# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

**February 2003**

BUDGET ACTIVITY
**1 - Basic research**

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

| COST (In Thousands) | | FY 2002 Actual | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate |
|---|---|---|---|---|---|---|---|---|---|
| Total Program Element (PE) Cost | | 13726 | 20608 | 24121 | 24256 | 25384 | 25632 | 26246 | 17100 |
| 91A | ILIR-AMC | 9545 | 15748 | 18775 | 18890 | 19812 | 19973 | 20455 | 11178 |
| 91C | ILIR-MED R&D CMD | 3485 | 3658 | 3862 | 3897 | 4010 | 4086 | 4184 | 4278 |
| 91D | ILIR-CORPS OF ENGR | 696 | 1202 | 1484 | 1469 | 1562 | 1573 | 1607 | 1644 |

**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 scientis ts and engineers. Successful ILIR projects are typically transitioned to start-up projects under 6.1 or 6.2 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to this program.

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| **B. Program Change Summary** | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|
| Previous President's Budget (FY 2003) | 14688 | 22998 | 26886 | 27271 |
| Current Budget (FY 2004/2005 PB) | 13726 | 20608 | 24121 | 24256 |
| Total Adjustments | -962 | -2390 | -2765 | -3015 |
| Congressional program reductions | | -1000 | | |
| Congressional rescissions | | -793 | | |
| Congressional increases | | | | |
| Reprogrammings | -666 | -118 | | |
| SBIR/STTR Transfer | -296 | -479 | | |
| Adjustments to Budget Years | | | -2765 | -3015 |

Change Summary Explanation

Significant Changes:
FY04/05 - Funds realigned to increase investments in applied research and advanced technology major efforts.

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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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 2002 Actual | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate |
|---|---|---|---|---|---|---|---|---|---|
| 91A | ILIR-AMC | 9545 | 15748 | 18775 | 18890 | 19812 | 19973 | 20455 | 11178 |

**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. Past and current ILIR efforts have had and are having significant impacts on technology development efforts supporting the Army Transformation to the Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The work in this program is performed by the Army Materiel Command. This program element contains no duplication with any effort within the Military Departments. This project supports the Objective transition path of the Transformation Campaign Plan.
No Defense Emergency Response Funds (DERF) were provided to the project.

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

**February 2003**

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

| **Accomplishments/Planned Program** | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|
| - Aviation and Missile RDEC Missile Efforts - In FY02, transitioned long shelf lifetime gel propellant technology to the Compact Kinetic Energy Missile (CKEM) development effort; validated and transitioned methods to reduce the propellant synthesis waste by 90%; transitioned analytical and Computational Fluid Dynamics models and new designs into current and future missile systems; validated improved heatshield designs for hypervelocity missiles nose cones, IR domes, and reduction of nozzle throat erosion. FY03 – Transition secure communications link based on chaotic waveform to Unmanned Ground Vehicle Project Office. Transition advanced Computational Fluid Dynamics models and designs into future hypersonic missile development programs. Transition protective coatings based on Photonic Band-Gap materials to applied technology programs of missile sensor protection from laser threats. Demonstrate in the laboratory a cost-effective three dimensional display. Establish a laboratory for the evaluation of ultra-short (femtosecond) pulsed laser radiation. FY04 – Evaluate the propagation characteristics of ultra-short pulsed laser radiation in realistic atmosphere. Demonstrate and quantify the damage characteristics of ultra-short pulse laser radiation to materials common to missile, aircraft, and UAV structure and components. Demonstrate techniques to predict and engineer the optical properties of materials to be used for laser-based optical communications and optical information technology. Demonstrate flat panel display technology capable of providing full frame rate, full resolution stereo viewing to the user and transfer this technology to advanced development programs. FY05 – Demonstrate 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. | 1667 | 3169 | 3272 | 3292 |

