

UNCLASSIFIED

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET
Exhibit R-2

DATE: February 2003

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT IN-HOUSE LABORATORY INDEPENDENT RESEARCH

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
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In-House Laboratory Independent Research (ILIR)	16,095	15,992	17,400	17,745	18,064	18,404	18,481	18,843
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MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program (a) sustains U.S. Naval Science and Technology (S&T) superiority, providing new technological concepts for the maintenance of naval power and national security, and helping to avoid scientific surprise while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities; and (b) supports basic biomedical research at the Uniformed Services University for the Health Sciences (USUHS) by providing funding for military-specific medical research that is typically leveraged into over \$30 million in new extramural funds each year. The Department of Navy (DON) component responds to S&T directions of the 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, and Naval Personnel Research, Bureau of Medicine and Surgery laboratories. The Uniformed Services University of the Health Sciences (USUHS) component is executed by the President of USUHS.

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, superior human performance/training/care of Sailors and Marines and combat casualty care/infectious diseases/military operational medicine.

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,

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private industry, and other Navy and Department of Defense laboratories, in particular the corporate Naval Research Laboratory (NRL).

Navy In-house Laboratory Independent Research (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 Contract Officers (CO) and Technical Directors (TD) 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 FY02, about 50 projects were completed and 70 initiated.

Support for the basic medical research at the Uniformed Services University of the Health Sciences (USUHS) provides the only programmed research funds received by the University. In addition, it facilitates the recruitment and retention of faculty; supports unique research training for military medical students and resident fellows; and allows the University's faculty researchers to collect pilot data in order to secure research funds from extramural sources (estimated \$35 million annually). Eighty to 100 intramural research projects are active each year, including 20-25 new efforts. Projects are investigator-initiated and funded on a peer-reviewed, competitive basis. Results from these studies contribute to the fund of knowledge intended to enable technical approaches and investment strategies within Defense Science and Technology (S&T) programs. They are designed to answer fundamental questions of importance to the military medical mission of the Department of Defense in the areas of Combat Casualty Care (CCC), Infectious Diseases (ID), and Military Operational Medicine (MOM).

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Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Submission:	16,147	16,352	17,082	17,254
Adjustments from FY 2003 President's Budget:				
S&T Reduction			-1,164	-1,210
Cong. Rescissions/Adjustments/Undist. Reductions	-79	-187		
Execution Adjustments	-31			
Efficiencies at NWCF Activities	+58		-293	-309
NWCF Rate Adjustments			-10	+6
PBD-277 Def-Wide R&D Devolvment			+2,187	+2,387
Pay Raise/Inflation Adjustments		-173	-402	-383
FY 2004/2005 President's Budget Submission:	16,095	15,992	17,400	17,745

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical Not applicable

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Project Title: IN-HOUSE
LABORATORY INDEPENDENT
RESEARCH

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
	16,095	15,992	17,400	17,745	18,064	18,404	18,481	18,843

A. 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, Bureau of Medicine and Surgery laboratories and Uniformed Services University of the Health Sciences (UHS).

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).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Ocean/Space Sciences	4,183	4,156	4,002	4,081

FY 2002 ACCOMPLISHMENTS:

- Developed an inverse method for analyzing three-dimensional shallow water sound propagation.
- Developed and applied solutions for strong non-linear wave-wave interactions.
- Studied the turbulent structure in the ocean environment so that such effects can be compensated for in the propagation of sound underwater.

FY 2003 PLANS:

- Determine the effects of compressibility of surrounding air in the stability properties of a high speed shell of liquid. Observe spatial and temporal turbulent mixing near fronts.

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PROGRAM ELEMENT: 0601152N

PROGRAM ELEMENT: IN-HOUSE LABORATORY INDEPENDENT RESEARCH

Project Title: IN-HOUSE
LABORATORY INDEPENDENT
RESEARCH

- Create the first continuous spatial and temporal characterization of Sperm Whale underwater bioacoustic behavior population structure, and three dimensional spatial distribution within the Tongue of the Ocean.

