersonic missile programs. Transitioned protective coatings based on Photonic Band-Gap materials to applied technology programs for missile sensor protection from laser threats. Tested and evaluated in the laboratory a cost-effective three dimensional display. Established a laboratory for the evaluation of ultra-short (femtosecond) pulsed laser radiation. In FY04, evaluate the propagation characteristics of ultra-short pulsed laser radiation in realistic atmosphere. Analyze and quantify the damage characteristics of ultra-short pulse laser radiation to materials common to missile, aircraft, and UAV structure and components. Investigate techniques to predict and engineer the optical properties of materials to be used for laser-based optical communications and optical information technology. Test and evaluate flat panel display technology capable of providing full frame rate, full resolution stereo viewing to the user and transfer this technology to advanced research programs. In FY05, test and evaluate at the laboratory breadboard level the fundamental operations of a quantum computer. Perform the necessary experiments and/or analysis to allow the transition of ultra-short pulse laser technology to appropriate applied technology programs.	3112	3546	3171
- Armaments RDEC - In FY03, conducted basic research in: higher/tailorable output energetics to include nanomaterial additives; synthesis of amino-Nitroimididazoles insensitive materials; reactive warhead liner materials; mechanical properties of energetics; nanotechnology enhanced energy density capacitance; biometric "grip recognition" to render weapons, grip control, "safe" from unwanted use; and sensitivity of eddy current non-destructive characterization of coatings. In FY04, conduct basic research in: synthesis of new energetic formulations for higher output with lower vulnerability; multi-sensor fusion for smart munitions; nanotechnology enhanced energy density capacitance; and synergistic directed energy effects. In FY05, 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, directed energy target effects.	2280	3179	3272

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Tank-automotive RDEC - In FY03, investigated terrain models for unmanned ground vehicle perception; designed fuzzy logic and neural net control strategies for unmanned ground vehicles; tested and evaluated engine combustion models and materials for laser eye protection; modeled and tested composite materials; and tested active and passive nonlinear suspensions. In FY04, mature fuzzy logic and neural net control strategies and terrain models for unmanned ground vehicle perception; continue maturation and testing of engine combustion models and materials for laser eye protection; modeling and testing of mechanisms for cooling vehicle electronics; and investigations into high speed ballistic impact imaging and modeling. In FY05, continue maturation and testing of fuzzy logic and neural net control strategies, terrain models, engine combustion models, and laser eye protection materials; and modeling and testing of high speed ballistic impacts.	2229	2067	2298
- Natick Soldier Center – In FY03, researched and modeled novel nanomaterials having potential for ballistic and chemical protection; completed 3D scanning of inflated model parachute canopies to understand added air mass effects; developed theoretical model of carbon nanotube periodic array optical properties; performed research on a novel DNA approach with potential for uniquely detecting multiple biological agents. In FY04, model new nanocomposites for use in improved ballistic/optical materials; examine layered nanomaterials for potential optical applications; validate mathematical model of microbial inactivation using high pressure in model foods; research influence of optical properties of textiles on thermal/signature management; model airdrop platform motion and measure unsteady aerodynamic characteristics; quantify nanoparticle-polymer interaction in nanocomposites using electron spin resonance. In FY05, examine parameters for processing nanofilms that could be used in photovoltaic devices; examine proteomics for advanced biosensing; model inactivation of pressure resistant bacterial spores; perform basic research to identify personal characteristics that contribute to claustro-intolerance in warfighters; investigate interaction between movement in complex environments and cognitive processing of information.	1492	1482	1630

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Edgewood Chemical Biological Center - In FY03, conducted basic research that supported chemical and biological defense requirements, as well as biotechnology efforts in support of Objective Force Warrior. Specific accomplishments included studies of a solid-state nanosensor for the detection of nitrate-based explosives, exploration of advanced sensor technologies for the detection of biological, viral, and biologically-derived warfare agents, and the use of enzymes for the bioremediation of concrete surfaces contaminated with militarily significant chemicals. FY04 efforts continue to focus primarily on addressing fundamental scientific questions pertaining to chemical and biological defense technology. These efforts are exemplified by studies of antibody-based magnetic nanosensors in conjunction with nuclear magnetic resonance for the detection of toxic warfare agents, the use of metabolomics as a means to identify biomarkers that can be used to detect soldier exposure to chemical warfare agents, and the verification of computational fluid dynamics modeling that would contribute to the design of aerosol sampling inlets for biological agent detection systems. Efforts will also include biotechnology-based efforts, to include the development of a recombinant protein production and downstream processing protocol for bacteriorhodopin, a light absorbing protein that has potential application in the future development of biologically derived electronic and photonic materials. In FY05, will continue basic research efforts focused on addressing fundamental questions pertaining to chemical and biological defense technology and biotechnology that address Army requirements.	1800	2236	1992
- Aviation and Missile RDEC Aviation Efforts - In FY03, conducted research and applied Stereoscopic Schlieren technique to a full-scale helicopter vortex model to improve rotor blade performance. Conducted low Reynolds number airfoil tests for Unmanned Aerial Vehicle (UAV) application. In FY04, investigate active on-blade control for a swashplate-less rotor concept. Conduct research on semi-active control actuators for vibration control to reduce adverse fuselage aerodynamics allowing for increased speed and range. In FY05, perform research to achieve robust control architecture for UAV missions. Conduct research to measure boundary layer properties in separated-flow regions to construct new turbulence models.	2514	2919	3005

