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

BA: 02 PROGRAM ELEMENT: 0602236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Applied Research

COST: (Dollars in Thousands)

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Warfighter Sustainment Applied Research	102,075	100,645	63,726	74,244	66,583	56,202	57,525

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This PE funds applied research supporting the Future Naval Capabilities (FNCs) of Capable Manpower, Expeditionary Logistics, Littoral Combat/Power Projection, Total Ownership Cost (TOC) Reduction, and Warfighter Protection; and innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on manpower and personnel; naval systems training; expeditionary logistics distribution and command/control; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; biocentric technologies; and high speed sealift. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts; the critical human system, "Sea Warrior"; and Naval business efficiencies within "Sea Enterprise."

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

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	106,745	52,213	59,157
Cong. Rescissions/Adjustments/Undist.Reductions	0	-1,137	0
Congressional Actions	0	49,575	0
Execution Adjustments	-2,273	0	0
Inflation Savings	-812	0	-191
Expeditionary Logistics Information Integration	0	0	2,000
Rate Adjustments	0	-6	60

SBIR Assessment	-1,585	0	0
Technical Adjustments	0	0	2,700
FY 2005 President's Budget Submission	102,075	100,645	63,726

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.
Schedule: Not applicable.

FY 2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2004

Exhibit R-2a

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B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Manpower and Personnel	6,228	4,812	3,188

These technologies enhance the Navy's ability to select, assign, and manage its people by responding to a variety of requirements, including: managing the force efficiently and maintaining readiness with fewer people and smaller budgets; providing warfighting capabilities optimized for low-intensity conflict and littoral warfare; and operating and maintaining increasingly sophisticated weapons systems while managing individual workload and supporting optimal manning. This activity supports the Capable Manpower FNC.

FY 2003 Accomplishments:

- Completed workload assessment and allocation for land attack tasks; Training Analysis for Land Attack Human-Computer Interaction (HCI) rapid prototype; and cognitive task analysis, flow development, task

requirements, software requirements, and design of selected tasks and HCI components.
- Completed implementation of selected task and HCI designs into a rapid prototype for usability testing.
- Completed Training Analysis for Land Attack HCI prototype.
- Continued psychometrics of measures, non-cognitive metrics for identifying individual differences.
- Continued testing a cohort in the Recruit Training Center and A-school and began data analysis on the cohort for the person-organization fit program.
- Continued developing experiments that apply auction theory to Navy incentive allocation problems in order to measure sailor preferences in volunteering for hard-to-fill jobs.
- Continued Cognitive Agents Technologies for Sailor-command negotiation in making job assignments.
- Initiated enterprise management system approach to manpower and personnel management.
- Initiated adaptability screening for military service, a battery of non-cognitive metrics to ascertain the probability of attrition as it relates to military culture and environment.

FY 2004 Plans:

- Complete investigation of adaptability for military service, psychometrics of measures, and measures of fit between the person and the organization resulting in improved constructs of selection and classification.
- Complete testing of auction theory and development of models for efficient allocation of incentives.
- Complete enterprise management system statistical and analytical foundation.
- Continue Cognitive Agents Technologies.
- Initiate Land Attack Training Tool analysis and design.

FY 2005 Plans:

- Complete Cognitive Agents Technologies reliability testing and optimization of member/command agents.
- Complete Land Attack Training Tool analysis and design.
- Initiate applicant cultures and values program to assess the practicality and predictive validity of socialization measures for selection into the military.
- Begin modeling integration of forecasting/trend analysis models across the personnel enterprise.

	FY 2003	FY 2004	FY 2005
Training Technologies	9,929	9,206	12,212

Training technologies enhance the Navy's ability to train effectively and affordably in classroom settings, in simulated environments, and while deployed, and to operate effectively in the complex, high-stress, information-rich and ambiguous environments of modern warfare. Technology development responds to a variety

of requirements, including providing more affordable approaches to training and skill maintenance.

FY 2003 Accomplishments:

- Completed development of measures to link shared cognition with team performance.
- Completed programs on cognitive style in multimedia training and performance assessment tools.
- Completed development of a class of instructional authoring tools emphasizing simulation and artificially intelligent tutoring of trouble-shooting for maintenance training.
- Continued program on intelligent agents for objective-based training of multiple distributed teams.
- Continued immersive interaction applications for weapons handling for dismounted combatants in virtual environments (VE).
- Continued Computer Generated Forces (CGF) aimed at improved techniques for human cognitive and behavioral modeling techniques to support realistically behaving simulated teammates and adversaries.
- Continued impact study of personified pedagogical agents in computer-based problem solving training.
- Continued work on effective feedback in artificially intelligent tutoring for dynamic task environments such as anti-air warfare, instrument flying and other characteristic military tasks.
- Continued development of the physics tutor (electricity and magnetism) as well as associated experimentation to determine the most effective instructional strategies for tutors of this general type.
- Continued task aimed at improved techniques for human cognitive and behavioral modeling to support more realistic behavior simulation teammates and adversaries.
- Continued task to improve the capability of CGF to act as instructional agents and task to develop enhanced modeling techniques for representing individual differences such as levels of training, aptitude, and experience.
- Continued task to create highly realistic simulated teammates to support team training relevant to shipboard combat information center activities.
- Began developing optimized strategies (e.g., intelligent tutoring) for performance aiding and training.
- Initiated training aid research for Close Quarters Battle (CQB) devices which will assist the trainee in understanding the spatial relationships critical to fighting in CQB.
- Began study supporting students in becoming independent users of broad-based information resources.
- Began task to develop multi-agent based architectures for modeling human behavior in order to exploit the inherent modularity of these architectures to enhance reusability and therefore, affordability of modeling.