FY 2004 PLANS:

- Identify and study species of graywater bacteria that are important to the efficient operation of graywater membrane bio-reactor treatment systems.
- Apply inverse methods to experimental underwater sound data to understand when three dimensional propagation effects are important and investigate a computationally efficient method for estimating the range and depth of a sound source.
- Develop knowledge supporting development of a vaccine to protect Navy working marine mammals.

FY 2005 PLANS:

- Continue to identify and study species of graywater bacteria that are important to the efficient operation of graywater membrane bio-reactor treatment systems.
- Continue to apply inverse methods to experimental underwater sound data to understand when three dimensional propagation effects are important and investigate a computationally efficient method for estimating the range and depth of a sound source.
- Continue to develop knowledge supporting development of a vaccine to protect Navy working marine mammals.

	FY 02	FY 03	FY 04	FY 05
Advanced Materials	3,058	3,039	2,958	3,017

FY 2002 ACCOMPLISHMENTS:

- Produced laboratory specimens of a non-chromate conversion coating which offers the promise an environmentally friendly corrosion protection system.
- Developed materials which can shield internal guidance/imaging components from radio frequencies(RF) and infra-red(IR) radiation, thus hardening the system.
- Studied the properties of directionally solidified high temperature composites.

FY 2003 PLANS:

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PROGRAM ELEMENT: IN-HOUSE LABORATORY INDEPENDENT RESEARCH

Project Title: IN-HOUSE
LABORATORY INDEPENDENT
RESEARCH

- Develop polymer engineering guidelines for use in applications where specific ultimate tensile properties are required.
- Develop new, low cost, high strength materials for actuators, transducers, sensors for sonar, noise cancellation, and anti-vibration devices.
- Reproduce and understand the chemical makeup of a recently discovered surface passivation technique so that it can be applied to new types of electro-optic devices.

FY 2004 PLANS:

- Develop amorphous steel compositions and subsequently predict their nucleation and growth of grains into devitrified nano-composite steel.
- Research and develop novel ceramic materials (both dielectrics and electrodes) as candidates for high-voltage/high-frequency/low loss/thermally stable capacitors for use in shipboard power systems.
- Investigate the effect of external environmental stimuli on the mechanisms that cause coating system degradation in naval aircraft.

FY 2005 PLANS:

- Continue to develop amorphous steel compositions and subsequently predict their nucleation and growth of grains into devitrified nano-composite steel.
- Continue to research and develop novel ceramic materials (both dielectrics and electrodes) as candidates for high-voltage/high-frequency/low loss/thermally stable capacitors for use in shipboard power systems.
- Continue to investigate the effect of external environmental stimuli on the mechanisms that cause coating system degradation in naval aircraft.

	FY 02	FY 03	FY 04	FY 05
Information Sciences	1,943	1,931	1,914	1,952

FY 2002 ACCOMPLISHMENTS:

- Developed improvements in the ultra high frequency advanced waveform.
- Investigated improved software agents for dissemination of sensor information and tasking.
- Studied route planning and control methods for unmanned vehicles.

FY 2003 PLANS:

- Investigate the performance of recently developed novel active sonar transmit signal models.
- Characterize the state of network traffic at the individual user and aggregate levels and develop tools that can be used to ascertain the state and health of network traffic.

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RESEARCH

- Investigate newly derived asynchronous track fusion algorithms.

FY 2004 PLANS:

- Apply newly available advances in tracking and classification based on the continuous-state hidden Markov model.
- Improve active and passive sonar signal processing through the use of non-parametric tolerance intervals.
- Examine ways of protecting computer networks' operating systems by obfuscating information that can be gained through a network scan.

FY 2005 PLANS:

- Continue to apply newly available advances in tracking and classification based on the continuous-state hidden Markov model.
- Continue to improve active and passive sonar signal processing through the use of non-parametric tolerance intervals.
- Continue to examine ways of protecting computer networks' operating systems by obfuscating information that can be gained through a network scan.

