DEPARTMENT OF THE NAVY
FISCAL YEAR (FY) 2005
BUDGET ESTIMATES

JUSTIFICATION OF ESTIMATES
FEBRUARY 2004

RESEARCH, DEVELOPMENT, TEST & EVALUATION, NAVY
BUDGET ACTIVITIES 1-3

DEPARTMENT OF THE NAVY
FY 2005 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 1319N Research, Development, Test & Eval, Navy

Date: February 2004

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2003	FY 2004	FY 2005	SEC
1	0601103N	University Research Initiatives	1		91,489	83,508	U
2	0601152N	In-House Laboratory Independent Research	1	12,878	17,196	17,664	U
3	0601153N	Defense Research Sciences	1	393,056	375,363	375,812	U
	TOTAL Basic Research			405,934	484,048	476,984	

DEPARTMENT OF THE NAVY
FY 2005 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 1319N Research, Development, Test & Eval, Navy

Date: February 2004

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2003	FY 2004	FY 2005	SEC
4	0602114N	Power Projection Applied Research	2	110,232	142,626	98,831	U
5	0602123N	Force Protection Applied Research	2	113,066	112,868	96,269	U
6	0602131M	Marine Corps Landing Force Technology	2	28,247	32,375	35,398	U
7	0602232N	Communications, Command and Control, Intell, Surveillance	2	1,333			U
8	0602233N	Human Systems Technology	2	1,000	1,705		U
9	0602234N	Materials, Electronics and Computer Technology	2	9,553	1,780		U
10	0602235N	Common Picture Applied Research	2	142,203	95,432	60,134	U
11	0602236N	Warfighter Sustainment Applied Research	2	102,075	100,645	63,726	U
12	0602271N	RF Systems Applied Research	2	69,232	49,244	49,151	U
13	0602435N	Ocean Warfighting Environment Applied Research	2	66,431	62,305	48,482	U
14	0602747N	Undersea Warfare Applied Research	2	85,424	76,788	64,060	U
15	0602782N	Mine and Expeditionary Warfare Applied Research	2	49,363	47,929	48,016	U
		TOTAL Applied Research		778,159	723,697	564,067	

DEPARTMENT OF THE NAVY
FY 2005 RDT&E PROGRAM EXHIBIT R-1

APPROPRIATION: 1319N Research, Development, Test & Eval, Navy Date: February 2004

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2003	FY 2004	FY 2005	SEC
16	0603114N	Power Projection Advanced Technology	3	176,336	260,688	92,359	U
17	0603123N	Force Protection Advanced Technology	3	89,085	119,838	82,130	U
18	0603235N	Common Picture Advanced Technology	3	45,656	79,690	79,521	U
19	0603236N	Warfighter Sustainment Advanced Technology	3	90,501	86,464	61,103	U
20	0603271N	RF Systems Advanced Technology	3	70,973	62,041	44,046	U
21	0603640M	USMC Advanced Technology Demonstration (ATD)	3	73,607	90,110	58,222	U
22	0603712N	Environmental Quality and Logistics Advanced Technology	3	960			U
23	0603727N	Navy Technical Information Presentation System	3	101,816	137,315	167,626	U
24	0603729N	Warfighter Protection Advanced Technology	3	32,757	28,318	16,719	U
25	0603747N	Undersea Warfare Advanced Technology	3	45,080	46,544	26,515	U
26	0603757N	Joint Warfare Experiments	3		19,956	26	U
27	0603758N	Navy Warfighting Experiments and Demonstrations	3	42,138	39,490	16,006	U
28	0603782N	Mine and Expeditionary Warfare Advanced Technology	3	42,266	38,913	32,899	U
29	0603792N	Advanced Technology Transition	3	2,381			U
		TOTAL Advanced Technology Development		813,556	1,009,367	677,172	

Fiscal Year 2005 Budget Estimates
Budget Appendix Extract Language

RESEARCH, DEVELOPMENT, TEST & EVALUATION, NAVY (RDTEN)

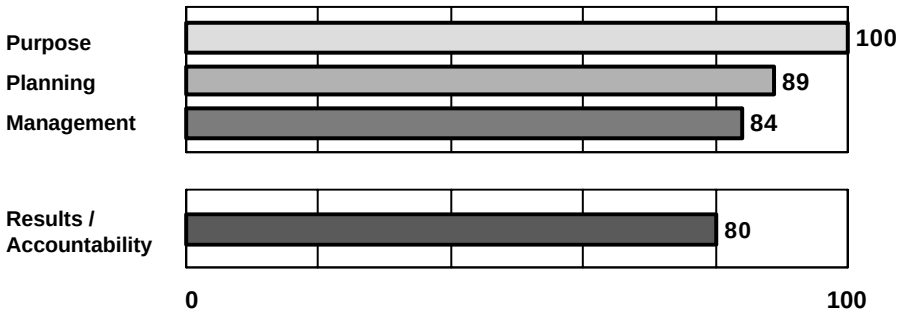
For expenses necessary for basic and applied scientific research, development, test and evaluation, including maintenance, rehabilitation, lease, and operation of facilities and equipment, **[**$15,146,383,000**]** *$16,346,391,000*, to remain available for obligation until September 30, **[**2005**]** *2006*: *Provided*, That funds appropriated in this paragraph which are available for the V–22 may be used to meet unique operational requirements of the Special Operations Forces: *Provided further*, That funds appropriated in this paragraph shall be available for the Cobra Judy program. *(10 U.S.C. 174, 2352–54, 7522; Department of Defense Appropriations Act, 2004.)*

[For an additional amount for ''Research, Development, Test and Evaluation, Navy'', $34,000,000, to remain available until September 30, 2005.**]** *(Emergency Supplemental Appropriations Act for Defense and for the Reconstruction of Iraq and Afghanistan, 2004.)*

Program: *Basic Research*

Agency: *Department of Defense--Military*

Bureau: *Research, Development, Test, and Evaluation*



☑ Results Achieved ☑ Measures Adequate

☐ Results Not Demonstrated ☐ New Measures Needed

Key Performance Measures	*Year*	*Target*	*Actual*
Certification in biennial reviews by technically competent independent reviewers that the supported work, as a portfolio, is of high quality, serves to advance the national security and is efficiently managed and carried out.	2003 and later	100%	
Long-term Measure: Portion of funded research that is chosen on the basis of merit review Reduce non-merit-reviewed and -determined projects by one half in two years (from 6.0% to 3.0%)	2005	-50%	

****Rating:*** *Effective*

Program Type *Research and Development*

Program Summary:

The Basic Research program includes scientific study and experimentation to increase fundamental knowledge in the physical, engineering, environmental and life sciences and consists of a wide portfolio of projects. The program is carried out primarily through grants to universities and non-profits. The results of this research are expected to improve the country's defense capabilities, although the actual results of any specific project are unpredictable. Notable successes in the past have led to advances in satellite communications and imagery, precision navigation, stealth, night vision and technologies allowing greatly expanded battlefield awareness. Due to the long-term nature of research results, the R&D PART emphasizes assessment of the process of choosing funded projects and independent assessments of how well the research portfolio is managed.

The assessment indicates that the basic research program has clear purposes of providing options for new weapons systems, helping prevent technological surprise by adversaries, and developing new scientists who will contribute to the DoD mission in the future. DoD can document--through its contracts and grants management regulations, public announcements of award competitions and results from independent review panels--the methodical management of its program. Additional findings include:
1. The grants/contract solicitation, review and award processes are competitive.
2. The program is reviewed regularly by technically capable outside reviewers, which recommend improvements they would like to be implemented. They indicate that the work is of overall high quality.
3. The program has competent planning and management.
4. Earmarking of projects in the program has increased in the past decade and contribute less than the typical research project to meeting the agency's mission.

In response to these findings, the Administration will:
1. Continue to emphasize the use of independent review panels in assessing the performance of the program.
2. Work with the research community and Congress to explain the need to limit claims on research grant funds to proposals that independently can meet the standards of a strict merit-review process.

Program Funding Level (in millions of dollars)

* This assessments has not changed since publication in the FY 2004 Budget. For updated program funding levels, see Data File - Funding, Scores, and Ratings.

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

BA: 01 PROGRAM ELEMENT: 0601103N
PROGRAM ELEMENT TITLE: University Research Initiatives

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
University Research Initiatives	0	91,489	83,508	75,980	72,963	74,618	75,975

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program includes support for multidisciplinary basic research in a wide range of scientific and engineering disciplines that are important for maintaining the technological superiority for the U.S. Navy and for university research infrastructure by acquiring research instrumentation needed to maintain and improve the quality of university research important to the Navy. Multidisciplinary research efforts involve teams of researchers investigating high priority topics that intersect more than one traditional technical discipline. For many military problems, this multidisciplinary approach serves to stimulate innovations, accelerate research progress and expedite transition of results to Naval applications. The Defense University Research Instrumentation Program (DURIP) supports university research infrastructure essential to high quality Navy relevant research. The instrumentation program complements the research program by supporting the purchase of high cost research instrumentation that is necessary to carry out cutting-edge research. In addition, the program also supports Presidential Early Career Awards for Scientists and Engineers (PECASE), which are single investigator research efforts performed by outstanding academic scientists and engineers early in their research careers. This program provides the knowledge base, scientific concepts, and technological advances for the maintenance of naval power and national security.

The program was transferred from RDT&E, Defense-Wide, University Research Initiative, PE 0601103D8Z.

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

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

BA: 01 PROGRAM ELEMENT: 0601103N
PROGRAM ELEMENT TITLE: University Research Initiatives

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	0	70,669	76,843
Cong. Rescissions/Adjustments/Undist.Reductions	0	-1,030	0
Congressional Actions	0	21,850	0
Inflation Savings	0	0	-271
Technical Adjustments	0	0	6,936
FY 2005 President's Budget Submission	0	91,489	83,508

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

BA: 01 PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: University Research Initiatives

PROJECT TITLE: University Research Initiatives

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
University Research Initiatives	0	91,489	83,508	75,980	72,963	74,618	75,975

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project includes support for multidisciplinary basic research in a wide range of scientific and engineering disciplines that are important for maintaining the technological superiority for the U.S. Navy and for university research infrastructure by acquiring research instrumentation needed to maintain and improve the quality of university research important to the Navy. Multidisciplinary research efforts involve teams of researchers investigating high priority topics that intersect more than one traditional technical discipline. For many military problems, this multidisciplinary approach serves to stimulate innovations, accelerate research progress and expedite transition of results to Naval applications. The Defense University Research Instrumentation Project (DURIP) supports university research infrastructure essential to high quality Navy relevant research. The instrumentation project complements the research project by supporting the purchase of high cost research instrumentation that is necessary to carry out cutting-edge research. In addition, the project also supports Presidential Early Career Awards for Scientists and Engineers (PECASE), which are single investigator research efforts performed by outstanding academic scientists and engineers early in their research careers. This project provides the knowledge base, scientific concepts, and technological advances for the maintenance of Naval power and national security.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Multidisciplinary University Research (MURI)	0	55,658	59,000

Research efforts include high priority topics that intersect more than one traditional discipline. Multidisciplinary University Research Initiative (MURI) topics are selected to address high priority science and technology directions of the Department of the Navy, including the four ONR Grand Challenges (Naval Battlespace Awareness, Electric Power Sources for the Navy and Marine Corps, Naval Materials by Design, and

Multifunctional Electronics for Intelligent Naval Sensors).