FY 2004 Plans:

- Complete task to improve the capability of CGF as instructional agents.
- Complete instructional impact study of personified pedagogical agents and physics tutor project.
- Continue development of optimized strategies for performance aiding and training.

- Continue training aid research for Close Quarters Battle, immersive interaction applications, and Computer Generated Forces (CGF) for improving training effectiveness in Virtual Environments.
- Continue research to support students in becoming independent users of broad-based information.
- Continue task to develop multi-agent based architectures for modeling human behavior.
- Continue program on intelligent agents for objective-based training.
- Continue CGF task aimed at improved techniques for human cognitive and behavioral modeling.
- Initiate task to test (in a military context) newly developed techniques for automating significant parts of the processes of knowledge acquisition and engineering with the goal of reducing these activity costs by 50%.
- Initiate modeling of the integration of different military domains into a distributed Virtual Technologies and Environments Full Spectrum Combat simulation.

FY 2005 Plans:

- Continue development of optimized strategies for performance aiding and training.
- Continue training aid research for Close Quarters Battle, immersive interaction applications, and Computer Generated Forces for improving training effectiveness in Virtual Environments.
- Continue research to support students in becoming independent users of broad-based information.
- Continue task to develop multi-agent based architectures for modeling human behavior, improve techniques for human cognitive and behavioral modeling, and create highly realistic simulated teammates.
- Continue program on intelligent agents for objective-based training.
- Continue Computer Generated Forces (CGF).
- Continue Full Spectrum Combat simulation research.
- Continue to test newly developed techniques for automating knowledge acquisition and engineering.
- Initiate a systematic program of applied research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring.
- Initiate task to apply recently developed learning techniques that can be used in a model interacting with its application environment to extend or refine its knowledge base and behavioral competence.

	FY 2003	FY 2004	FY 2005
Expeditionary Logistics	6,608	0	2,000

Expeditionary Logistics addresses surface distribution considerations and supported efforts in logistics modeling and simulation. Investment focus is on replenishment in an open seaway and interfacing to commercial shipping as a force multiplier, and internal Seabase material and cargo handling and conveyance mechanisms for selective off-load.

FY 2003 Accomplishments:

- Completed concept work in high capacity at-sea transfer through modeling and simulation of load dynamics, system response, and robotic manipulation. Conducted three laboratory demonstrations of risk reduction componentry. Transitioned technology to PE 0603236N.
- Terminated "seabase to shore" surface craft with a technology design wrap-up and delivered a feasibility study. Postponed the planned transition of technologies for propulsion and lift fan considerations of a heavy lift Landing Craft Air Cushion.
- Transitioned "skin to skin" material transfer technologies for seakeeping and 20-Ton unit material transfer in an open seaway to PE 0603236N.

FY 2005 Plans:

- Begin effort on integration of logistics for knowledge project and readiness.

	FY 2003	FY 2004	FY 2005
Littoral Combat / Power Projection	0	1,137	3,254

This activity provides technologies which enhance the ability of the Navy-Marine Corps team to assure access and sustained operations in the littorals. The Littoral Combat/Power Projection FNC considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); fires; maneuver; sustainment; and force protection.

FY 2004 Plans:

- Initiate efforts on laser safety testing for Streak Tube Imaging Light Detection and Ranging (LIDAR) technology being developed as part of the collision avoidance system for the Expeditionary Fighting Vehicle (EFV).
- Initiate and complete testing of the stabilization algorithms and auto-tracker software developed for the EX-45 Stable Gun Mount for use on Marine Corps riverine craft. Transition to acquisition.
- Initiate efforts on network management tools to increase the reliability and availability of tactical networks by improving network performance and security.

FY 2005 Plans:

- Complete testing of LIDAR safety onboard the EFV.

- Continue efforts on network management tools.

	FY 2003	FY 2004	FY 2005
Advanced Naval Materials	20,685	15,122	15,357

Advanced Naval Materials efforts include: advanced, lightweight materials and processes to reduce weight and cost; ultrareliable materials and sensors to reduce cost by enabling condition-based and zero maintenance capabilities; enhanced sonar transducers; and environmentally acceptable long-life coatings for aircraft and ships to improve the quality of life for sailors. This activity includes the Navy's share of the Integrated High Performance Turbine Engine Technology (IHPTET) program. Airframe and ship corrosion efforts develop advanced cost effective prevention and life cycle management technologies.

