FY 2003 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2002

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research (ILIR)

(U) COST: (Dollars in Thousands)

| PROJECT NUMBER & TITLE | FY 2001 ACTUAL | FY 2002 ESTIMATE | FY 2003 ESTIMATE | FY 2004 ESTIMATE | FY 2005 ESTIMATE | FY 2006 ESTIMATE | FY 2007 ESTIMATE | TO COMPLETE | TOTAL PROGRAM |
|---|---|---|---|---|---|---|---|---|---|
| 0601152N | 13,698 | 16,147 | 16,352 | 17,082 | 17,254 | 17,531 | 17,853 | CONT. | CONT. |

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program sustains U.S. Naval Science and Technology (S&T) superiority, provides new technological concepts for the maintenance of naval power and national security, and helps avoid scientific surprise, while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities. It responds to S&T directions of the Department of the Navy (DON) Integrated Warfare Architecture Requirements for long term Navy and Marine Corps improvements, is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command, and enables technologies to significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities. It is managed by the Chief Scientist of the Office of Naval Research (ONR) and executed by the Commanding Officers (COs) and Technical Directors (TDs) of the Naval Warfare Centers, Naval Personnel Research, and Bureau of Medicine and Surgery laboratories.

The vision of the DON S&T strategy is "to inspire and guide innovation that will provide technology-based options for future Navy and Marine Corps Capabilities", where "Innovation is a process that couples Discovery and Invention with Exploitation and Delivery". DON Basic Research, which includes scientific study and experimentation directed toward increasing knowledge and understanding in national-security related aspects of physical, engineering, environmental and life sciences, is the core of Discovery and Invention. Basic research projects are developed, managed, and related to more advanced aspects of research in some hundred-plus technology and capability-related 'thrusts', which are consolidated in 22 research areas. These in turn support the major motivational research focus areas of the Navy and Marine Corps after Next: maritime and space environments that impact operational capability, information science/knowledge management in network-centric operations, sensors and electronic systems for surveillance and tactical applications, energy/power/propulsion for performance gain and sustainment advanced air/surface/undersea and multi-environment Naval platforms design/signature reduction, and superior human performance/training/care of Sailors and Marines.

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This portion of the DON Basic Research Program provides participating Navy Centers and Laboratories with funding for basic research to support the execution of their assigned missions, for developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Naval problems, to promote hiring and development of new scientists, and to encourage collaboration with universities, private industry, and other Navy and Department of Defense laboratories, in particular the corporate Naval Research Laboratory (NRL).

Navy ILIR procedures were revised in FY00 to further encourage collaboration and the participation of new scientists, to relate the program more closely to the overall DON S&T strategy and the ONR/NRL thrusts, and to strongly encourage projects comprising teams of investigators that are of sufficient scope and risk to have a potentially significant impact on DON priorities. Those procedural changes resulted in additional S&T initiatives between ONR and the Naval Warfare Centers and laboratories in FY02 and the trend is expected to continue in FY03. ILIR status, results, and management are reported annually to the Deputy Under Secretary of Defense (Science and Technology).

ILIR projects are selected by Center/Lab COs and TDs near the start of each Fiscal Year through internal competition. Projects typically last 3 years, and are generally designed to assess the feasibility of new lines of research. Successful efforts attract external, competitively awarded funding. Because the Warfare Centers and Labs encompass the full range of naval technology interests, the scope of ILIR topics roughly parallels that of PE 0601153N, Defense Research Science. In FY01, about 50 projects were completed and 70 initiated.

JUSTIFICATION FOR BUDGET ACTIVITY: This program is funded under BASIC RESEARCH because it encompasses scientific study and experimentation directed towards increasing knowledge and understanding in broad fields directly related to long-term DON needs.

B. (U) PROGRAMS ACCOMPLISHMENTS AND PLANS:

1. (U) FY 2001 ACCOMPLISHMENTS:
   - (U) ($3,560) Ocean/Space Sciences: Extended large eddy simulation hydrodynamic methodology for predicting turbulence in complex generalized geometries. Improved acoustic propagation models in the littoral regime. Demonstrated automatic detection of a submarine in the littoral environment using an inexpensive deployable line array of hydrophones.

- (U) ($2,603) Advanced Materials: Identified specific molecular interactions involved in binding biofilms to surfaces to improve biofouling coatings. Improved the characterization of dielectric films for infrared scattering. Developed improved polyurethanes with reduced creep properties for improved acoustic coatings.

- (U) ($1,654) Information Sciences: Investigated the automatic processing of spoken language for team training and analysis of tactical communications in stressing military environments. Determined that a non-linear antenna could be switched between radiating periodic and chaotic electrical fields. Developed a methodology for modeling a distributed object-oriented software system with a defined set of users on a heterogeneous hardware system.

- (U) ($2,055) Electronics/Sensor Sciences: Developed improved sensors to detect Methyl tert-butyl ether, a gasoline additive that has become a serious ground water contaminant. Developed improved modeling algorithms for hyperspectral data processing. Developed algorithms for fully automated detection and classification of sea mines in the littoral.

- (U) ($1,106) Energy Sciences: Synthesized a new insensitive energetic heterocyclic material. Demonstrated the control and anti-control of chaos in thermal pulse combustor systems. Improved surface stabilization and characterization of electro-chemical catalysts in semi-fuel cells.