FY 2003 Accomplishments:
• Not applicable. Efforts funded within RDT&E, Defense Wide University Research Initiative, PE 0601103D8Z.

FY 2004 Plans:
• Conduct competition for new multidisciplinary research awards to address selected high priority naval science and technology areas, transformational initiatives, and grand challenges, including strategically important DoD research areas, such as bioengineering sciences, nanoscience, multifunctional materials and structures, information dominance, propulsion and energetic sciences, human performance sciences, advanced surveillance and knowledge architectures, and power and energy technologies. Continue MURI programs begun in prior years.

FY 2005 Plans:
• A competition for multidisciplinary basic research awards will focus on capability-based topical areas to provide enhanced capabilities for future Navy and Marine Corps warfighting needs, including the war on terrorism. Continue MURI programs begun in prior years.

	FY 2003	FY 2004	FY 2005
Defense University Research Instrumentation Program	0	13,112	23,398

Defense University Research Instrumentation Program (DURIP) funds are provided to universities to purchase relatively high cost research instrumentation that is normally not included in single-investigator type research grants, such as radio propagation measurement systems, instrument for fabrication and characterization of advanced electronic devices, sensor arrays for oceanography, ocean flow measurement systems, autonomous ocean profiling systems, hydrodynamic sound source localization systems, tunable lasers for near field microscopy, and instruments for material characterization.

FY 2003 Accomplishments:
• Not applicable. Efforts funded within RDT&E, Defense-Wide, University Research Initiative, PE 0601103D8Z.

FY 2004 Plans:
• Conduct competition for approximately 60 research instrumentation awards to universities.

FY 2005 Plans:
• Conduct competition for approximately 105 research instrumentation awards to universities. Increased FY 2005 funding for DURIP returns program to previous levels (e.g., FY 2001 and FY 2002).

	FY 2003	FY 2004	FY 2005
Presidential Early Career Awards	0	1,110	1,110

Extremely prestigious, presidential-rank, single-investigator research awards in areas of importance to the Navy, to recognize and encourage outstanding academic scientists and engineers early in their research career.

FY 2003 Accomplishments:
• Not applicable. Efforts funded within RDT&E, Defense-Wide, University Research Initiative, PE 0601103D8Z.

FY 2004 Plans:
• Select two outstanding university researchers to receive the five-year PECASE research award to conduct research of importance to the Navy. Continue PECASE programs begun in earlier years.

FY 2005 Plans:
• Select two outstanding university researchers to receive the five-year PECASE research award to conduct research of importance to the Navy. Continue PECASE programs begun in earlier years.

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ARMED FORCES FOOD SAFETY AND SECURITY RESEARCH	0	2,769

This funding will support efforts in food safety and security research for the armed forces.

	FY 2003	FY 2004
CENTER FOR MARITIME SYSTEMS	0	3,560

This effort will develop a state of the art tow tank with enhanced measurement accuracy to improve knowledge of performance metrics of innovative hull forms to aid in the design of fast efficient ships without the need for extensive prototype testing.

	FY 2003	FY 2004
CENTER FOR NANOSCIENCE AND NANOMATERIALS	0	2,967

This effort will develop new concepts for improved materials, novel structures, and integrated, multifunctional materials and structures with potential dual use applications for homeland security.

	FY 2003	FY 2004
CENTER FOR SOUTHERN TROPICAL ADVANCED REMOTE SENSING	0	4,945

This effort will develop a ground station to receive remote sensing data from commercial satellites to enhance the intelligence, surveillance, and reconnaissance mission of US SouthCom.

	FY 2003	FY 2004
LOW TEMPERATURE RESEARCH CENTER	0	989

This effort supports basic research into the properties of materials at very low temperatures.

	FY 2003	FY 2004
MEMS SENSOR FOR ROLLING ELEMENT BEARINGS	0	1,434

This effort will support development of a one-chip sensor solution for determining temperature, vibration, strain, and angular rotation in rolling element bearings.

	FY 2003	FY 2004
NANOMATERIALS FOR HIGH PERFORMANCE COATING APPLICATIONS	0	989

This effort will support basic research in the area of nanoparticle based coatings and thin films to aid in the development of coatings to improve marine hull fouling prevention, corrosion protection, stealth, and protection from chemical and biological weapons agents.

	FY 2003	FY 2004
NEURAL ENGINEERING FOR HUMAN RESPONSE AUGMENTATION	0	989

This effort will support basic research in the area of human neural networks by employing microscale devices that allow real-time analyses of human brain nerve signals. This effort will explore the feasibility of humans controlling autonomous devices via brain activity.

	FY 2003	FY 2004
SURA COASTAL OCEAN OBSERVATION PROGRAM (SCOOP)	0	2,967

This effort supports the development of a network of sensors and linked computers as part of the Southeastern Universities Research Association (SURA) Coastal Ocean Observing Program which will fully integrate several observing systems in the southern region. This network will provide data, in real-time and at high speed, for more reliable, accurate, and timely information to help guide effective coastal stewardship, plan for extreme events, facilitate safe maritime operations, and support coastal military security.

C. OTHER PROGRAM FUNDING SUMMARY: Not Applicable.

D. ACQUISITION STRATEGY: Not Applicable.

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

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT IN-HOUSE LABORATORY INDEPENDENT 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
	12,878	17,196	17,664	17,891	18,178	18,261	18,640

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This portion of the DON Basic Research Program provides participating Navy Centers and Laboratories with funding for basic research to support 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 DON laboratories, in particular the corporate Naval Research Laboratory (NRL). Basic biomedical research at the Uniformed Services University for the Health Sciences (USUHS) is supported by providing funding for military-specific medical research that is typically leveraged into over $30 million in new extramural funds each year. The program responds to Science and Technology (S&T) directions of the Department of the Navy (DON) Naval Power 21 (NP21) Transformational Roadmap and Chief of Naval Operations (CNO) N70 Mission Capability Package (MCP) requirements for long term Navy and Marine Corps needs. 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 Development Center, and Bureau of Medicine and Surgery laboratories. The USUHS component is executed by the President of USUHS.

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 continued in FY03. ILIR status, results, and management are reported annually to the Deputy UnderSecretary of Defense (S&T).

ILIR projects are selected by Center/Lab CO’s and TD’s 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 FY03, about 50 projects were completed and 70 initiated.

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

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

Support for the basic medical research at the 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 one hundred 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 pool of knowledge intended to enable technical approaches and investment strategies within Defense S&T programs. They are designed to answer fundamental questions of importance to the military medical mission of the DON in the areas of Combat Casualty Care (CCC), Infectious Diseases (ID), and Military Operational Medicine (MOM).

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

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 2003	FY 2004	FY 2005
FY 2003 President's Submission:	15,992	17,400	17,745
Cong. Rescissions/Adjustments/Undist. Reductions		-194	
Execution Adjustments	-3,017		
Inflation Savings			-57
Rate Adjustments		-10	-24
SBIR Assessments	-97		
FY 2005 President’s Budget Submission:	12,878	17,196	17,664

PROGRAM CHANGE SUMMARY EXPLANATION:

Technical: Not applicable
Schedule: Not applicable

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

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT 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
	12,878	17,196	17,664	17,891	18,178	18,261	18,640

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 and Development Center, Bureau of Medicine and Surgery laboratories, and Uniformed Services University of the Health Sciences (UHUHS).

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 DON laboratories, in particular the corporate Naval Research Laboratory (NRL).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Ocean/Space Sciences	3,347	3,955	4,063

FY 2003 ACCOMPLISHMENTS:

- Developed a method for analyzing very low frequency back scatter sound propagation measurements from a rippled bottom.
- Developed and applied solutions for large amplitude wave interactions with ships.
- Studied various properties of the ocean environment so that such effects can be compensated for in the propagation of sound underwater.

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

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 2003	FY 2004	FY 2005
Advanced Materials	2,447	2,923	3,003

FY 2003 ACCOMPLISHMENTS:
- Developed polymer engineering guidelines for use in applications where specific ultimate tensile properties are required.
- Developed new, low cost, high strength materials for actuators, transducers, sensors for sonar, noise cancellation, and anti-vibration devices.
- Reproduced and understood 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.
- Research polymers with ‘self-healing’ properties for use in fuel tanks.
- 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 03	FY 04	FY 05
Electronics Sensor Sciences	1,932	2,235	2,297

FY 2003 ACCOMPLISHMENTS:
- Continued to explore new robust waveform designs for use in tactical underwater communications.
- Investigated the effect of thermal, electric, and elastic boundaries on the electromechanical properties of new singe crystal sonar transducers.
- Investigated the advantages of fractal antennas for Navy activities.
- Investigated the potential advantages of the tunable multi-frequency vertical cavity surface emitting laser as a component of a communications system.
- Developed a novel atomic interferometer based on slow moving atoms extracted from a magneto-optical trap.

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.

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

	FY 2003	FY 2004	FY 2005
Human Performance Sciences	1,536	1,892	1,943

FY 2003 ACCOMPLISHMENTS:
- Mapped meteorology and oceanography decision maker information usage into visualization tools and compare that mapping to mappings of other Navies.
- Began development of a vaccine that would protect against one of the major causes of bacterial diarrhea world-wide.
- Studied the interrelationships among bioenergetic and neural determinants of fatigue.
- Studied the changes in the activity and levels of glutamate transporters in response to hyperbaric oxygen treatment.

FY 2004 PLANS:
- Continue development of a vaccine that would protect against one of the major causes of bacterial diarrhea world-wide.
- 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.

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 2003	FY 2004	FY 2005
Information Sciences	1,555	1,892	1,943

FY 2003 ACCOMPLISHMENTS:
- Investigated the performance of recently developed novel active sonar transmit signal models.
- Characterized the state of network traffic at the individual user and aggregate levels and developed tools that can be used to ascertain the state and health of network traffic.
- Investigated newly derived asynchronous track fusion algorithms.
- Continued to study route planning and control methods for unmanned vehicles.

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 2003	FY 2004	FY 2005
Combat Casualty Care, Infectious Diseases & Military Operational Medicine (USUHS)	*	1,891	1,943

FY 2003 ACCOMPLISHMENTS:
*Executed under 0601101D8Z

FY 2004 PLANS:

- Conduct studies in the following areas (representative projects):
    - Combat Casualty Care (CCC) – Explore the use of energy metabolites in the treatment of hemorrhagic shock and oxidative stress; investigate the function of natural antibodies (chiefly related to B1 cells) in post-ischemic recovery; establish basic science framework for using benzoquinone ansamycin to treat traumatic brain injury.
    - Infectious Diseases (ID) – Investigate the endothelium-related pathogenesis of Ebola and similar potential Weapons of Mass Destruction (WMD); and continue to test novel combinations of antiviral and anti-inflammatory agents to treat influenza in a rat model; and continue to delineate interactions between Shigella proteins and host cells, identifying new targets for effective treatment of dysentery.
    - Military Operational Medicine (MOM) – Delineate the role of the proteasome in neuroprotection from hemorrhagic shock in rates; complete first dose-response study of control of altitude-induced pulmonary hypertension using oral sildenafil; complete study of Immersion precooling on performance during and after warm-water exercise; and explore the long-term neuroendocrine effects of exposure to neurotoxins.