FY 2003 Accomplishments:

- Initiated the development of ultralight, blast resistant metallic and composite structural materials for force protection. These materials are based on metallic sandwich panels with periodic open-called cores which absorb blast energy in faceplate stretching and in plastic crushing of the core.
- Initiated the development of low cost Phthalonitrile based organic resins and hybrid composites with improved fire resistant behavior. These resins will be instrumental for the introduction of composite materials in all man rated areas aboard ships.
- Initiated development of nanotube reinforced composite materials for the improvement of the out-of-plane mechanical properties.
- Initiated development of non-destructive evaluation (NDE) technique for corrosion detection in ship pipes without the need for removal of lagging material.
- Initiated development of durable new materials for naval gas turbine engine hot sections. This work will provide improved performance, engine life, and reduced operating costs for naval aircraft engines and includes new light temperature Aluminum (Al) alloys, advanced thermal barrier coatings and novel damping coatings.
- Continued development of: friction stir welding of steels; high strength, high toughness, affordable ship steels for weight reduction; weld processing of stainless steel; improved welding consumables; and modeling and process control development for reduced distortion and residual stresses for affordable construction of reduced weight, survivable ships.
- Continued development of multifunctional transducer materials; high-force high-strain actuators; and advanced transducer single crystal high-strain materials.
- Continued multi-laser-processing techniques for the fabrication of ultra hard materials to achieve zero maintenance components for pumps and valves.
- Continued development of oxidation resistant molybdenum alloys and new thermal barrier technology for

higher hot section operating temperatures; materials and processes for high temperature turbine disks; and higher temperature aluminum alloys to reduce weight and cost of components.
- Continued development of: single-coat corrosion control coatings for potable water ship tanks; standardized road test methodology and coating test metrics for the USMC vehicles; corrosion monitoring sensors to enable early detection of incipient corrosion; longer-life, enhanced-performance, self-priming topcoat; high performance, environmentally safe corrosion prevention compounds (CPC); and integrated spectral imaging/thermography nondestructive inspection (NDI) technology for detecting on and under surface corrosion without paint removal for aircraft.
- Continued development of longer-life, low-maintenance Modular Hybrid Pier (MHP).
- Continued development of fighter/helicopter arc fault circuit breaker (AFCB) technology enhancing safety of operation; and advanced smart wire for rapid aircraft maintenance.
- Completed development of ultra-light heat exchanger for the E-2C aircraft, obviating expensive aircraft structural changes.
- Completed frequency agile polymers for laser eye protection; transitioned to Warfighter Protection Future Naval Capability (WPFNC).
- Completed land based tests of upgraded 40-year seawater valves, eliminating current 10-year replacement intervals.

FY 2004 Plans:

- Initiate development of advanced welding for cost-efficient joining of titanium for 25% weight reduction of large seaborne structures.
- Initiate development of advanced composites and polymers with fire resistance for ship structures.
- Initiate development of acceptance testing methodologies for advanced transducer single-crystal high-strain materials. Define standardized materials properties and composition ranges.
- Initiate development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines.
- Initiate innovative crystal growth methodologies for low-cost high-quality single-crystal piezoelectrics.
- Initiate a comprehensive shipboard coating study.
- Initiate the development of Nondestructive Inspection (NDI) Technology for aircraft structures.
- Continue development of ultra light, blast resistant metallic and composite structural materials.
- Continue low cost Phthalonitrile based organic resin material and hybrid composite development with improved fire resistance; and process development of fiber reinforced foam material.
- Continue the development of nanotube reinforced composite materials for the improvement of their out-of-plane mechanical properties.
- Continue the development of a NDE technique for corrosion detection in ship pipes without the need for

removal of lagging material.
- Continue development of: durable new materials and thermal barrier coatings for naval gas turbine hot sections; environmental barrier coatings for ceramics/composites for gas turbine engines; new thermal barrier technology; materials and processes for high temperature turbine disks; and higher temperature aluminum alloys for propulsion.
- Continue development of: friction stir welding of steels; high strength, high toughness, affordable ship steels for weight reduction; weld processing of stainless steel; improved welding consumables; and the modeling and process control development for reduced distortion and residual stresses for affordable construction of reduced weight, survivable ships.
- Continue development of multifunctional transducer material, high-force high-strain actuators; and evaluation of advanced transducer single crystal high strain materials.
- Continue multi-laser-processing technique for the fabrication of ultra hard materials for wear resistance applications.
- Complete development of oxidation resistant molybdenum alloys to provide major enhancement in performance and fuel economy for gas turbines.
- Continue development of: road test methodology and coating test metrics for the USMC vehicles; longer-life, enhanced-performance self-priming topcoat and corrosion preventive compounds for aircraft; and spectral imaging/thermography technology.
- Complete the development of single coat corrosion control coatings for ballast ship tanks.
- Continued development of longer-life, low-maintenance Modular Hybrid Pier (MHP).
- Complete development of electrospark deposited coatings and scratch/hole fillers for corrosion and wear applications.