- (U) ($1,634) Human Performance Sciences: Completed a study of shipboard stressors to enable better preparation of new sailors to the afloat environment. Developed a test to identify Sailors/Marines with good multitasking abilities to improve person-to-job matching. Investigated whether hot or cold environments influence decompression sickness.

- (U) ($1,086) Naval Platform Design Sciences: Developed techniques for improved design of underwater maneuvering and control surfaces. Utilized the farfield wake theory to estimate impact of naval operations on nearby commercial vessels. Improved environmental quality of navy bioreactors with reduced downtime.

2. (U) FY 2002 PLAN:

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research (ILIR)

- (U) ($4,198) Ocean/Space Sciences: Develop an efficient range-dependent elastic propagation model for improved undersea surveillance. Develop an inverse method for analyzing three dimensional shallow water sound propagation. Develop a new matrix for classification of non-stationary acoustic transient signals.

- (U) ($3,068) Advanced Materials: Develop structural amorphous metals for improved wear and corrosion applications. Develop low cost, rugged magnetostrictive alloys for naval and industrial transduction needs. Investigate advanced complex metal oxide materials for electromagnetic shielding.

- (U) ($1,948) Information Sciences: Develop improved receiver synchronization for continuous-phase modulation waveforms. Develop improvements in the ultra high frequency advanced digital waveform. Investigate improved software agents for dissemination of sensor information and tasking.

- (U) ($2,422) Electronics/Sensor Sciences: Improve navigation accuracy of microelectro-mechanical sensor gyroscopes by exploiting nonlinear oscillator dynamics. Design an efficient and extremely wideband phased array antenna. Demonstrate a second order convergence of an adaptive tracking algorithm.

- (U) ($1,302) Energy Sciences: Develop new organometallic energetic materials with the potential for twice the energy content of CL-20. Develop improved energy and power densities for thermal batteries and enable critical weight and volume savings. Investigate stabilized aluminum-based nanocomposite materials.

- (U) ($1,928) Human Performance Sciences: Investigate reducing metabolic demand as a treatment for battlefield injuries that involve major blood loss. Develop a novel approach to estimating parasite challenge to enhance development of anti-malarial prophylactic agents. Research to develop a method to increase the time a hypoxic pilot can safely control an aircraft.

- (U) ($1,281) Naval Platform Design Sciences: Extend current computational fluid dynamics techniques to cavitation and super-cavitation flow regimes. Improve underwater shock analysis of naval structures to reduce testing costs. Develop improved high density passive components for power electronics.

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601152N
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3. (U) FY 2003 PLAN:

- (U) ($4,252) Ocean/Space Sciences: Develop advances in maneuvering target tracking and classification algorithms based on continuous-state Markov processes. Determine the effects of compressibility of surrounding air on the stability properties of a high speed shell of liquid. Develop techniques to use buried seismometers to detect submarines.

- (U) ($3,107) Advanced Materials: Develop improved high temperature materials for micro-electro-mechanical sensors for ships and aircraft. Develop improved high temperature composite matrix materials. Investigate ductile to brittle fracture of high strength low alloy steels.

- (U) ($1,972) Information Sciences: Demonstrate that an adaptive robust tracking parameter provides smoothed estimates of targets during a maneuver. Improve receiver syncronization for continuous-phased modulation waveforms to enhance digital communications. Investigate application of stochastic nonlinear dynamics to communications arrays.

- (U) ($2,453) Electronics/Sensor Sciences: Investigate properties of a new gyroscope design based on squeezed light beams to enable highly accurate navigation systems. Develop stand-off detection of explosive signatures on mine-like objects. Investigate and develop new non-Markov switching matrix-based adaptive multiple model tracking filters.

- (U) ($1,318) Energy Sciences: Investigate synthesis of high-Nitrogen salts for propellants of missile and guns systems. Investigate use of a hydrogen peroxide catholyte in combination with an aluminum anode for improved fuel cells. Characterize and extend current expertise in battery technology through lithium-manganese oxides.

- (U) ($1,952) Human Performance Sciences: Develop rapid inexpensive screening tests for industrial chemicals in the littoral environment. Enhance training techniques with simulation-based computer games. Study the importance of information prioritization and organization in submarines.

- (U) ($1,298) Naval Platform Design Sciences: Investigate novel use of particle imaging velocimetry to quantify bubbly flow and fluid-bubble coupling. Develop understanding of the role that critical surface tension plays on

biofilm adhesion. Develop a series of closely integrated hydrodynamic tools for hull form design and optimization.

C. (U) PROGRAM CHANGE SUMMARY:

| | 2001 | 2002 | 2003 |
|---|---|---|---|
| FY 2002 President's Budget Submission | 16,193 | 16,291 | |
| SBIR | -68 | | |
| Execution Adjustment | -2,427 | | |
| Section 8123 Mgmt Reform Initiative Reduction | | -144 | |
| FY 2003 President's Budget Submission | 13,698 | 16,147 | 16,352 |

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: Not Applicable.
(U) Schedule: Not Applicable.

(U) OTHER PROGRAM FUNDING SUMMARY:

(U) NAVY RELATED RDT&E:
(U) 0601153N Defense Research Sciences

(U) NON NAVY RELATED RDT&E:
(U) 0601101A In-House Laboratory Independent Research (Army)
(U) 0601101F In-House Laboratory Independent Research (Air Force)

(U) SCHEDULE PROFILE: Not applicable.