FY 2005 PLANS:

- Conduct continuing studies in the following areas (representative projects listed):

- CCC – Test the ability of nerve growth factor to provide both long-term and acute protection against the effects of trauma to the cerebral cortex; Metabolic Antioxidants and Complement in Rat Hemorrhagic Shock.
- ID – Screen a selected range of Staphylococcus aureus isolates to determine which Deoxyribonucleic acid (DNA) sequence in the accessory gene regulator group underlie the production of its toxins; investigate the adaptations of N. gonorrhea as it infects the female genital tract; and continue to explore the mechanisms of Shiga toxins generated by enterohemorrhagic E. coli.
- MOM – Continue to characterize the expression of photoreceptive melanocytes to the effects of specific wavelengths of electromagnetic radiation upon ocular pigment cells as well as upon the entrainment of circadian rhythms; examine the role of the proteasome in neuroprotection from hemorrhagic shock; and establish the role of the enzyme serine palmitoyltransferase (SPT) in protecting the skin from penetration by noxious environments.

	FY 2003	FY 2004	FY 2005
Naval Platform Design Sciences	1,021	1,204	1,236

FY 2003 ACCOMPLISHMENTS:

- Continued to extend current computational fluid dynamics techniques and computer codes.
- Developed a series of closely integrated hydrodynamic tools for hull form design and optimization.
- Demonstrated the potential of suppressing hydrodynamic cavitation through the use of high-frequency, high-amplitude acoustic noise.

- Investigated 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:

- Continue to characterize the salient near wake turbulent physics of curved circular cylinders using large-eddy simulation methodology.

- 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 2003	FY 2004	FY 2005
Energy Sciences	1,040	1,204	1,236

FY 2003 ACCOMPLISHMENTS:
- Investigated the use of a hydrogen peroxide catholyte in combination with an aluminum node for improved fuel cells.
- Developed a propellant suitable for undersea propulsion with a high concentration of condensable exhaust products.
- Continued to develop and demonstrate new synthetic methodology that lead to the precursors of superior insensitive explosives.
- Continued to investigate the characteristics of novel materials intended for use in lighter/smaller batteries.

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.

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 0601102F Defense Research Sciences (Air Force)

D. ACQUISITION STRATEGY:

Not Applicable.

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

BA: 01 PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: Defense Research Sciences

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
Defense Research Sciences	393,056	375,363	375,812	390,131	397,748	405,168	413,046

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. Additionally, it exploits scientific breakthroughs and provides options for new Future Naval Capabilities (FNCs). It responds to S&T direction from Department of the Navy (DON) Naval Power 21 (NP21) Transformational Roadmap, and Chief of Naval Operations (CNO) N70 Mission Capability Package (MCP) requirements for long term Navy and Marine Corps improvements. Defense Research Sciences 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 (JCS) Future Joint Warfighting Capabilities. It is managed by the Office of Naval Research (ONR) through Program Officers at ONR Headquarters, and the base program of the corporate Naval Research Laboratory (NRL).

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 is the core of Discovery and Invention. It includes scientific study and experimentation directed toward increasing knowledge and understanding in national-security related aspects of physical, engineering, environmental and life sciences. Basic research efforts are developed, managed, and related to more advanced aspects of research in some hundred-plus technology and capability-related 'thrusts', which are consolidated in 15 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, weapons systems for Naval forces, and superior human performance/training/care of Sailors and Marines.

BA: 01 PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: Defense Research Sciences

Key aspects of the program are the four ONR Grand Challenges which 'inspire and guide' the direction of research: Naval Battlespace Awareness, Electric Power Sources for the Navy and Marine Corps, Naval Materials by Design, and Multifunctional Electronics for Intelligent Naval Sensors; and the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental naval capabilities depend, and in which ONR is and likely will remain the principal US research sponsor. NNRs are ratified only after close scrutiny, and currently comprise Ocean Acoustics (started FY99), Underwater Weaponry (started FY02), and Naval Engineering (started in FY03).

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	396,330	368,517	377,223
Cong. Rescissions/Adjustments/Undist.Reductions	-7,053	-4,254	0
Congressional Actions	0	11,100	0
Execution Adjustments	3,779	0	0
Inflation Savings	0	0	-932
Rate Adjustments	0	0	-479
FY 2005 President's Budget Submission	393,056	375,363	375,812

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

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

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
Defense Research Sciences	393,056	375,363	375,812	390,131	397,748	405,168	413,046

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. Additionally, it exploits scientific breakthroughs and provides options for new Future Naval Capabilities (FNCs). It responds to S&T direction from the Department of the Navy (DON) Naval Power 21 (NP21) Transformational Roadmap, and Chief of Naval Operations (CNO) N70 Mission Capability Package (MCP) requirements for long term Navy and Marine Corps improvements. Defense Research Sciences 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 (JCS) Future Joint Warfighting Capabilities. It is managed by the Office of Naval Research (ONR) through Program Officers at ONR Headquarters, and the base program of the corporate Naval Research Laboratory (NRL).

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 is the core of Discovery and Invention. It includes scientific study and experimentation directed toward increasing knowledge and understanding in national-security related aspects of physical, engineering, environmental and life sciences. Basic research efforts are developed, managed, and related to more advanced aspects of research in some hundred-plus technology and capability-related 'thrusts', which are consolidated in 15 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, weapons systems for Naval forces, and superior human performance/training/care of Sailors and Marines.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

Key aspects of the program are the four ONR Grand Challenges which 'inspire and guide' the direction of research: Naval Battlespace Awareness, Electric Power Sources for the Navy and Marine Corps, Naval Materials by Design, and Multifunctional Electronics for Intelligent Naval Sensors; and the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental naval capabilities depend, and in which ONR is and likely will remain the principal US research sponsor. NNRs are ratified only after close scrutiny, and currently comprise Ocean Acoustics (started FY99), Underwater Weaponry (started FY02), and Naval Engineering (started in FY03).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Ocean/Space Sciences	140,615	141,150	142,119

Efforts include: Battlespace environments; environmental processes; environmental model development; environmental sensors and data; data assimilation and information exploitation; validation studies; space platforms; environmental biology/quality; cooperative ASW; wide area ASW surveillance; and battlegroup ASW defense.

FY 2003 Accomplishments:

- Initiated investigation of fate and effects of unexploded ordnance in the marine environment to reduce the threat to civilian population and military explosive ordnance disposal personnel.
- Initiated an integrative ecosystem study to develop environmental predictors of whale presence or absence to reduce impacts of Naval systems to marine mammals.
- Commenced development of major ionospheric interactions research capability at the High Frequency Active Auroral Research Program (HAARP) to identify or improve Command, Control, Communications, Intelligence (C3I) capabilities for Naval undersea warfare applications.
- Continued validation of environmental data and models used by S&T community to ensure reliability and realistic depiction of actual ocean and atmospheric conditions.
- Developed techniques for utilizing high resolution, motion imagery to predict beach evolution.
- Developed global on-scene, accurate, theater scale, high resolution environmental characterizations and forecasts to improve all weather operations and defense, capabilities of acoustic/electro-optical/Infrared(EO/IR) sensors, and the performance of Naval weapons in the atmosphere and under the sea.
- Developed improvements to specification and prediction of the space environment to improve space system performance and their on-call availability.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

• Developed new techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.
• Developed new methods for combining "through the sensor" data with other views of the battlespace environment to improve real-time environmental predictions.
• Developed understanding of physical and biological processes responsible for the formation, maintenance, and breakdown of thin oceanographic layers which have a significant impact on undersea warfare sensors and weapons.

FY 2004 Plans:
• Initiate field programs to understand physical and biological processes responsible for the formation, maintenance, and breakdown of thin oceanographic layers which have a significant impact on undersea warfare sensors and weapons.
• Continue enhancement of ionospheric interactive research capabilities at HAARP and begin program of S&T development leading to improved performance of Naval undersea applications.
• Develop programs to validate techniques for utilizing high resolution, motion imagery methods to predict beach evolution.
• Conduct opportunistic validation of global on-scene, accurate, theater scale, high resolution environmental characterizations and forecasts to improve all weather operations and defense, capabilities of acoustic/electro-optical(EO)/infrared (IR) sensors, and the performance of Naval weapons in the atmosphere and under the sea.
• Implement investigation of fate and effects of unexploded ordnance in the marine environment to reduce the threat to civilian population and military explosive ordnance disposal personnel.
• Assess improvements to specification and prediction of the space environment to improve space system performance and their on-call availability.
• Develop and initiate validation of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.
• Assess validation of environmental data and models used by S&T community to ensure reliability and realistic depiction of actual ocean and atmospheric conditions.
• Implement field trials of an integrative ecosystem study to provide environmental predictors of whale presence or absence to reduce impacts of Naval systems to marine mammals.
• Develop advanced methods for combining "through the sensor" data with other views of the battlespace environment to improve real-time environmental predictions.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

FY 2005 Plans:

• Initiate an assessment of the role of emerging sub-mesoscale parameterization techniques for improving next generation high resolution/high accuracy environmental models.
• Initiate design evaluation for a persistent mobile sampling network based on autonomous undersea vehicle platform and sensor technologies.
• Continue and assess field trials of an integrative ecosystem study to provide environmental predictors of whale presence or absence to reduce impacts of Naval systems to marine mammals.
• Analyze field programs to validate techniques for utilizing high resolution, motion imagery methods to predict beach evolution.
• Assess validation of global on-scene, accurate, theater scale, high resolution environmental characterizations and forecasts to improve all weather operations and defense, capabilities of acoustic/EO/IR sensors, and the performance of Naval weapons in the atmosphere and under the sea.
• Assess the fate and effects of unexploded ordnance in the marine environment to reduce the threat to civilian population and military explosive ordnance disposal personnel.
• Develop advanced improvements to specification and prediction of the space environment to improve space system performance and their on-call availability.
• Pursue additional validation of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.
• Assess validation of environmental data and models used by S&T community to ensure reliability and realistic depiction of actual ocean and atmospheric conditions.
• Implement field programs to understand physical and biological processes responsible for the formation, maintenance, and breakdown of thin oceanographic layers which have a significant impact on undersea warfare sensors and weapons.
• Implement advanced methods for combining "through the sensor" data with other views of the battlespace environment to improve real-time environmental predictions.
• Complete all enhancements to HAARP interactive research, providing full capability to address all anticipated applications for Naval undersea warfare operations.

	FY 2003	FY 2004	FY 2005
Electronics/Sensor Sciences	42,510	43,430	49,222

Efforts include: Sensing, diagnostics, and detectors; navigation and timekeeping; nano-electronics; wide band gap power devices; real-time targeting; EO/IR electronics; EO/IR electronic warfare; EO/IR sensors for surface/aerospace surveillance; Radio Frequency (RF) sensors for surface/aerospace surveillance; solid state electronics; vacuum electronics; advanced multi-function RF system (AMRFS); and RF electronic warfare.