FY 2005 Plans:

- Initiate development of novel processing technologies for increasing the fatigue strength and corrosion resistance of weldments for ship structures with reduced weight and maintenance requirements.
- Initiate development of new environmentally friendly, affordable and structurally sound Bio-Composite materials and genetic manufacturing routes to enable unprecedented structural and functional qualities using conventional fabrication methods.
- Initiate development of compositional-tuning, single-crystal, high-strain transducer materials, for specialized naval system applications.
- Initiate development of portable, real-time, wide area nondestructive inspection (NDI) technology for heat damage detection in composite materials.
- Initiate development of single coat corrosion control coatings for collection, holding and transfer (CHT) ship tank.

- Continue development of ultra-light, blast resistant metallic and composite structural materials.
- Continue development of: integrated structural composites with blast resistance; manufacturing technologies; and low-cost organic resins with improved fire resistance.
- Continue development of nanotube reinforced composite materials for the improvement of their out-of-plane mechanical properties.
- Continue development of a NDE technique for corrosion detection in ship pipes without the need for removal of lagging material.
- Continue development of: durable new materials for gas turbine engine hot sections; novel thermal barrier coating technology, including multiphase coatings for oxidation resistant molybdenum alloys in gas turbine engine components; materials and processes for high temperature turbine disks; and higher temperature aluminum alloys.
- Continue development of advanced welding of titanium; friction stir welding of steels; and more affordable, higher performance ship steels.
- Continue development of: multifunctional transducer materials; high-force high-strain actuators; evaluation of advanced transducer single-crystal high-strain materials; and innovative crystal growth methods.
- Continue multi-laser-processing technique for the fabrication of ultra hard materials for wear resistance applications.
- Continue to develop single coat corrosion control coatings for potable water ship tanks; and longer-life, enhanced-performance, self-priming topcoat and corrosion preventive compounds (CPC).
- Continue development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines.
- Continue a comprehensive shipboard coating study.
- Continue development of spectral imaging/thermography NDI technology for corrosion and development of aircraft structure NDI technology.
- Complete development of Modular Hybrid Pier (MHP).
- Complete development of modeling and process control for reduced weld distortion and residual stresses, reducing fabrication costs associated with welding and flame-straightening by a factor of 40%.
- Complete development of weld processing of stainless steel for non-magnetic, damage tolerant ships.
- Complete development of corrosion and corrosivity monitoring sensors for aircraft.

	FY 2003	FY 2004	FY 2005
Medical Technologies	15,781	16,967	14,707

Medical technologies improve warfighter safety and personnel performance under adverse operational conditions, enhance field medical diagnoses and the treatment of casualties, and prevent costly occupational injury and disease in hazardous environments (including undersea). Navy investment in these areas is essential because

Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care, or the logistics of providing self/buddy-carried, life saving technologies for massive battlefield wounds. The National Institute of Health (NIH) focuses on disease processes, not product demonstration. The Army fights linearly, with echeloned health support in trace, and has dedicated medevac platforms. Naval forces operate asymmetrically, evacuate casualties using multi-role platforms (not pre-configured or supplied for medical use), and fight up to 200 nautical miles from their support bases. This project supports the Warfighter Protection Future Naval Capability (WPFNC).

FY 2003 Accomplishments:

- Terminated development of a dressing that controls bleeding and incorporates an antimicrobial agent.
- Completed studies for fielding a portable hand-held ultrasound device for medical diagnoses by corpsmen.
- Terminated efforts on a device utilizing high intensity focused ultrasound (HIFU) technology for hemostasis (control of bleeding).
- Continued study of drugs and devices for uncontrolled hemorrhage in the far forward battlefield. Blood loss is the leading cause of preventable death of Marines in combat.
- Initiated study of candidate analgesics that control severe pain and have neither the adverse effects of morphine (cardiorespiratory depression, sedation) nor the addiction potential. Naval casualties are expected to "stay in the fight" as long as possible and the use of morphine removes that capability.
- Continued efforts on resuscitative fluids to increase cardiovascular function and tissue perfusion in combat casualties. Fluids save lives by preventing hemorrhagic shock and tissue/organ failure.
- Continued research into medical devices to monitor patient status and identify casualties in danger of progressing into hemorrhagic shock.
- Continued characterization of therapeutics to protect against hemorrhagic shock. Such protection would reduce the need for resuscitative fluids and relieve the logistical burden for Naval forces.
- Completed work on new components/subsystems for Naval casualty data models, to include more precise identification of types of injuries sustained in various combat or human assistance environments. Logistical support of casualty care requires meaningful prediction of casualty types and treatment needs in various operational settings.
- Completed efforts on protective personal gear and physiologic monitoring ensembles to enhance personnel safety in operational settings that include: shipboard firefighting and damage control, warm and cold water operations for naval divers, and extreme aircraft operations (g-force, altitude and heat protection).
- Continued work on standards for personal armor systems to protect from "behind armor blunt trauma" (BABT).
- Continued applied research on real-time, in situ tests for confirmation of vaccination, diagnosis of systemic diseases, exposure to toxins, allergies and other conditions.