	FY 02	FY 03	FY 04	FY 05
Electronics Sensor Sciences	2,415	2,399	2,262	2,307

FY 2002 ACCOMPLISHMENTS:

- Studied new techniques in sonar signal processing that, coupled with signal design, could lead to significantly better sonar performance.
- Characterized the intrinsic noise effects micro electro-mechanical systems(MEMS) type magneto resistive sensors.
- Explored new robust waveform designs for use in tactical underwater communications.

FY 2003 PLANS:

- Determine the effect of thermal, electric, and elastic boundaries on the electromechanical properties of new single crystal sonar transducers.
- Investigate the advantages of fractal antennas for Navy activities.
- Investigate the potential advantages of the tunable multi-frequency vertical cavity surface emitting laser as a component of a communications system.
- Develop a novel atomic interferometer based on slow moving atoms extracted from a magneto-optical trap.

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Project Title: IN-HOUSE
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RESEARCH

FY 2004 PLANS:

- Investigate the feasibility of acoustic-optic reception of various in-water, composite signals for communications decoding.
- Investigate the properties of a new gyroscope design that uses both squeezed light to enhance photo-detector sensitivity and Einstein-Podolsky-Rosen correlations that exist between the two squeezed light beams to enhance the interferometric phase sensitivity.
- Investigate the use of the adaptation of control of chaos techniques to develop antennas capable of operating across an enormous bandwidth and the development of non-linear antennas incorporating analog signal processing at the plane of radiation collection to perform beam steering and beam forming.

FY 2005 PLANS:

- Continue to investigate the feasibility of acoustic-optic reception of various in-water, composite signals for communications decoding.
- Continue to investigate the properties of a new gyroscope design that uses both squeezed light to enhance photo-detector sensitivity and Einstein-Podolsky-Rosen correlations that exist between the two squeezed light beams to enhance the interferometric phase sensitivity.
- Continue to investigate the use of the adaptation of control of chaos techniques to develop antennas capable of operating across an enormous bandwidth and the development of non-linear antennas incorporating analog signal processing at the plane of radiation collection to perform beam steering and beam forming.

	FY 02	FY 03	FY 04	FY 05
Energy Sciences	1,300	1,291	1,218	1,242

FY 2002 ACCOMPLISHMENTS:

- Developed and demonstrated new synthetic methodology that lead to the precursors of superior insensitive explosives.
- Investigated the characteristics of novel materials intended for use in lighter/smaller batteries.

FY 2003 PLANS:

- Investigate the use of a hydrogen peroxide catholyte in combination with an aluminum node for improved fuel cells.
- Develop a propellant suitable for undersea propulsion with a high concentration of condensable exhaust products.

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Project Title: IN-HOUSE
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RESEARCH

FY 2004 PLANS:

- Investigate the synthesis of high-nitrogen salts because of their potential use as propellants.
- Investigate two new approaches to thermal battery technology (an all solid state thermal battery and new molten salt electrolyte thermal battery).
- Evaluate the feasibility of using aluminum as fuel and sea water as oxidizer in an underwater propulsion combustor.

FY 2005 PLANS:

- Continue to investigate the synthesis of high-nitrogen salts because of their potential use as propellants.
- Continue to investigate two new approaches to thermal battery technology (an all solid state thermal battery and new molten salt electrolyte thermal battery).
- Continue to evaluate the feasibility of using aluminum as fuel and sea water as oxidizer in an underwater propulsion combustor.

	FY 02	FY 03	FY 04	FY 05
Human Performance Sciences	1,920	1,908	1,914	1,952

FY 2002 ACCOMPLISHMENTS:

- Identified and characterized the genome sequence of one of the major causes of bacterial diarrhea world wide.
- Developed a method and an instrument to measure the stressors of shipboard life and studied successful coping strategies.
- Developed techniques to model/predict participants' decisions in a tactical setting.

FY 2003 PLANS:

- Map Meteorology and Oceanography decision maker information usage into visualization tools and compare that mapping to mappings of other Navies.
- Study the interrelationships among bioenergetic and neural determinants of fatigue.
- Study the changes in the activity and levels of glutamate transporters in response to hyperbaric oxygen treatment.