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FY 2003 Accomplishments:

- Began effort to complete the HAARP Gakona Facility by completing the antenna array pad and foundations. Five research campaigns were conducted.
- Developed an approach to extract multiple unresolved target detections from a single range bin. Technique allows improvements in initiating and maintaining tracks on multiple targets in a single range bin of a radar.
- Applied field plate technology to GaN HEMTs (High Electron Mobility Transistors) with a resulting increase in power density to 30 Watts/mm and efficiencies of over 70%.
- Proved the theory of temporal-spatial circuit architecture for direct RF sampling, and demonstrated devices for a sub-100 micron sensor.
- Demonstrated production of a Bose-Einstein condensate of molecules.
- Achieved quantum cascade laser (QCL) emission at 6 microns producing 640 mW of continuous-wave power at room temperature, compared with previous record of 20 mW.
- Developed optical track of moving target algorithms and are integrating them into Unmanned Air Vehicles (UAVs) for convoy surveillance.
- Developed and demonstrated thin film diffractive lenses on a passive millimeter wave sensor.
- Proved and used the distributed polarization concept to demonstrate effective three-dimensional carrier gas channels for future power nitride semiconductor HEMTs.
- Developed several techniques to deposit high quality Magnesium Diboride (MgB2) superconducting films as first step in 3 terahertz (THz) digital device process.
- Commercialized nanoimprint lithography and adopted it in the International Technology Roadmap for Semiconductors (ITRS) 2003.
- Developed a miniature inexpensive highly sensitive fluxgate magnetometer.
- Completed research for low frequency RF markers and tags.

FY 2004 Plans:

- Incorporate non-equilibrium considerations into modeling of realistic superconducting tunnel junctions when barrier is near the metal/insulator transition.
- Demonstration of the crossover between the Bardeen-Cooper-Schrieffer and Bose-Einstein condensation phase transitions.
- Explore optical super resolution techniques with atmospheric turbulence reduction techniques.
- Research multiple target extraction techniques from single and adjacent range cells to handle unresolved targets. Integrate the extractor in the existing MD Benchmark for system performance evaluations.
- Assess impact of field plate technology on scaling of power density of HEMT output periphery, broad band matching and reliability.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

- Employ distributed polarization effect to enable linear higher power microwave bipolar transistors.
- Demonstrate temporal-spatial sampling circuits and architectures for digital-to-analog conversion.
- Demonstrate sub 100 micron cell sized sensor circuitry.
- Reduce emission wavelength of room temperature quantum cascade laser to 4.5-4.8 microns and further increase power to meet laser source requirements for infrared countermeasures against heat-seeking missiles.
- Continue advanced height finding and detection algorithms for high frequency radar.
- Continue project to complete HAARP facility. All antennas will be installed by end of 2004. Planned research campaigns during ongoing construction will investigate Extremely Low Frequency (ELF) modulation and efficiency improvements and magnetospheric propagation.
- Design and test coupled miniature fluxgate magnetometers to improve sensitivity.
- Demonstrate Vertical Magnetic Random Access memory (VMRAM).

FY 2005 Plans:
- Initiate non-cooperative target identification from multiple aspects.
- Investigate superresolution signal processing techniques for closely spaced and unresolved targets in Doppler, range and direction of arrival spaces for a variety of radars.
- Investigate ultra high speed logic and multiple-quantum-well devices with a goal of >500 GHz samplers, in support of analog-to-digital conversion.
- Demonstrate basis for improved time and frequency standards using quantum-entangled ions and atoms.
- Research superlattice detectors for future infrared detectors.
- Demonstrate Cellular Nonlinear Network (CNN) fast image processor with integrated multi-spectral focal plane array sensors.
- Improvement in the performance of the HAARP Facility will begin with the installation of transmitters.
- Continue research program with more advanced capability to generate and evaluate ELF techniques.
- Explore function of sensitive miniature fluxgate magnetometers.
- Demonstrate bipolar microwave circuit demonstration employing distributed polarization (graded composition) base growth and processing technology.
- Complete proof that superconductive A to D converters have uniquely positive performance critical to their use in wideband receivers.

	FY 2003	FY 2004	FY 2005
Advanced Naval Materials Sciences	72,456	66,940	65,832

Efforts include: Structural materials; functional materials; synthesis, processes, and characterization; prediction and simulation; and maintenance reduction technology.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

FY 2003 Accomplishments:

- Initiated work to develop the scientific basis for revolutionary approaches to discover advanced dielectrics for energy storage for eventual application in electric war ships.
- Developed understanding and procedures for growing controlled iron films with adlayer cappings of arsenic and gallium for spin injection structures and devices.
- Developed novel magnetic materials for ship board high power applications.
- Developed physics-based models to predict weld induced distortion in high strength, low alloy steels.
- Continued work to improve heat treatments and low alloy compositions for high strength low alloy steels with superior strength and toughness for enhanced shipboard blast protection, reduced weight, and reduced production cost.
- Explored three dimensional nature of solid phases in ferrous alloys for improved high strength steels.
- Designed, synthesized and developed advanced polymers including high temperature and flame resistant polymer composites and ceramics for aerospace and ship applications.
- Performed three dimensional microstructure analysis of high and low carbon steels to provide the scientific basis for fatigue and failure processes.
- Established the scientific basis for advanced materials with improved potential for blast resistance.
- Developed x-ray computed microtomography of composite materials using a synchrotron light source.
- Explored materials and structures capable of limiting optical transmission at variable wavelengths for enhanced eye and sensor protection against agile laser illumination.
- Explored dynamic behavior of high strength steels as a function of microstructure.
- Developed atomic-scale simulations of friction and wear in metallic sliding systems.
- Explored the use of a contact potential difference probe (Kelvin effect) as a sensor to determine the in situ spectrum in sliding metallic contact.

FY 2004 Plans:

- Begin to explore the processing and microstructures of novel titanium alloys that may be enabled by new co-reduction of mixed metallic oxide processes.
- Develop first principle methods to calculate second and third rank tensor properties of sonar materials such as lead zirconate titanate and lead magnesium niobate.
- Advance the understanding of deformation mechanisms in nanometer scale aluminum and steels to provide new high strength-high toughness alloys for naval platforms.
- Develop understanding and methodology to predict high deformation rate blast processes for engineered topological structures.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

• Identify stress corrosion control methods for friction stir welded high-strength aluminum alloys using advanced thermal treatments, chemical modifications, and surface mechanical processes to tailor compressive stresses.
• Link ab initio calculations of structure to mesoscale simulations of alloy behavior to provide the scientific basis for the design of advanced steels for naval ship applications.
• Develop and validate physics-based models of thermal and materials flow during friction stir welding of steels, including the development of residual stresses that will lead to distortion.
• Identify, quantify, and control the atomic scale properties that limit or enhance the performance of magnetic semiconductor materials.
• Develop integrated bio-magneto-electronic structures and devices for experimental evaluation.
• Develop the science of sliding contact and lubrication using physical and chemical first principles.
• Develop first-principles based methodologies for predicting the thermodynamics and kinetics controlling microstructural evolution for the design of advanced naval steels.
• Design, synthesize and develop welding consumables and process methodologies for joining superaustenitic stainless steels.
• Develop theoretical basis for composite materials behavior based on x-ray computed micro-tomography.
• Continue to develop understanding and constitutive models of dynamic behavior of naval steels.

FY 2005 Plans:
• Explore superplasticity in advanced high strain nanometer scale ceramic composites to provide the basis for the development of such materials in naval applications.
• Develop materials and fabrication science for fugitive phase processes for engineered topological structures for ship blast protection.
• Identify hydrogen embrittlement resistant high strength alloys based on nickel-cobalt-chrome-molybdenum material systems.
• Begin first lubrication-by-design experiments.
• Begin to explore the design of advanced steels for weldability based on previous first-principles efforts.
• Explore solid-state joining and localized microstructural modification of weldments in titanium alloys for improved toughness and fatigue resistance.
• Explore advanced coatings with multifunctional corrosion/fouling properties.
• Explore advanced theoretical concepts for corrosion control.
• Extend first principle calculations of sonar materials tensor piezoelectric and dielectric properties to complex solid solutions to provide the basic understanding and predictive capability for ultra high strain materials.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

• Continue to link ab initio calculations of structure to mesoscale simulations of alloy behavior for the design of advanced steels.
• Continue the theoretical development of composite materials behavior based on x-ray computed micro-tomography.
• Continue to explore advanced integrated bio-magneto-electronic materials, structures and devices.
• Continue development of first-principles based methodologies for predicting and controlling microstructural evolution for the design of naval steels.
• Continue exploration of processing and microstructure development of novel titanium alloys.
• Continue development of physics-based models of thermal and materials flow during friction stir welding, including the development of residual stresses that will lead to distortion.
• Continue to develop understanding and constitutive models of dynamic behavior of naval steels.
• Continue to explore and develop materials for high energy density passive power electronics.

	FY 2003	FY 2004	FY 2005
Naval Platform Design Sciences	17,776	17,023	20,677

Efforts include: Surface/subsurface reduced signatures; free-surface, subsurface and propulsor hydromechanics; hull life assurance; advanced ship concepts; distributed intelligence for automated survivability; advanced electrical power systems; air vehicles; air platforms propulsion and power; air platforms survivability and signature control; special aviation projects; UAV/UCAV; environmental quality; and logistics.

FY 2003 Accomplishments:
• Developed reliable sea-keeping prediction methods for advanced surface ship hull forms in heavy seas.
• Developed an integrated acoustics model for complex propulsors.
• Developed infrared ship predictions for low observable ships that include bi-directional reflectance distribution functions.
• Conducted quantitative measurements of bubble concentrations at-sea around a ship to develop prediction methods.
• Examined simulations of far wakes in a stratified medium evolution of vertical vortices.
• Measured and analyzed high levels of turbulence interacting with blade flow for noise generation.
• Developed a method to infer, for the first time, fluctuating pressure in turbulent flow from Three Dimensional (3-D) Particle Image Velocimetry (PIV) measurements.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

• Validated Six Degrees-Of-Freedom (6DOF) Reynolds Average Navier-Stokes (RANS) predictions of surface ship forced roll response.
• Developed a Large-Eddy Simulation (LES) prediction method for unsteady propulsor flow.
• Developed physics-based analysis tools and models for non-linear circuits and loads and highly coupled ship board power systems.
• Developed robust turbulence models in three dimension boundary layers to improve submarine maneuvering predictions.
• Developed next-generation infrared scene model to enable optimal infrared reflectance ship surfaces.
• Improved and extended durability of foul-control marine coatings to reduce energy use and adverse environmental impacts, and to extend the time between physical removal of hull and marine structure foulants.
• Investigated the fate and effects of chemical and biological contaminants in marine/estuarine environments.
• Continued work on understanding, predicting, and controlling scattering from discontinuities such as antennas and ship-sea surface radar cross section interactions.
• Incorporated nonlinear incident wave representations in a ship motions prediction method.
• Conducted micro-bubble drag reduction experiments on a large plate.
• Constructed and tested a new instrument for spatial measurement of surface waves around models.
• Developed a hydrodynamic test facility on a small boat platform to enable in situ performance of foul-release coatings.