- Continued identification of causes of injury in shipboard scenarios, and development of exposure guidelines and engineering specifications for preventing shock-related injury.
- Continued the development of improved hearing protection systems for personnel supporting aircraft operations, and initiated improved treatment for restoring noise induced hearing loss (NIHL). Compensation for hearing loss currently costs DoN over $70M per year.
- Continued studies on decompression sickness (DCS), to include: novel agents that prevent DCS-induced neurological damage, methods for non-invasive detection of bubbles in tissue and blood for improved diagnostics, and treatment for DCS using perfluorocarbon-based compounds.
- Continued development of predictive measures for oxygen-induced seizures in Naval divers, and continued efforts to develop prophylactic agents preventing hyperbaric oxygen toxicity.
- Continued efforts to assess the impact of thermal (i.e., heat and cold) stress on operational performance in Navy and Marine Corps personnel.
- Completed studies to evaluate immunological function during harsh operational conditions.

FY 2004 Plans:

- Continue study of drugs and devices for uncontrolled hemorrhage.
- Continue study of analgesics without adverse effects.
- Continue efforts on resuscitative fluids.
- Continue applied research into medical devices for casualty monitoring and impending hemorrhagic shock.
- Continue characterization of therapeutics to protect against hemorrhagic shock.
- Complete work on standards for personal armor systems to protect from BABT.
- Continue developing tests for confirmation of vaccination and diagnosis of diseases and toxin exposure.
- Continue work on shipboard injury, exposure guidelines, and engineering specifications for preventing shock-related injury.
- Continue work on hearing protection systems and on improved treatment for restoring NIHL.
- Continue studies on decompression sickness.
- Continue efforts to develop prophylactic agents preventing hyperbaric oxygen toxicity.
- Complete work on predictive measures for oxygen-induced seizures in Navy and Marine Corps divers.
- Continue efforts to assess the impact of thermal (i.e., heat and cold) stress on operational performance.

FY 2005 Plans:

- Complete study of drugs and devices for uncontrolled hemorrhage.
- Complete study of analgesics without adverse effects.
- Complete efforts on resuscitative fluids.

- Continue applied research into medical devices for casualty monitoring and impending hemorrhagic shock.
- Continue characterization of therapeutics to protect against hemorrhagic shock.
- Continue developing tests for confirmation of vaccination and diagnosis of diseases and toxin exposure.
- Continue work on shipboard injury, exposure guidelines, and engineering specifications for preventing shock-related injury.
- Continue work on hearing protection systems and on improved treatment for restoring NIHL.
- Continue studies on decompression sickness.
- Continue efforts on prophylactic agents preventing hyperbaric oxygen toxicity.
- Continue efforts to assess the impact of thermal (i.e., heat and cold) stress on operational performance.

	FY 2003	FY 2004	FY 2005
Environmental Quality	2,390	3,127	3,308

Environmental Quality technologies enable sustained world-wide Navy operations in compliance with all local, state, regional, national and international laws, regulations and agreements, and support the Navy Transformational Roadmap in the areas of Sea Basing, Sea Strike and Sea Warrior. Compliant operations enable training evolutions and exercises that are critical for maintaining readiness.

FY 2003 Accomplishments:

- Initiated development and evaluation of novel membranes, bioreactor quick start-up package and copper biosensor technology for treatment and control of ship generated liquid wastes.
- Continued development and testing of environmentally benign marine anti-fouling (AF) coatings, air and noise pollution control technologies, underwater hull surface preparation and coating technology and evaluated the efficacy of Navy double ballast exchange for invasive species control.

FY 2004 Plans:

- Initiate development of far-term noise and air pollution emissions abatement technology for unrestricted operations, testing of new aqueous film forming foam (AFFF) formulations (without perfluoroctanylsulfonates, PFOS), studies to accurately determine input of copper into harbor environments from Navy ship hull coatings, and development of non-chlorofluorcarbon (CFC/HCFC) cooling methodologies.
- Complete Navy ship ballast water exchange efficacy evaluation, evaluation of novel membranes, bioreactor package, and development of “hardened” copper biosensor technology.
- Continue efforts in marine antifouling (AF) coatings, air and noise pollution abatement technologies, and automated underwater hull surface preparation.

FY 2005 Plans:

- Initiate development of sensor and system control technology for future Navy platforms and microwave technology for RF plasma torch applications.
- Continue efforts in marine AF coatings, air and noise pollution abatement technologies, underwater hull surface preparation and coating technology, AFFF without PFOS, copper release studies, and non-CFC/HCFC cooling.

	FY 2003	FY 2004	FY 2005
Biocentric Technologies	2,002	1,251	0

Biocentric Technologies provide novel solutions for naval needs based upon the applications of biosensors, biomaterials, and bioprocesses. Modern biotechnology methods are applied to naval problems in demo-centric programs that reduce technical risks. Topic areas include advanced sensors for force protection against weapons of mass destruction, novel methods for radar and acoustic signature reduction, chemical sensing in the marine environment for unexploded ordnance detection, green synthesis of energetic materials, and novel energy sources for chemical and biological sensors deployed in the littorals.