FY 2004 PLANS:

- Investigate the effects of providing uncertainty information on decision making and how the form and format of that information affects performance.
- Evaluate the effectiveness of training using Virtual-Reality environments as compared to training using a real world environment.

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FY 2005 PLANS:

- Continue to investigate the effects of providing uncertainty information on decision making and how the form and format of that information affects performance.
- Continue to evaluate the effectiveness of training using Virtual-Reality environments as compared to training using a real world environment.

	FY 02	FY 03	FY 04	FY 05
Naval Platform Design Sciences	1,276	1,268	1,218	1,242

FY 2002 ACCOMPLISHMENTS:

- Extended current computational fluid dynamics techniques and computer codes.
- Extended the techniques used to study the hydrodynamics effects and trajectory of an underwater launched vehicle.
- Investigated a statistical approach for conducting electromagnetic vulnerability testing.

FY 2003 PLANS:

- Develop a series of closely integrated hydrodynamic tools for hull form design and optimization.
- Demonstrate the potential of suppressing hydrodynamic cavitation through the use of high-frequency high-amplitude acoustic noise.
- Investigate the possibility of analytically identifying a limiting range of physical parameters (e.g. elasticity modulus, mass density, layer spacing, thickness, etc,) that will produce a specified level of high acoustic transparency while satisfying low in-plane stress-to-failure strength ratio constraints and optional electromagnetic stealth constraints for a generic layered window configuration.

FY 2004 PLANS:

- Characterize the salient near wake turbulent physics of curved circular cylinders using large-eddy simulation methodology.
- Study the environmental effects on the development of ship air-wakes.
- Investigate the use of Diagonally Implicit Multistage Integration Methods to solve stiff systems of differential equations which frequently arise in modeling and simulation problems associated with Navy research and development.

FY 2005 PLANS:

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- Continue to study the environmental effects on the development of ship air-wakes.
- Continue to investigate the use of Diagonally Implicit Multistage Integration Methods to solve stiff systems of differential equations which frequently arise in modeling and simulation problems associated with Navy research and development.

	FY 02	FY 03	FY 04	FY 05
Combat Casualty Care, Infectious Diseases & Military Operational Medicine (USU)	*	*	1,914	1,952

FY 2002 ACCOMPLISHMENTS: *Executed under 0601101D8Z.

FY 2003 PLANS: *Executed under 0601101D8Z.

FY 2004 PLANS:

- Conduct representative studies in the following areas:
 - Combat Casualty Care (CCC) - Delineate the molecular signaling processes that use aurin tricarboxylic acid (ATA) in order to understand how those signals exert their protective effects and maintain cell survival during stresses due to growth-factor deprivation and/or various toxicities.
 - Infectious Diseases (ID) - Investigate the role of regulatory cytokines in mediation of antibody response *in vivo* to a model extracellular bacterium, *Streptococcus pneumoniae*, as a mechanism of natural immunity to infection.
 - Military Operational Medicine (MOM) - Determine the function of vasopressin and oxytocin in the regulation of water balance in the body and brain.

FY 2005 PLANS:

- Continue to conduct representative studies in the following areas:
 - CCC - Test the ability of nerve growth factor (NGF) to provide both long-term and acute protection against the effects of trauma to the cerebral cortex.
 - ID - Screen a selected range of *Staphylococcus aureus* isolates to determine which DNA sequences in the accessory gene regulator (*agr*) group underlie the production of its toxins.

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- MOM - Characterize the expression of photoreceptive molecules in isolated melanocytes to understand the effects of specific wavelengths of electromagnetic radiation upon ocular pigment cells as well as upon the entrainment of circadian rhythms.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:

PE 0601153N Defense Research Sciences

NON-NAVY RELATED RDT&E:

PE 0601101A In-House Laboratory Independent Research (Army)

PE 0601101F In-House Laboratory Independent Research (Air Force)

D. ACQUISITION STRATEGY: NOT APPLICABLE

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