FY 2004 Plans:
• Initiate efforts to design and test stability and control mechanisms for power distribution in nonlinear circuits.
• Initiate scientific approaches to alternate heat transfer and cooling methodologies.
• Initiate assessment of the fate and effects of chemical and biological contaminants in marine/estuarine environments.
• Conduct studies of thermoelectric material requirements for shipboard cooling applications.
• Evaluate electromagnetic signature basic physics including scattering from multi-scaled dielectric materials and evaluation of visual rendering studies into high fidelity infrared modeling.
• Identify and rank bubble sources around surface ships.
• Evaluate a breaking wave prediction method.
• Quantify a 3-D turbomachinery flow using stereo PIV.
• Conduct first measurements of effects of full scale level turbulence on appendage fluctuating surface pressures.
• Conduct detailed measurements of total wave field and resulting ship motions using new instrumentation.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

• Further develop computational mechanics to provide predictive capabilities of acoustics, linear and nonlinear dynamic response and failure mechanisms of structures.
• Develop reliability methodology for hull structures and hybrid joints.
• Develop physics based understanding of composite materials to characterize thermo-mechanical behavior, response to multi-axial loads and improve mechanical properties.
• Develop methods to reduce acoustic modeling requirements and techniques for physical modeling at small scale to better characterize signature phenomenology and control and structure amplified flow noise.
• Develop expanded scaleable simulation capabilities for virtual distributed control.
• Explore and evaluate control system algorithms and strategies in a virtual environment including affordability issues.
• Establish limits for energy-time transients as a function of power system impedance parameters.
• Determine durability of foul-control marine coatings to reduce energy use and adverse environmental impacts and to extend the time between physical removal of hull and marine structure foulants.
• Continue efforts to understand and control the generation and propagation of far-field jet noise.
• Continue examination of scientific methods for pollution prevention, waste reduction and hazardous material reduction for Naval Operations.
• Continue development of reliable sea-keeping prediction methods for advanced surface ship hull forms in heavy seas.
• Continue development of LES method for unsteady propulsor flow predictions.
• Develop high thermal conductivity polymer nanocomposites.
• Construct and test run a thermoacoustic piezoelectric generator.
• Complete work on quantification of active combustion control.

FY 2005 Plans:
• Initiate development of advanced magnetocaloric materials for magnetic refrigeration.
• Initiate effort on pierside robotic hull fouling control / surveillance technologies.
• Evaluate electromagnetic signature basic physics to further understand low observable and infrared technology performance against evolving threats.
• Quantify and model bubble sources around surface ships for prediction methods.
• Validate a breaking wave prediction method against experimental data.
• Examine turbomachinery flow using holographic PIV.
• Validate 6DOF RANS predictions of surface ship motion.
• Validate LES predictions of turbomachinery flow against experimental data.
• Further examine computational mechanics in order to address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis and error control.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
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- Integrate distributed heterogeneous control simulation capability into the overall control system simulation infrastructure.
- Test and evaluate control system algorithms and strategies in a virtual environment including affordability issues.
- Further evaluate stability and control of model electrical power systems.
- Assess durability of foul-control marine coatings to reduce energy use and adverse environmental impacts and to extend the time between physical removal of hull and marine structure foulants.
- Initiate the Research Tools Development Consortia Program under the Program Decision Memorandum (PDM) for University Research - Engineering Design Consortia.
- Continue development of reliable sea-keeping prediction methods for advanced surface ship hull forms in heavy seas.
- Continue scientific approaches to alternate heat transfer and cooling methodologies.
- Continue assessment of the fate and effects of chemical and biological contaminants in marine/estuarine environments.
- Continue efforts to understand and control the generation and propagation of far-field jet noise.
- Continue examination of scientific methods for pollution prevention, waste reduction and hazardous material reduction for Naval Operations.
- Continue development of computational mechanics to provide predictive capabilities of acoustics, linear and nonlinear dynamic response and failure mechanisms of structures.
- Continue to develop methods to reduce acoustic modeling requirements and techniques for physical modeling at small scale to better characterize signature phenomenology and control and structure amplified flow noise.
- Continue development of reliability methodology for hull structures and hybrid joints.
- Continue development of physics based understanding of composite materials to characterize thermo-mechanical behavior, response to multi-axial loads and improve mechanical properties.
- Determine most promising foul-release approaches based on silicones to meet Navy durability requirements for further development and testing.
- Perform 1/2 and full-scale engine testing of most promising on-board noise reduction technologies (e.g.air/water injection).

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	FY 2003	FY 2004	FY 2005
Information Sciences	55,003	47,926	46,322

Efforts include: Computational theory and tools for design, communication, and control of intelligent autonomous systems; decision theory, algorithms, and tools; heterogeneous information integration, management, and presentation; information assurance, secure and reliable information infrastructure for Command and Control; mathematical optimization for optimal resource allocation and usage; modeling and computation of complex physical phenomena; modeling and computation for electromagnetic and acoustic wave propagation and scattering; seamless, robust connectivity and networking; and expeditionary operations Command, Control, Communications, Computers Intelligence Surveillance and Reconnaissance(C4ISR).

FY 2003 Accomplishments:
• Initiated development of mathematical optimization framework and heuristic algorithms to be used as basis for network design, optimal sensor allocation, and logistics.
• Initiated development of mathematical theory and computational algorithms that take advantage of multi-pathing effects for improved sensing.
• Continued refinement of techniques for ensuring privacy of information transferred across public networks.
• Continued development of turbo-codes and iterative processing techniques to enable high data rates for wireless communication applications.
• Continued to refine techniques for extracting maximum knowledge from multi-modal imagery, text, and electromagnetic and acoustic signal data.
• Continued to investigate methods to deal with light dispersion on image formation underwater to enable precise navigation, station keeping, and mapping capabilities for unmanned underwater vehicles.
• Continued development of improved tactical and battlespace decision aids through creation of synthetic natural environments.
• Developed theory and algorithms for autonomous systems to recognize a particular scene from different perspectives.
• Solved one of the most-famous and long-standing conjectures in discrete mathematics, known as the Strong Perfect Graph Conjecture, whereby providing a mathematical basis for development of new techniques for design of more efficient communications networks.
• Developed basis for collaborative mission planning tools to facilitate knowledge sharing and management, regulation of information flow, and work-process monitoring.
• Developed adaptive routing protocols to select the links for routing information packets that maximize communication network throughput with minimum energy consumption.

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FY 2004 Plans:

- Initiate efforts on modeling chaotic phenomena in network operations.
- Initiate efforts for integrating domain knowledge into learning methods.
- Initiate efforts for semantic-based information gathering.
- Initiate efforts in extended augmented/virtual reality with haptics, sound, and olfactory components.
- Continue development of mathematical optimization framework and heuristic algorithms that serve as theoretical and computational basis for network design, optimal sensor allocation, and logistics.
- Continue refinement of techniques for ensuring privacy of information transferred across public networks.
- Continue development of improved tactical and battlespace decision aids through creation of synthetic natural environments.
- Continue to refine techniques for extracting maximum knowledge from multi-modal imagery, text, and electromagnetic signal data.
- Continue to investigate methods to deal with light dispersion on image formation underwater to enable precise navigation, station keeping, and mapping capabilities for unmanned underwater vehicles.
- Continue efforts for enabling teams of autonomous systems to work together and work on representations for evolution of cooperative behaviors, including efforts in multi-modal interactions with autonomous systems.
- Continue developing framework for dealing with effect of variable latencies in communication within teams of humans and autonomous systems.
- Continue efforts on development of mathematical foundations for image enhancement, feature extraction, feature-based/texture-based compression, denoising, and segmentation; data representation and metrics, content-based indexing and retrieval; reconstruction, interpolation, and registration; and scene analysis and image understanding.
- Continue efforts on quantum computing and cryptography.
- Continue efforts on general automated theorem prover technologies and biometric technologies for authentication.
- Continue efforts in multi-modal dialog.
- Continue efforts in physics-based modeling of natural phenomena.
- Continue efforts in mathematical techniques for inverse problems, including reliable approximate solutions in 3D; adequate representation of the physics of the media and the scatterer; and improved resolution of structural and material properties.
- Refine theory and algorithms for autonomous systems to recognize a particular scene from different perspectives.
- Refine turbo-codes and iterative processing techniques to enable high data rates for wireless communication applications.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
PROJECT TITLE: Defense Research Sciences

• Develop a framework for collaborative mission planning tools to facilitate knowledge sharing and management, regulation of information flow, and work-process monitoring.
• Develop adaptive routing protocols to select the links for routing information packets that maximize communication network throughput with minimum energy consumption.

FY 2005 Plans:
• Develop computational framework for integrating information of disparate sources - Program Decision Memorandum (PDM) for University Research - Surveillance & Knowledge Systems.
• Develop a systematic approach that will serve as a theoretical and computation basis for automated image understanding and automatic object recognition.
• Continue development of mathematical optimization framework and heuristic algorithms that serve as theoretical and computational basis for network design, optimal sensor allocation, and logistics.
• Continue to refine techniques for extracting maximal knowledge from multi-modal imagery, text, and electromagnetic signal data.
• Continue efforts for enabling teams of autonomous systems to work together, on representations for evolution of cooperative behaviors and in multi-modal interactions with autonomous systems.
• Continue developing framework for dealing with effect of variable latencies in communication within teams of humans and autonomous systems.
• Continue efforts on development of mathematical foundations for image enhancement, feature extraction, feature-based/texture-based compression, denoising, and segmentation; data representation and metrics, content-based indexing and retrieval; reconstruction, interpolation, and registration; and scene analysis and image understanding.
• Continue efforts on quantum computing and cryptography and on biometric technologies for authentication.
• Continue efforts on general automated theorem proven technologies.
• Continue efforts on modeling chaotic phenomena in network operations.
• Continue efforts for multi-modal dialog.
• Continue efforts for integrating domain knowledge into learning methods.
• Continue efforts for semantic-based information gathering.
• Continue efforts for in physics-based modeling of natural phenomena.
• Continue efforts in extended augmented/virtual reality with haptics, sound, and olfactory components.
• Continue efforts in automatic inference of context from images/video.
• Continue efforts in mathematical techniques for inverse problems, including reliable approximate solutions in 3D; adequate representation of the physics of the media and the scatterer; and improved resolution of structural and material properties.

BA: 01 PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: Defense Research Sciences
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• Complete refinement of techniques for ensuring privacy of information transferred across public networks.
• Complete collaborative mission planning tools to facilitate knowledge sharing and management, regulation of information flow, and work-process monitoring.
• Complete development of improved tactical and battlespace decision aids through creation of synthetic natural environments.
• Complete methods to deal with light dispersion on image formation underwater to enable precise navigation, station keeping, and mapping capabilities for unmanned underwater vehicles.

	FY 2003	FY 2004	FY 2005
Human Performance and Medical Sciences	22,019	23,240	25,198

Efforts include: human factors and organizational design; manpower, personnel, and training; integrated avionics, displays, and advanced cockpit; pattern recognition; biosensors, biomaterials, bioprocesses; marine mammals; casualty care and management; fit and healthy force; casualty prevention; biorobotics; expeditionary operations training and education; and chemical-biological defense.