FY 2003 Accomplishments:

- Initiated efforts on stochastic chemical sensors for naval applications to provide single molecule detection.
- Continued development of novel biosensors for detection of explosives underwater.
- Continued to evaluate if sensors for trinitrotoluene (TNT) and other explosives can be used as autonomous underwater vehicle payloads for detection of unexploded ordnance (UXO).
- Evaluated applicability of chemical sensing from Autonomous Underwater Vehicles to Special Forces issues.
- Completed work on locating chemical plume source in very shallow waters using sensors on Autonomous Underwater Vehicles.
- Completed characterization of chemical plume structure in very shallow waters.
- Completed bulk synthesis of elastomeric polypeptides as acoustic absorbers.
- Completed development of novel bio-conjugates using fluorescent quantum dots for sensing applications.
- Completed development of biocentric algorithm (retina inspired) for image processing applications.

FY 2004 Plans:

- Conduct field testing of handheld diver sensors developed in Chemical Sensing in the Marine Environment Program at a protected UXO site.
- Terminate the development of stochastic chemical sensors to provide single molecule detection.
- Complete evaluation of applicability of chemical sensing from Autonomous Underwater Vehicles to Special Forces issues.
- Terminate the development of electrochemical based sensor for detection of explosive compounds (TNT).

	FY 2003	FY 2004	FY 2005
High Speed Sealift	0	0	9,700

Fast sealift continues to be a military priority. However, friction drag reduction is increasingly essential for long-range, large-payload Navy ships to travel at high speeds (greater than 70 knots). The High Speed Sealift effort focuses on the design of a hydrodynamic experimentation capability to resolve questions pertaining to full-scale implementation of friction drag reduction procedures. This effort relates to work funded in FY03 in PE0603236N, Project R3008.

FY 2005 Plans:

- Initiate procurement of major components required to modify the existing flow facility at the William B. Morgan Large Cavitation Channel (LCC) operated by Naval Surface Warfare Center-Carderock Division in Memphis, TN. These components will be used to construct a liner section to increase flows and pressures within the LCC to meet the goals of high-speed drag reduction experimentation.
- Initiate development of experimentation test plans and management procedures.

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ADVANCED FOULING AND CORROSION CONTROL COATINGS	4,670	5,537

This project uses combinatorial synthesis to explore advanced development of polymers for use as coatings to prevent corrosion and biofouling of metals such as ship hulls.

	FY 2003	FY 2004
ADVANCED MATERIALS AND INTELLIGENT PROCESSING	1,432	1,236

This effort develops a resin molding process utilizing both sensor and model-based approaches. New materials will provide the Navy with the capability to produce battle damage-resistant aircraft with improved stealth characteristics.

	FY 2003	FY 2004
AEROSPACE MATERIALS TECHNOLOGY CONSORTIUM	0	1,854

This effort creates a virtual, collaborative environment connecting the military, industrial, and academic materials communities to support state-of-the-art aerospace materials research focused on Naval aviation issues. The primary focus is to develop and construct the user base and to integrate a consortium of partners into an electronic web-based portal.

	FY 2003	FY 2004
AGILE VACCINOLOGY	3,850	3,955

This project conducts investigations on modern vaccine technologies, including DNA-based vaccines. An example is a malaria DNA vaccine effort that focuses on comparing various vaccination strategies in animal models.

	FY 2003	FY 2004
AUTOMATED DIODE ARRAY MANUFACTURING	2,381	0

This project included efforts to enhance the materials in diode arrays at various steps in the manufacturing process, reduce the heat load, improve the reliability, and reduce the cost of large diode arrays used in shipbuilding and other Navy systems.

	FY 2003	FY 2004
BIODEGRADABLE POLYMERS FOR NAVAL APPLICATIONS	952	1,558

This effort includes the development of natural polymers based on filled soybean protein/vegetable oil derivatives for possible use in a chaff cartridge; the preparation of polylactic acid/cellulose acetate blends

that optimize softening point and biodegradability considerations; and the development of novel exfoliated clay reinforcements which should provide physical and thermal reinforcement and a mechanism to encourage biodegradation in high salt environments.

	FY 2003	FY 2004
BIOENVIRONMENTAL HAZARDS RESEARCH PROGRAM	1,142	989

This applied research assesses the adverse impacts of Navy operations and training activities on the environment as well as the adverse health effects of contaminated environments on naval personnel.

	FY 2003	FY 2004
CARBON FOAM FOR NAVY APPLICATIONS	428	2,101

This effort develops carbon foam materials for Navy use. Such advanced materials have significantly improved mechanical, thermal, and fire-resistant properties that will permit their use in man-rated areas aboard ships and submarines.

	FY 2003	FY 2004
CERAMIC AND CARBON BASED MATERIALS	952	0

This effort developed ceramic and carbon based materials to reduce cost of propulsion systems and heat shields. The effort focused on developing alternate improved refractory ceramic and/or carbon composite fabrication processes which are more robust and less expensive than those currently in use.

	FY 2003	FY 2004
CHARACTERIZATION OF NOVEL MATERIALS	2,666	0

This effort designed and initiated development of an electrically driven high dynamic pressure ramp wave facility for the characterization of material properties under shock loading for potential applications in electromechanical gun and ordnance systems.