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Communications-Electronics RDEC - In FY03, investigated technologies for prediction of the transport phenomenon of explosive-related chemicals (ERCs) as they are released from buried land mines, for enhanced target acquisition and identification, and for low altitude antenna communication using the Uniform Theory of Diffraction. In FY04, study and monitor ERC levels in surface soils over time and correlate air flux to surface soil ERC concentrations. Perform chemical evaluations to understand the basic solvent/ion interactions of new solutions for determining optimum composition for use in new Lithium Ion Batteries. Investigate a software engine that will convert natural language to a control language and then to eXtensible Mark-up Language (XML) for C2 applications. Investigate a very high order of encryption algorithm for communications networks. In FY05, investigate models for fused sensors and the maturation and training of automatic/aided target recognition algorithms. Identify techniques for practical electrolyte research for Lithium Ion Batteries. Investigate phased array systems that will deliver the necessary energy to cause the perturbation of the index of refraction of the air that the laser beam is traveling through to cause it to scatter and be intercepted.	1760	2747	2829
Small Business Innovative Research/Small Business Technology Transfer Programs	0	439	0
Totals	15187	18615	18197

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
91C	ILIR-MED R&D CMD	3594	3829	4058	4243	4315	4390	4466

A. Mission Description and Budget Item Justification: This project addresses medical and force protection research needs at the six 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 will 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 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 WRAIR, Silver Spring, MD; USAMRICD, Aberdeen Proving Ground, MD; UASMRIID, Fort Detrick, MD; USARIEM, Natick, MA; USAISR, Fort Sam Houston, TX; and USAARL Fort Rucker, AL. This project contains no duplication with any effort within the Military Departments.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
In FY03, performed research to further exploit candidate countermeasures against militarily relevant infectious diseases identified through application of microarray technology. Investigated candidate methods of testing for infection. Performed research to further develop models to predict physiological and operational stressors on the battlefield. Exploited use of promising gene therapies to reverse early tissue damage in organs. In FY04, solicit basic research proposals and make awards that focus on militarily relevant research to identify countermeasures against infectious diseases, defense against environmental extremes and operational hazards to health, and mechanisms of combat trauma and innovative treatment and surgical procedures. Monitor progress of research and evaluate scientific results from final reports. In FY05, solicit basic research proposals and make awards that focus on militarily relevant research to identify countermeasures against infectious diseases, defense against environmental extremes and operational hazards to health, and mechanisms of combat trauma and innovative treatment and surgical procedures. Monitor progress of research and evaluate scientific results from final reports.	3594	3720	4058
Small Business Innovative Research/Small Business Technology Transfer Programs	0	109	0
Totals	3594	3829	4058

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COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
91D	ILIR-CORPS OF ENGR	1181	1470	1414	1476	1502	1527	1556

A. Mission Description and Budget Item Justification: This project supports In-House Laboratory Independent Research (ILIR) in the areas of Battlespace Environments, Military Engineering, and Environmental Quality/Installations within the seven laboratories that make up the Corps of Engineers' Engineer Research and Development Center. 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 Defense Technology Area Plan (DTAP). Work in this project is performed by the U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi.

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Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
Battlespace Environment/Military Engineering/Environmental Quality and Installations - In FY03, explored the chemical phenomena needed to ultimately develop highly selective and sensitive DNA biosensors for detection of explosives (i.e., landmines and unexploded ordnance). Exploited phase profilometry, an optical technique, to accurately measure surface topography and objects, a capability that is critical to sensing for robots maneuvering in complex terrain. Investigated the effects of soils on the strength of ground and air surface waves as input to the design of a short-range ground radiowave communications system for networked battlefield sensors. In FY04, investigate response of human cells to environmental contamination using novel bio-chemical chemistry procedures to potentially develop cell-based analyses for on-site sensing of environmental contamination. Evaluate electrokinetics as a means for rapidly strengthening soils. Explore applications of laws of electromagnetic energy transfer for use in characterizing media reflections. Investigate neural nets as a tool for predicting geologic fracture properties from imagery to enhance weapons effects and penetrability. In FY05, will conduct scientific exploration in promising research areas such as fluorescence and biotechnology. Will obtain a fundamental understanding of energy absorption of metal alloy structures subjected to dynamic loading (explosions). Will formulate a new photocatalyst with selectivity toward energetic compounds to enhance their degradation and reduce their harmful effects on the environment. Will examine in situ soil extraction techniques to more accurately describe biomarkers at the molecular level in surface soils on training ranges for the purpose of environmental restoration and compliance. Will investigate techniques to remotely map soil moisture for Future Combat Systems and unmanned ground vehicles mobility determinations, and for assessing open-field landing sites.	1181	1438	1414
Small Business Innovative Research/Small Business Technology Transfer Programs	0	32	0
Totals	1181	1470	1414