FY 2003 Accomplishments:
• Initiated the development of new theoretical treatment of the differences in individual humans.
• Initiated studies on microbial degradation of energetic compounds in marine sediments.
• Initiated research effort on the physiological effects of exposure to non-lethal stimuli for a better understanding of human vulnerabilities and enhanced protection.
• Continued research on human cognition and performance to create more realistic simulations and to improve decision algorithms.
• Continued research into the efficacy of a group of compounds that mimic or assist endogenous defenses to hearing damage to sailors and marines.
• Continued work on stress physiology, hyperbaric physiology, and biological effects of Naval operational exposures (e.g., directed energy).
• Continued work on genomics, genetic immunization, stem cells, and signal transduction.
• Completed specification of computational linguistic techniques to emulate one-to-one tutoring behavior.
• Completed proofs-of-concept of microbial synthesis of energetics, micro-biofuel cell, and modular, reagentless, and fast biosensors.
• Completed robust algorithms for threat and situation assessment decision aids, automatic target recognition in cluttered environments, and detection and classification of buried mines.

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FY 2004 Plans:
• Initiate program to combine cognitive architectures with computational neuroscience to better predict human performance.
• Initiate efforts to develop next-generation, supramolecular antibiotics.
• Initiate work to recharge UUV sensor packages with sediment fuel cell.
• Initiate development of novel multidisciplinary approaches to human-activity inference from video imagery to enable force protection and counterterrorism.
• Continue development of novel genetic sequencing tools for marine algae and seaweeds.
• Continue work on stress physiology, hyperbaric physiology, and biological effects of Naval operational exposures (e.g., directed energy).
• Continue work on genomics, genetic immunization, stem cells, and signal transduction.
• Continue non-lethal bioeffects research.

FY 2005 Plans:
• Initiate study of methods to allow active vision for mobile robotics.
• Initiate study of social networks for counterterrorism.
• Continue development of novel multidisciplinary approaches to human-activity inference from video imagery to enable force protection and counterterrorism.
• Continue program to combine cognitive architectures with computational neuroscience to better predict human performance.
• Continue efforts to develop next-generation, supramolecular antibiotics.
• Continue work on stress physiology, hyperbaric physiology, and biological effects of Naval operational exposures (e.g., directed energy).
• Continue work on genomics, genetic immunization, stem cells, and signal transduction.
• Continue non-lethal bioeffects research.
• Continue work to recharge UUV sensor packages with sediment fuel cell.

	FY 2003	FY 2004	FY 2005
Weapon and Energy Sciences	30,258	24,677	26,442

Efforts include: Undersea Weaponry including undersea energetics, undersea guidance and control, and supercavitation physics; expeditionary operations firepower and maneuver; ground mine countermeasures; energetic materials; advanced energetics; propulsion; electrochemical power sources; and novel power sources and energy transfer.

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FY 2003 Accomplishments:

- Identified new approaches to efficiently transfer thermal, electrical and optical energy from primary sources.
- Initiated research in materials and processes for novel concepts in efficient energy conversion.
- Conducted preliminary studies on multivalent ion insertion in nanoscale vanadium pentoxide cathode materials to improve the capacity of rechargeable lithium batteries.
- Analyzed synchronization of 19 diode lasers to produce intense beams.
- Designed a thermoacoustic piezoelectric generator working via a temperature gradient.
- Expanded fundamental understanding of direct electrochemical oxidation in solid oxide fuel cells and the use of logistic fuels.
- Developed improved and new sensor technology that will include (but not be limited to) low-volume and high-directivity acoustic arrays, laser-based passive acoustic arrays, magnetometers for target classification and signal processing algorithms for counter-countermeasure.
- Expanded the University Laboratory Initiative program to provide a further infusion of educated and career minded scientists and engineers in support of the NNR for undersea weapons research.
- Synthesized and characterized new energetic materials with higher energy density and acceptable sensitivity.
- Continued conducting basic research related to critical S&T (including vehicle control, maneuverability, and stability) associated with the development of high-speed supercavitating vehicles (HSSV).
- Demonstrated active and passive combustion control of supersonic and subsonic flows to reduce combustion instability and pressure oscillations and to improve performance, while reducing emissions.
- Performed research to develop pulse detonation engine (PDE) technology for operation on logistics fuels.
- Expanded research into new materials and processes for converting thermal to electric energy.
- Continued work on developing the scientific basis of nanostructure enhancement of direct energy conversion materials performance for power generation.
- Continued development of nanostructured electrode and polymer electrolyte materials for electrochemical power sources.
- Continued improvements to catalyzed carbon microfiber electrode development for semi-fuel cells.
- Continued to develop fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.
- Continued to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications.
- Continued to develop spectroscopic capabilities to accurately determine aluminum combustion characteristics in various oxidizing environments.

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• Continued to develop synthesis routes to difluoramino-based and organometallic-based highly energetic ingredients.
• Developed materials for enabling rechargeable batteries with an energy density approaching 500 watt-hours per kilogram.
• Created metamodel-Kriging models for performance measurement of potential HSSV designs.
• Demonstrated cyclic pulse detonation engine (PDE) operation with JP-10 fuel.
• Performed numerical simulations of multi-tube multi-cycle PDE operation with nozzles.
• Identified record high figure of merit bulk thermoelectric material for power generation.
• Completed Visual/Optical approach to determine supercavitating projectile dynamics with its cavity.
• Demonstrated that seismic Rayleigh waves can be used to generate detectable resonances in anti-personnel landmines buried in a wide range of soil types.
• Developed 6DOF simulation environment of HSSV motion and trajectories.

FY 2004 Plans:
• Begin to explore the union of explosion/detonation theory with electron transfer theory.
• Design and explore new processes for ceramic, organic and hybrid dielectric materials for energy storage for electric warship needs.
• Develop interaction between the basic research in the direct oxidation and reforming of logistics fuels and the related tri-service programs to improve transition pathways for relevant breakthroughs.
• Investigate novel initiation techniques, optimize injection parameters, and demonstrate integrated single tube operation for Pulse Detonation Engine (PDE).
• Enhance activities in nano-science based approaches to novel power sources.
• Enhance research on energy transfer science and research into materials and processes for energy efficiency.eeee
• Synchronize coupled diode laser arrays.
• Continue investigations toward modeling and exploiting the nonlinear seismic interactions between buried land mines and their surrounding soil for purposes of landmine detection.
• Continue development of nanostructured electrode and polymer electrolyte materials for electrochemical power sources.
• Continue research in man-portable electrical energy storage and conversion.
• Continue conducting basic research related to critical Science and Technology (including vehicle control, maneuverability, and stability) associated with the development of HSSVs.
• Continue developing improved and new sensor technology that will include (but not be limited to) low-volume and high-directivity acoustic arrays, laser-based passive acoustic arrays and signal processing algorithms for counter-countermeasure.

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- Continue the University Laboratory Initiative program.
- Continue research into alternative binder materials for explosives and propellants which are compatible with higher energy ingredients.
- Continue to develop fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.
- Continue to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications.
- Continue to develop spectroscopic capabilities to accurately determine aluminum combustion characteristics in various oxidizing environments.
- Continue to develop synthesis routes to difluoramino-based and organometallic-based highly energetic ingredients.
- Continue computer code refinements and investigation of supercavitating vehicle dynamics and instability.
- Continue work in science related to direct energy conversion.
- Continue work in science related to new materials and processes (including nanostructures) for converting thermal to electric energy for shipboard power generation and waste energy conversion.
- Construct and test run a thermoacoustic piezoelectric generator.
- Complete work on quantification of active combustion control.

FY 2005 Plans:
- Initiate research using Program Decision Memorandum (PDM) II funding into fundamental understanding of initiation/energy release processes of reactive and other energetic materials as part of the Advanced Energetics program.
- Implement new & nanostructured materials design concepts for direct energy conversion and waste energy conversion.
- Investigate multi-tube multi-nozzle Pulse Detonation Engines (PDEs) and multi-tube common nozzle PDEs.
- Identify, synthesize and evaluate novel metal and non-metal based ingredients for reactive and other energetic material applications and characterize their energy release contributions.
- Continue exploring novel materials and approaches toward high energy storage dielectrics.
- Continue investigations toward modeling and exploiting the nonlinear seismic interactions between buried land mines and their surrounding soil for purposes of landmine detection.
- Continue development of nanostructured electrode and polymer electrolyte materials for electrochemical power sources.
- Continue research in man-portable electrical energy storage and conversion.

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- Continue developing improved and new sensor technology that will include (but not be limited to) low-volume and high-directivity acoustic arrays, laser-based passive acoustic arrays and signal processing algorithms for counter-countermeasure.
- Continue the University Laboratory Initiative program.
- Continue to develop fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.
- Continue to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications.
- Continue to develop spectroscopic capabilities to accurately determine aluminum combustion characteristics in various oxidizing environments.
- Continue to develop synthesis routes to organometallic-based highly energetic ingredients.
- Continue research into alternative binder materials for explosives and propellants which are compatible with higher energy ingredients.
- Continue conducting basic research related to critical Science and Technology (including vehicle control, maneuverability, and stability) associated with the development of HSSVs.
- Continue efforts in novel power source development.

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CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ACADEMY FOR CLOSING AND AVOIDING ACHIEVEMENT GAPS	0	989

Basic research to examine methods of determining college student's strengths and weaknesses in sciences and tailor a program to improve in these gaps.

FY 2004 Plans
• Initiate a program for: (1) systemic mentoring, including research participation, of 50-100 undergraduate college Science, Technology, Engineering and Mathematics students known as scholars, (2) extensive educational enrichment services for 150-200 K-12th grade students during summer, and (3) the conduct of research, publishing, and delivering presentations and workshops for the community at large.

	FY 2003	FY 2004
CENTER FOR PHOTOCHEMICAL SCIENCES	0	495

Basic research associated with development and use of a photopolymerization process for rapid curing of novel anti-corrosive bilge coatings, nonskid deck coatings, and/or low solvent hull AF coatings.

FY 2004 Plans
• Initiate support of the Center for Photochemical Sciences.

	FY 2003	FY 2004
CONSORTIUM FOR MILITARY PERSONNEL RESEARCH	1,332	0

Manpower is the critical resource to the Naval service. Retention, accession, selection, classification, distribution, assignment, personnel policy and training management are all vital to successfully manning it.

FY 2003 Accomplishments
• Completed efforts in military personnel research that advanced the Navy’s ongoing efforts in the areas of retention, accession, selection, classification, distribution, assignment, personnel policy and training management.

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	FY 2003	FY 2004
INTEGRATED WMD DETECTION AND COLLECTION SYSTEM	0	2,076

Basic research in the area of micro sensors for unmanned air vehicle (UAV) reconnaissance systems.

FY 2004 Plans
• Initiate development of sensors tailored to collect evidence of weapons of mass destruction sized to fit on small UAVs.

	FY 2003	FY 2004
NANOSCALE ARCHITECTURES FROM PROTEIN NANOCAGES	0	1,978

Basic research in three areas: 1) biomedical nanoparticles for drug delivery and imaging; 2) magnetic nanoparticles; and 3) catalytic nanoparticles.

FY 2004 Plans
• Establish a center for bioinspired nanomaterials.

	FY 2003	FY 2004
NAVAL BASIC RESEARCH	4,986	0

The solar radiation spectrum affects militarily critical areas such as communications, navigation, surveillance and guidance systems. Expanded knowledge and understanding of this spectrum will dramatically improve the fidelity of models of the Earth’s upper atmosphere, thus greatly enhancing our ability to mitigate the effects of radiation-induced space weather. Detection of toxic substances is also of critical importance because of the military’s need to operate in potentially harmful chemical and biological dangerous environments during wartime.