	FY 2003	FY 2004
COASTAL AREA TACTICAL MAPPING SYSTEMS	0	1,978

This effort provides the Marine Expeditionary Forces (MEF) with the next-generation airborne-scanning laser-mapping system in support of quick and decisive amphibious assaults. To deliver resources from sea to land, the MEF require timely, highly accurate imagery of both the surface and underwater environment in order to detect obstacles and mines. Recent advances provide the means to develop a next-generation airborne-scanning laser-mapping system, optimized for deployment on an unmanned aerial vehicle.

	FY 2003	FY 2004
DIAGNOSTIC TOOL FOR BIOWARFARE-INFLICTED INFECTIOUS DISEASE	0	1,978

This effort develops a mass spectrometric-based diagnostic tool capable of early, sensitive, and agent-specific detection of infectious disease for large numbers of exposures. This automated diagnostic equipment will be activated quickly after an attack to perform triage and recommend treatment.

	FY 2003	FY 2004
FIBROUS MONOLITHIC MATERIALS INSERTION	2,143	2,472

This effort develops fibrous monolithic composite materials for application in turbine engines and missiles. The new high temperature materials will replace current metal and composite materials. The applications for these materials are rocket components such as fuel shields and turbine engine components.

	FY 2003	FY 2004
FORMABLE ALIGNED CARBON THERMO SETS (FACTS)	954	1,236

This project advances formable aligned carbon thermosets (fiber stretch breaking) by refining material fabrication processes, developing part-forming processes, and fabricating complex parts. Complex parts are currently formed from materials other than composites resulting in parts that are heavy, expensive, and subject to corrosion.

BA: 02 PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: Warfighter Sustainment Applied Research
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	FY 2003	FY 2004
HUMAN SYSTEMS TECHNOLOGY	952	989

This project includes human-centered display and interfaces to enable non-pilot operators to successfully operate unmanned combat air vehicles; supports psychophysical studies of combining tactile interfaces designed for sensory substitution (e.g. sight) and for sensory augmentation in complex dynamic environments such as aviation; develops two classes of advanced Boolean algorithms that support solutions to practical problems (e.g. scheduling, cryptography, network design); and develops data mining and optimization techniques for Navy personnel data.

	FY 2003	FY 2004
IMPROVED PERFORMANCE INTEGRATION TOOL (IMPRINT) MODELING	1,003	0

This project enhanced an Army-developed system called IMPRINT to be used in support of human factors engineering in Navy applications. A major part of the FY03 effort was to scale up the IMPRINT modeling technique for application in the human factors and manning requirements for the larger Navy platforms. This project continues in FY04 under PE 0603236N.

	FY 2003	FY 2004
INTEGRATED BIODEFENSE RESEARCH INITIATIVE	0	989

This effort supports applied research to develop state-of-the-art, integrated biowarfare defense capabilities.

	FY 2003	FY 2004
LOW VOLUME PRODUCTION	0	1,978

This effort develops an eximer laser-based welding capability for the repair of worn and/or corroded ship components. The laser system eliminates the high heat associated with conventional welding that can distort the critical size and shape of the ship components.

	FY 2003	FY 2004
MARINE MAMMAL RESEARCH	952	1,088

This project investigates the effects of noise on dolphin hearing (Temporary Threshold Shift) and dolphin biosonar capabilities. Additional efforts include joint visual and acoustic surveys of humpback whales in Kauai, and an internationally recognized summer graduate course in Bioacoustical Oceanography.

	FY 2003	FY 2004
NATIONAL UUV TEST AND EVALUATION CENTER	4,486	2,720

This effort supports the development of an integrated unmanned underwater vehicle (UUV) testbed environment to meet the broad needs of current and future UUV programs. The test center will serve technology development, multi-mission UUV test and evaluation, fleet training and UUV system support.

	FY 2003	FY 2004
NAVAL TRAINING, PERFORMANCE, AND EXPERTISE	0	495

This effort supports applied research to improve Naval training, performance, and expertise.

	FY 2003	FY 2004
NOVEL MATERIALS SYNTHESIS AND CHARACTERIZATION	0	2,423

This effort establishes a compact experimental facility/capability to use magnetically induced dynamic pressure for acquiring dynamic material property data over a broad range of loading conditions considerably faster and at less expense than is possible with existing methods. This capability is exploited to determine the time scales and loading conditions associated with the initiation of mechanically stimulated metal/polymer reactions, characterize the material properties of novel structural and reactive materials, and extend the characterization capabilities to very high dynamic loading regimes.

	FY 2003	FY 2004
OPTIMIZING ADAPTIVE WARRIOR PERFORMANCE	0	2,076

This project develops a National Center for Cognitive Science recognized for excellence in manpower,

personnel, and training research. The effort focuses on understanding cognitive mechanisms that support adaptive warrior cognition and action.

	FY 2003	FY 2004
POROUS MATERIALS RESEARCH	0	989

This effort supports applied research in porous materials important to Naval operations.

	FY 2003	FY 2004
PORTABLE LANGUAGE TRANSLATION SYSTEM AND COMPUTING PLATFORMS	0	2,076

This effort develops a portable, 2-way, voice translation system. This work leverages current Navy programs that seek to provide field translation (e.g. remote, wireless) capabilities for military applications. The effort is motivated by strong DoD and Homeland Defense anti-terrorism issues coupled with a lack of trained translators.