| **Accomplishments/Planned Program (continued)** | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|
| - Armaments RDEC - FY02 - Investigated and evaluated biometrics for use in grip recognition for weapons and other applications to restrict usage to designated operators only; investigated multi-stage variable range compressed air propulsion for constant energy non-lethal projectile effects across tactical ranges; investigated computational modeling techniques to predict muzzle flash in cannons; interface with gun tube rifling in support of composite sabot application to rifled tube; investigated Low-Energy Variable Propulsion to tailor main propulsion combustion characteristics to achieve higher energy outputs; investigated structural, high energy composite materials to survive highÂ–g launch as well as provide additional energy to internal combustion to achieve higher velocities; investigated sonic rarefraction wave combustion venting in eliminating recoil force without degradation to projectile velocity. FY03: Conduct 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. 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. 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. | 1717 | 2320 | 3325 | 3346 |

| **Accomplishments/Planned Program (continued)** | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|
| - Tank-automotive RDEC - FY02 - Developed warfighting requirements simulation models for advanced propulsion, non-linear multibody dynamics, signature management, and nontraditional materials to support development of vehicles for the Objective Force. In FY03, investigate terrain models for unmanned ground vehicle perception; design fuzzy logic and neural net control strategies for unmanned ground vehicles; develop and test engine combustion models and materials for laser eye protection; model and test composite materials; and test active and passive nonlinear suspensions. In FY04, develop fuzzy logic and neural net control strategies and terrain models for unmanned ground vehicle perception; continue development 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 development 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. | 1222 | 2268 | 2320 | 2335 |

| **Accomplishments/Planned Program (continued)** | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|
| - Natick Soldier Center - FY02 - Evaluated nanomaterials for potential range uses in soldier survivability/sustainability equipment; modeled effects of air gaps in clothing on heat transfer to address protective clothing related heat stress reduction; visualized/quantified air mass trapped by a parafoil and applied to airdrop modeling/simulation; investigated polymerization of peptides for use as biosensors for integration with soldier clothing/individual equipment. FY03: Research promising nanomaterials for ballistic and chemical barrier performance improvements; perform 3D laser scanning of subscale personnel parafoil opening in Doriot Climatic Chambers to quantify added air mass effects generated during inflation; model and experimentally blend polymers containing tailored particulates to enhance bulk and fiber mechanical/durability properties for ballistic, chem/bio (CB) and airdrop applications; create new carbon nanotube-based composite materials with laser light blocking capability for laser eye and sensor protection; evaluate novel DNA detection technology as a method to uniquely and simultaneously identify biological warfare (BW) agents. FY04: Model new nanocomposites/arrays for use in improved ballistic/optical materials; perform biotechnology effort to identify protein biomarkers that correlate with warrior physiological status; develop mathematical model to predict effects of temperature and high pressure processing on antimicrobial activity in foods; investigate the effect of optical properties of military clothing as a means to improve thermal signature management and flame/thermal protection; create novel materials having variable porosity for parachute applications. FY05: Employ combinatorial chemistry to identify peptides capable of nucleating ceramic hard-faced materials for body armor; examine the use of proteomic methods for advanced biosensing; perform research on potential approaches to high accuracy, rapid screening for pathogens in food. | 650 | 1518 | 1631 | 1642 |
| - Edgewood Chemical Biological Center - FY02 - Developed an extractionless sample preparation process for the detection of BW agents. Began an examination of the molecular basis underlying the low-level toxicity of CW agents. Examined, for the first time, the temporal and thermal decay of a virus. Developed a head simulator for the assessment of new protective mask/helmet concepts. FY03-05 – Initiate research work on advanced obscurants, non-lethal agents and biotechnology applications to OFW. Initiate research to eventually develop a hand-held BW-aerosol detector. Begin synthesis of hardened enzymes (ureases) for the decontamination of CB agents. Initiate research to develop a high-throughput toxicity-assay for BW agents. Research on a process to detect soldier exposure to nerve agents under field conditions. | 1225 | 1832 | 2009 | 2020 |

| **Accomplishments/Planned Program (continued)** | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|
| Aviation and Missile RDEC (AMRDEC) – Aviation. In FY02, conducted buildup of Background Oriented Stereoscopic Schlieren, Doppler Global Velocimetry, and Particle Imaging Velocimetry techniques for full-scale vortex and wake applications to improve rotor blade and airfoil performance. In FY03, conduct research and apply Stereoscopic Schlieren technique to a full-scale helicopter vortex model to improve rotor blade performance. Conduct low Reynolds number airfoil tests for Unmanned Aerial Vehicle (UAV) application. In FY04, investigate active on-blade control for a swashplate-less rotor concept. Perform research to develop 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. | 1578 | 2559 | 3050 | 3069 |
| - Communications-Electronics RDEC - In FY02, evaluated concepts for new electronics materials for more powerful, reliable and lighter weight battlefield visualization tools, communications systems, power sources technology, and sensors. In FY03, investigate 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 development and training of automatic/aided target recognition algorithms. Identify technigues for practical Electrolyte development 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. | 1486 | 1791 | 2868 | 2886 |