FY 2003 Accomplishments
• Investigated the solar spectrum and its effects on military systems.
• Conducted modeling of cell-based biosensor arrays in an effort to assist in the rapid detection and identification of potentially toxic substances.

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	FY 2003	FY 2004
NEUTRON DETECTOR	0	989

Neutron detectors are used to monitor nuclear weapons, detect fissionable materials, and assess radiation exposure of personnel in real time. Existing devices are very large, expensive, easily damaged, inefficient, and require large amounts of power. Novel neutron detection devices based on boron carbide semiconductors are small, lightweight, able to withstand high temperatures and corrosion, and can be powered by small batteries or solar cells. Thus they can be used in handheld systems, or in applications where such monitoring must be stealthy.

FY 2004 Plans
• Research and testing to improve detector efficiencies and increase the range of the neutrons detected, and to improve reliability.

	FY 2003	FY 2004
QUANTUM OPTICS RESEARCH	4,672	2,472

Basic research into quantum optics shows promise in the development of novel device configurations for infra-red sources and detectors that have high applicability to Naval sensors and weapons.

FY 2003 Accomplishments
• Initiated work in infrared semiconductor lasers based on coherent wave mixing, infrared imaging up-conversion and resonant four-wave mixing, ultra-sensitive spectroscopy, spontaneous emission manipulation, quantum computation and information processing, and quantum thermodynamics.
• Continued designing experimental versions of these devices built based on theoretical advances in areas having to do with quantum interference processes such as lasing without inversion.

FY 2004 Plans.
• Continue work in infrared semiconductor lasers.

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	FY 2003	FY 2004
ROBOTIC COUNTERMINE TECHNOLOGIES	1,429	1,978

Mine countermeasures in shallow water and particularly, the surf zones are extremely challenging. Use of robots designed with aquatic characteristics and features have been shown to be particularly promising in this task based on earlier ONR and DARPA research.

FY 2003 Accomplishments
• Designed an undersea robotic platform based on biologically derived engineering concepts.

FY 2004 Plans
• Enhance efficient operation, power supply, and autonomous control procedures.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0601152N In-House Laboratory Independent Research

NON-NAVY RELATED RDT&E:
PE 0601102A Defense Research Sciences (Army)
PE 0601102F Defense Research Sciences (Air Force)

D. ACQUISITION STRATEGY:
Not Applicable.

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

BA: 02 PROGRAM ELEMENT: 0602114N
PROGRAM ELEMENT TITLE: Power Projection 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
Power Projection Applied Research	110,232	142,626	98,831	89,335	81,799	63,367	64,558

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) addresses the technology issues involving the Navy's capability to project Naval power on the broad seas and in the littoral regions. In particular, the technology developed in this PE will support Navy power projection requirements related to fleet defense and protection of Naval assets in the littoral area, Naval strike operations against critical shore targets, and support for Naval expeditionary forces ashore. This PE supports the Time Critical Strike (TCS) Future Naval Capability (FNC) and the Autonomous Operations (AO) FNC. Within the Naval Transformation Roadmap, this investment will achieve two of four key transformational capabilities required by Sea Strike as well as technically enable the Littoral Sea Control key transformational capability within Sea Shield.

NOTE: This PE previously divided the program into 3 primary mission areas: Fleet Defense & Air Dominance, Naval Precision Strike, and Support for Naval Expeditionary Forces Ashore. Many of the technologies developed in this PE applied to more than one and in some cases all 3 mission areas. For example unmanned vehicle technologies are applicable to all 3 areas. Therefore, in order to provide a clearer picture and a more logical description of the program, it was decided to restructure the PE into the following technology areas: Strategic Sustainment, High Speed Propulsion and Advanced Weapon Technologies, Unmanned Vehicles, Navigation EO/IR and Sensor Technologies, Electric Weapons, and Strike Technologies. To enable to reader to track individual projects, each of the new sections contain a mapping of where the individual efforts were located in the previous submission.

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

BA: 02 PROGRAM ELEMENT: 0602114N
PROGRAM ELEMENT TITLE: Power Projection Applied Research

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	105,324	114,144	107,260
Cong. Rescissions/Adjustments/Undist.Reductions	0	-1,614	0
Congressional Actions	0	30,100	0
Execution Adjustments	4,820	0	0
Inflation Savings	812	0	-352
Joint Non-Lethal Weapons Program	0	0	2,000
Rate Adjustments	0	-4	-77
SBIR Assessment	-724	0	0
Technical Adjustments	0	0	-10,000
FY 2005 President's Budget Submission	110,232	142,626	98,831

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

BA: 02 PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: Power Projection Applied Research

PROJECT TITLE: Power Projection 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
Power Projection Applied Research	110,232	142,626	98,831	89,335	81,799	63,367	64,558

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses the technology issues involving the Navy's capability to project naval power on the broad seas and in the littoral regions.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Strategic Sustainment	9,988	23,149	31,160

The Strategic Sustainment activity develops technologies which will sustain and improve Navy's strategic system capabilities in the areas of Radiation Hardened System Design (RAD HARD), Solid Rocket Motor Ignition (SRM) Response, and drag reduction devices. This activity contains the Technology for the Sustainment of Strategic Systems (TSSS) and the Strategic Systems Infrastructure (SSI) effort. Funding increases beginning in 2004 are due to the addition of the tasks for the SSI effort.

In the prior R2 submission for this Program Element (PE), the tasks in this new activity were contained in the Naval Precision Strike Operations activity.

FY 2003 Accomplishments:

- TSSS program: Upgraded and linked RAD HARD codes and evaluated the software. The SRM effort performed code validation with legacy models and preliminary verification on new models. Developed a first order Computational Fluid Dynamics (CFD) model in drag reduction.

FY 2004 Plans:

- TSSS: RAD HARD task will continue efforts in upgrading and linking software. The SRM ignition response

effort will perform advanced nonlinear model comparisons with ground test data. Drag Reduction Devices will develop an advanced aerospike drag reduction model. The accelerometer effort will fabricate a Proof of Concept Superconducting and Atom Interferometer and Gravity Gradient Sensor.
- SSI: Initiate formulation of high performance propellants, development of the preliminary design and parametric testing for a Post Boost Control System (PBCS). Perform preliminary design of an Exploding Bridgewire (EBW) detonator and conduct evaluation of test data of the effects of the external environment on missile electronics. Begin transition of ONR's advanced transducer design and develop a new hydrophone array.

FY 2005 Plans:

- TSSS: RAD HARD System Design Tool task completes. The SRM ignition response effort completes code validation and verification with flight test data. The Drag Reduction Devices task completes the development of an aero elasticity tool for performance prediction of missiles with drag reduction devices. Gravity Gradient Sensors and a new technology accelerometer for the Fiber Optic Gyro Navigator (FOGN) unit will be tested.
- SSI: Missile propulsion effort continues with subscale static motor tests. PBCS will develop thermal/mechanical valve and flow impingement models. Ordnance Initiation technology effort will conduct design reviews and purchase prototype systems for evaluation. Missile electronics will continue the model development. Navigation Sonar will initiate development of a common electronics architecture to accommodate affordable hardware.

	FY 2003	FY 2004	FY 2005
High Speed Propulsion and Advanced Weapon Technologies	31,919	16,884	30,034

The work in this activity supports technologies that support high speed weapons delivery and advanced weapons development. High speed weapons (Mach 3 to Mach 6+) will provide the Navy the capability to attack time critical targets by delivering a weapon over long distances in very short periods of time.

Funding drop from FY03 to FY04 was due to the end of one year programs that were not funded in FY04. The increase from FY04 to FY05 was due to increased funding for the National Aerospace Initiative (NAI) hypersonics effort (+12M) and additional funding in HyFly in FY05 (+4M).

In the prior R2 submission for this PE, the following tasks were previously described in the Fleet Defense & Air Dominance activity: Asymmetric Threat Defense weapons, Advanced Reactive Materials, and the Integrated High Performance Rocket Propulsion Technology (IHPRPT). These tasks were in Naval Precision Strike Operations activity: HyFly, Ordnance for High Speed Penetration, Precise Tactical Targeting (PTT), Weapons Supersonic

Airframe Control, Advanced Reactive Weapons for Hard and Deeply Buried Targets (HDBT), Configurable Automatic Target Recognition (ATR), Microelectromechanical System (MEMS) antenna, Intelligence Surveillance and Reconnaissance (ISR) targeting, and the High Supersonic Turbine Vehicle (HSVT) Technology Base. The High Energy Density Materials (HEDM) task was in the Support for Naval Expeditionary Forces Ashore activity.

FY 2003 Accomplishments:

- Advanced Reactive Material: A one year program that completed development of advanced reactive material compositions for warhead fragments that combine both kinetic and chemical energy.
- Ordnance Systems for High Speed Penetration: A one year program that developed advanced fuze, warhead and structural components for strike weapons that are used to attack high value, deeply buried targets.
- Advanced Reactive Weapons for Hard and Deeply Buried Targets (HDBT): A one year program that developed and examined alternate methods of production for advanced energetic materials that provide high levels of exothermic energy.
- Weapons Program Supersonic Airframe Control: Completed with a ground test to demonstrate an integrated control concept extendable into the hypersonic speed regime.
- PTT: Completed with ground and aircraft testing.
- HEDM: Completed with performance evaluation of HEDM candidates; continued fabrication and testing of HEDM structural composites.
- HyFly National Aerospace Initiative (HyFly NAI): Continued development of a lightweight Dual Combustion Ramjet (DCR) concept Mach 5+ vehicle and demonstrated full-scale combustion control.
- IHPRPT: Continued with full scale testing of an aluminized boost propellant and investigation of propellant ingredient and formulations.
- Asymmetric Threat Defense: Initiated concept definition and preliminary design of the weapons control, launcher, ordnance, and guidance/seeker components of the weapons system required to counter the asymmetric (swarming, small boat) threat to ships in the littorals.

FY 2004 Plans:

- HyFly: Continue air vehicle and fuel system testing and validation of the operational flight program software using hardware in-the-loop testing.
- IHPRPT: Continue development of surface launch component technologies.
- Asymmetric Threat Defense: Continue subsystem design and development of detection/tracking algorithms and components for the Ship-Linked Interceptor (SLI) and Laser Annointed Interceptor (LAI) including the Inertial Measurement Unit (IMU), warhead, fuzing, explosive, control actuators, and signal processing algorithms.
- National Aerospace Initiative High Supersonic Turbine Vehicle (NAI HSTV) technology base: Program supports

the development of high-supersonic turbine engine and airframe technologies for expendable weapons applications. Initiate flow path and turbine engine component development and demonstration effort to increase the performance of inlet and nozzles, high temperature compressor and turbine.

FY 2005 Plans:

- IHPRPT: Continue surface launch component development and begin initial design for the air launched demonstration effort.
- Asymmetric Threat Defense: Continue development of detection and continuous target tracking algorithms. Continue design and fabrication of the SLI and LAI.
- NAI HSTV: Continue development and validation of flow path and turbine engine components and continue component rig testing. Begin design and fabrication of airframe components and assessment of thermal management techniques.
- Non-Leathal Weapons: Initiate a program for research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. Initial effort will examine non-lethal target effects/characterization of technologies spanning the non-lethal taxonomy.