	FY 2003	FY 2004
RAPID AND HIGHLY SENSITIVE DETECTION OF BIOWARFARE AGENTS	0	1,483

This project develops an inexpensive, sensitive, and reliable detector for biowarfare agents. The detector utilizes synthetic polymers incorporating molecular imprints that recognize and bind biowarfare agents and quartz crystal surfaces that, when acoustically vibrated, can detect characteristic noise generated by a bound bioagent.

	FY 2003	FY 2004
RAPID DETECTION AND RESPONSE FOR CHEM/BIO DEFENSE SYSTEMS	952	0

This effort developed technologies for rapid detection of, and response to, airborne biological and chemical agents in battlefield and key urban environments. This work supported the development of antibody-based and DNA-based detection systems in a ChemArray Chip (impedance imaging sensing system), and of data/models to predict the proper placement of real-time sensors in indoor environments for antiterrorism applications.

	FY 2003	FY 2004
RHODE ISLAND DISASTER INITIATIVE	1,142	0

This project developed technologies and techniques to determine effective solutions for medical disaster response, focusing on handling mass casualties from natural disasters, terrorist acts such as the USS Cole, and both military and civilian casualties produced by weapons of mass destruction.

	FY 2003	FY 2004
SINGLE-WALL CARBON NANOTUBE LOW OBSERVABLE MATERIALS FOR NAVY STEALTH APPLICATIONS	0	4,450

This project develops high performance, long lasting conductive polymeric materials for Naval aircraft gap sealants for stealth applications. Conductive gap sealants based on polymers loaded with carbon nanotube offer the potential for significant improvements over current technology, specifically in weight-savings, increased absorption/deflection potential, service life, and cost.

	FY 2003	FY 2004
THREE DIMENSIONAL PRINTING METALWORKING PROJECT	3,667	1,384

This project defines, develops and demonstrates a three dimensional printing (3DP) system on specific DOD applications. This effort advances the potential use of the 3DP process and its unique capabilities for the manufacture of components in an e-manufacturing environment.

	FY 2003	FY 2004
TITANIUM MATRIX COMPOSITES PROGRAM	2,107	989

This project develops titanium metal matrix composites to enhance future engine designs (rotating engine parts such as disks and spacers) by permitting greater thrust output to weight ratios than are achievable today with currently available materials. The application of titanium metal matrix composites will aid in achieving vertical/short take off and landing (V/STOL) aircraft designs without weight penalties.

	FY 2003	FY 2004
VISUALIZATION OF TECHNICAL INFORMATION	1,621	0

This project focused on intelligent agent technologies, applied to the understanding and presentation of the readiness status of a shipboard integrated logistics information system. The system assessed weapons platforms status, shipboard engine health, and other critical sustainment to the battlegroup readiness posture, and disseminated information via the intelligent agent community. In FY04, this program transitions successfully to the Acquistion Community within NAVSEA for distance learning.

C. OTHER PROGRAM FUNDING SUMMARY:
RDT&E

NAVY RELATED RDT&E:

PE 0601103N University Research Initiatives
PE 0601152N In-House Laboratory Independent Research
PE 0601153N Defense Research Sciences
PE 0602123N Force Protection Applied Research
PE 0602747N Undersea Warfare Applied Research
PE 0603236N Warfighter Sustainment Advanced Technology
PE 0603512N Carriers Systems Development
PE 0603640M Marine Corps Advanced Technology Demonstration
PE 0603721N Environmental Protection
PE 0603724N Navy Energy Program (Adv)
PE 0604561N SSN-21 Developments
PE 0604703N Personnel, Training, Simulation, and Human Factors
PE 0604771N Medical Development
PE 0604962N Naval Simulation System
PE 0605152N Studies and Analysis Support - Navy
PE 0708011N Industrial Preparedness

NON-NAVY RELATED RDT&E:

PE 0408042N National Defense Sealift Fund
PE 0601102A Defense Research Sciences
PE 0602105A Materials Technology

PE 0602211A	Aviation Technology
PE 0602303A	Missile Technology
PE 0602601A	Combat Vehicle and Automotive Technology
PE 0602705A	Electronics and Electronic Devices
PE 0602709A	Night Vision Technology
PE 0602716A	Human Factors Engineering Technology
PE 0602785A	Manpower, Personnel, and Training Technology
PE 0602786A	Warfighter Technology
PE 0602787A	Medical Technology
PE 0603002A	Medical Advanced Technology
PE 0603003A	Aviation Advanced Technology
PE 0601102F	Defense Research Sciences
PE 0602102F	Materials
PE 0602202F	Human Effectiveness Applied Research
PE 0602203F	Aerospace Propulsion
PE 0602204F	Aerospace Sensors
PE 0602702F	Command, Control and Communications
PE 0603216F	Aerospace Propulsion and Power Technology
PE 0603716D8Z	Strategic Environmental Research Program
PE 0602712E	Materials and Electronics Technology
PE 0603851D8Z	Environmental Security Technical Certification Program

D. ACQUISITION STRATEGY: Not Applicable