| **Accomplishments/Planned Program (continued)** | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|
| - Army Research Institute - 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 Objective Force. In FY03, focus on the ability of people to detect and react to changes in the digital environment. In FY04, address the development, utilization, and maintenance of values under stressful conditions. In FY05, focus on conditional reasoning and performance in the context of decision-making. | 0 | 291 | 300 | 300 |
| Totals | 9545 | 15748 | 18775 | 18890 |

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

| COST (In Thousands) | | FY 2002 Actual | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate |
|---|---|---|---|---|---|---|---|---|---|
| 91C | ILIR-MED R&D CMD | 3485 | 3658 | 3862 | 3897 | 4010 | 4086 | 4184 | 4278 |

**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 Aeromedical Research Laboratory, the Institute of Surgical Research, the Research Institute of Environmental Medicine, the Medical Research Institute of Chemical Defense, the Medical Research Institute of Infectious Diseases, and Walter Reed Army Institute of Research. 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program element contains no duplication with any effort within the Military Departments. This project supports the Objective transition path of the Transformation Campaign Plan (TCP).

There are no Defense Emergency Response Funds provided to this program or project.

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

| **Accomplishments/Planned Program** | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|
| In FY 2002, explored opportunities for identification of new countermeasures against militarily relevant infectious diseases using state-of-the-art techniques such as DNA microarray technology to facilitate identification of candidate genes for drug and vaccine development. Studied new vaccine delivery mechanisms including needle-less delivery. Pursued modeling to predict physiological, operational stressors on the battlefield. Studied the use of gene therapy to reverse early tissue damage in organs. FY03, perform research to further exploit candidate countermeasures against militarily relevant infectious diseases identified through application of microarray technology. Investigate candidate methods of testing for infection. Perform research to further develop models to predict physiological, operational stressors on the battlefield. Exploit use of promising gene therapies to reverse early tissue damage in organs. 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. FY05, continue research efforts begun in FY04. | 3485 | 3658 | 3862 | 3897 |
| Totals | 3485 | 3658 | 3862 | 3897 |

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**February 2003**

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

| COST (In Thousands) | | FY 2002 Actual | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate |
|---|---|---|---|---|---|---|---|---|---|
| 91D | ILIR-CORPS OF ENGR | 696 | 1202 | 1484 | 1469 | 1562 | 1573 | 1607 | 1644 |

**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 Corps of Engineers laboratories. Past and current ILIR efforts have had and are having significant impacts on technology development efforts supporting the Army Transformation to the Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The work under this program element is performed by the U.S. Army Engineer Research and Development Center. This program element contains no duplication with any effort within the Military Departments. This project supports the Objective transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to the project.

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**February 2003**

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

| **Accomplishments/Planned Program** | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|
| Battlespace Environment/Military Engineering/Environmental Quality and Installations - In FY02, 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. Assessed effectiveness of using a generalized filtering technique to classify hyperspectral data for use in terrain analysis. Developed a technique that maps the processes of cracking in construction materials while under dynamic loading conditions which is essential in preparing hardened materials for use in the battlefield. Investigated methods to kill potential pathogens, such as Anthrax spores, in soils as a prerequisite to developing approaches to decontaminate soils in diverse environmental conditions. In FY03, explore the chemical phenomena needed to ultimately develop highly selective and sensitive DNA biosensors for detection of explosives, including vapor signatures of landmines and unexploded ordnance. Investigate fluorescence signatures as a means of detecting and monitoring biological hazards in water and soil. Exploit 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. 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. In FY05, conduct scientific exploration in promising research areas such as fluorescence and biotechnology. | 696 | 1202 | 1484 | 1469 |
| Totals | 696 | 1202 | 1484 | 1469 |