	FY 2003	FY 2004	FY 2005
Unmanned Vehicles	15,280	14,548	11,354

The focus of this activity is on those technologies that relate to the development of Unmanned Vehicles (UVs) that will support Naval forces and expeditionary operations. Specific technology areas include the development of Intelligent Autonomy (IA) technologies to increase autonomy, performance, and affordability in Unmanned Underwater Vehicles (UUVs), Unmanned Air Vehicles (UAVs), Unmanned Ground Vehicles (UGVs), UAV control systems, UAV radar systems, and UAV propulsion and power systems.

In the prior R2 submission for this PE, the UAV advanced technology and UAV radar systems tasks were in the Naval Precision Strike Operations activity. The Micro UAV sensors, UUV sensors and control task, UAV propulsion and power technology, IA, and the UGV development tasks were in the Support for Naval Expeditionary Forces Ashore activity.

FY 2003 Accomplishments:

- UAV sensor: Completed with demonstration of a magnetic sensor to be made available for Micro UAV applications.
- IA: Continued developing and testing technologies for UV dynamic replanning, autonomous vehicle control,

alert management, maritime situation awareness, and multi-vehicle distributed cooperation.
- UUV: Continued development of deployed Intelligence, Surveillance and Reconnaissance (ISR) electro-magnetic and electro-optic (EM/EO) sensors, software, and integrated autonomous control approaches for Maritime Reconnaissance (MR) mission capabilities.
- UAV control: Continued development of a single frequency, multi-UAV imaging operations capability. Developed single operator command, control and information display for multiple UAVs. Began installation of Firescout UAV, and completed UAV see and avoid demonstration.
- UGV: Completed Phase I of the technology development and preliminary design phase, completed critical design reviews and down selected to two contractors.
- UAV propulsion: Continued component design, fabrication and component rig testing of UAV propulsion components and began design and fabrication of the Mach 3.5 capable missile demonstrator engine.
- UAV radar: Continued with field and lab tests of the system.

FY 2004 Plans:

- UAV radar: Completes by performing airborne testing using a Piper Aztec as a surrogate platform.
- IA: Continue development of dynamic replanning and autonomous control and operations technologies. Complete UAV/UGV reconnaissance demonstration jointly with Defense Advance Research Projects Agency (DARPA), and in-water maritime situation awareness demonstration.
- UUV: Continue development of EM/EO sensors, software, sensor data fusion, integrated autonomous control approaches for MR, and multi-vehicle Undersea Search and Surveillance (USS) and communication link development.
- UAV control: Continue testing of threat detection/collision avoidance software and the development of secure jam resistant communications and multiple UAV information displays.
- UGV: Continue development of robotic communication technologies in support of the Marine Corps Gladiator Tactical Unmanned Ground Vehicle (TUGV) program and transition them to the Marine Corps for System Design and Development (SDD).
- UAV propulsion: Continue development fabrication and rig testing of Navy UAV propulsion component technologies under the Integrated High Performance Turbine Engine technology (IHPTET) program, including the advanced PW-800 commercial gas generator core and the XTL-17 supersonic missile engine.
- Autonomous Mobile Platform (AMP): Initiate effort to create small sensor platforms capable of extended endurance. Develop propulsion/energy storage/replenishment, navigation/guidance systems, and locomotion technologies.

FY 2005 Plans:

-IA: Continue development of dynamic replanning and autonomous control technologies. Conduct simulation demonstration of multi-vehicle distributed cooperative control jointly with Air Force for ISR and strike missions.
- UUV: Continue development and transition of UUV-deployed ISR EM/EO sensors and software, multi-vehicle USS and communication link development.
- UAV control: Continue development of command, control and displays for multiple UAVs, and single frequency multi-point UAV communications.
- UAV propulsion: Ground test demonstrator engine and a Mach 3.5 capable expendable turbine engine.
- AMP: Integrate energy replenishment and storage with a mobile platform and demonstrate replenishment and relocation operation.

	FY 2003	FY 2004	FY 2005
Navigation, Electro Optic/Infrared (EO/IR), and Sensor Technologies	10,298	13,259	12,283

This activity describes Navy S&T investments in the areas of Electro Optic/Infrared devices, Global Positioning Station (GPS) and Fiber Optic Gyro Navigation systems, and advanced sensors.
The network centric and navigation technology effort is focused on improving the navigation accuracy of Naval forces through improvements in Fiber Optic Gyros (FOGs), distributed timekeeping systems, and GPS improvements.

In the prior R2 submission for this PE, the Advanced Imaging Seeker Countermeasures, low cost EO/IR airborne sensor tasks were located in the Fleet Defense & Air Dominance activity. The Network Centric Navigation Task, GPS and Navigation Device threat analysis, Network centric task, and Controlled Radiation Pattern Antenna (CRPA) isolation improvement tasks were in the Naval Precision Strike Operations activity.

FY 2003 Accomplishments:

- Smart Sensor Network: Completed linking of sensors into a grid to demonstrate different sensor packages observing and tracking targets in urban environments.
- Relative Navigation: Completed latency assessment task for GPS and Link 16; completed the high precision light source FOG task by developing the alternative laser design of the FOG system now in the acquisition process; and completed the Geophysical Low Observable Bathymetric Estimator (GLOBE) which is awaiting SP-24 implementation.

- Long Wave Infrared (LWIR) fiber: Completed production of fiber transmitting at wavelengths of 8-12 um, with a 100 micron diameter core, in lengths greater than 100 m, and having strength greater than 100 kpsi.
- Multispectral Infrared Focal Plane Array (IRFPA): Completed program by demonstrating via simulation the advantages of three-color IRFPAs for mid-course interceptors for missile defense. Initiated development of low-cost EO/IR sensors.
- Distributed Time Standards: Continued effort and associated Time Scaling algorithms, the Network Centric Navigation task by determining the latency of representative networks, and the Rb Double Bubble Maser Atomic Clock effort.
- Initiated three projects: the tightly-Coupled GPS/INS (Inertial Navigation System) to improve GPS receiver jamming immunity, Distributed Time Scale algorithm development to increase temporal precision in networks, and the CRPA element coupling reduction project.

FY 2004 Plans:

- Tightly coupled GPS/INS: Complete zero-age ephemeris and CRPA mutual coupling reduction projects.
- Multispectral IRFPA: Complete demonstration of two color longwave focal plane based algorithms for missile defense.
- Continue development of high-performance, low-cost EO/IR airborne surveillance sensors for unmanned aerial vehicles, and ultra-high performance EO/IR Imagers. Continue work to develop auto-target identification techniques for Laser Range-gated imagers.
- Distributed Time Standards, Rb Double Bubble Maser Atomic Clock, algorithm development for Distributed Time Scaling: Continue FY03 work.
- Network Centric Navigation: Continue FY03 effort by assessing the time synchronization and precision time transfer.
- Advanced Imaging and the Seeker Countermeasure (AISCM): Initiate effort to develop imaging infrared countermeasures (IRCM) against imaging missiles using a unique state of the art hybrid approach. Implement preprocessing and track algorithms into imaging surrogates.
- Millimeter Wave (MMW) threat detection: Initiate effort to develop preliminary hardware and software designs for channelized and photonic Ka/W band Electronic Warfare (EW) receiver designs.

FY 2005 Plans:

- Network-Centric Navigation: Complete effort by demonstrating the transfer of Precision Time and Time Interface.
- Distributed Time Scaling: Complete algorithm development for deeply coupled GPS/INS with nonlinear filter.
- Multispectral IRFPA: Continue assembly of a brassboard three-color seeker and testing in a simulation

facility.
- AISCM: Continue development of generic cooperative imaging IRCM techniques.
- MMW threat detection: Continue fabricating channelized and photonic prototype receivers.
- Continue development of high-performance, low-cost EO/IR airborne surveillance sensors for unmanned aerial vehicles, and ultra-high performance EO/IR Imagers. Continue work to develop auto-target identification techniques for Laser Range-gated imagers.
- Continue Distributed Time Standards Technology and Rb Double Bubble Maser Atomic Clock projects.
- Initiate the following four projects: Mirco Electronic Mechanical System (MEMS) INS device development, Communication Navigation and Identification (CNI) device, GPS receiver for landing systems, and Space and Frequency Adaptive Processing for GPS Anti-Jam (AJ) antennas.

	FY 2003	FY 2004	FY 2005
Electric Weapons	5,780	13,400	10,000

The goal of this work is to complete and commission upgrades to the infrared (IR) Free Electron Laser (FEL) and develop technologies related to average power scaling. If successful, the FEL could be considered for shipboard applications as a defense weapon against advanced cruise missiles and asymmetric threats.
In the prior R2 submission for this PE, the tasks in this new activity were contained in the FEL activity.

FY 2003 Accomplishments:

- FEL: Developed an optical klystron to extend the FEL performance into the IR bands. Continued commissioning and demonstration of the 10kW FEL.
- Femtosecond laser: This was a one year task to determine physical characteristics and the damage mechanisms involved with using femtosecond lasers as ship defense weapons. Conducted experiments on the interaction/damage mechanism of the femtosecond laser on thin radome; model beam propagation.

FY 2004 Plans:

- FEL: Complete commissioning and demonstration of a 10 kW FEL. Perform FEL beam quality experiments at the 10 kW level and conduct design studies for advanced injector configurations. Initiate design studies to evaluate multiple design alternatives and costs involved with the development, fabrication, and demonstration of a 100 kW FEL.
- Electromagnetic (EM) gun: Initiate program to develop EM gun technology. Initial effort will focus on rail wear issues, energy storage, and pulsed power switching. Transitions to PE 0603123N in FY05.

FY 2005 Plans:

- FEL: Continues with fabrication of high current, high brightness injectors including superconducting Radio Frequency (RF) cavity base design. Conduct experiments with alternative FEL amplifier configurations to compare performance to current oscillator configuration and to determine the best scale up path to a megawatt FEL.

	FY 2003	FY 2004	FY 2005
Strike Technologies	7,300	5,417	4,000

The focus of this effort is on those technologies that will support Naval Precision Strike Operations and provide the Navy of the future the ability to quickly locate, target, and strike critical targets ashore.

In the prior R2 submission for this PE, the Mission Responsive Ordnance (MRO), and Unmanned Combat Air Vehicle-Navy (UCAV-N) tasks were previously in the Naval Precision Strike Operations activity. The Enhanced Target Acquisition, and Location System (ETALS), and Advanced Gun Barrel Technology (AGBT) tasks were previously in the Support for Naval Expeditionary Forces Ashore activity.

FY 2003 Accomplishments:

- MRO: Performed mid-scale penetration tests, demonstrated dispenser component functionality, and performed static ground tests of the effectiveness of the warhead against various real world targets (missiles, trucks, aircraft, etc.) MRO was discontinued at the end of FY03 due to lack of transition.
- ETALS: Target Location Designation and Handoff system (TLDHS) effort completed a limited user test for the AN/GVS-5 and TLDHS, and developed an interface prototype and AN/GVS-5 production interfaces.
- AGBT: Completed the analysis of material thermal transfer and the development of structural and thermal predictive models for the next generation/high barrel life, gun barrel design for current and future Naval gun systems.

FY 2004 Plans:

- ETALS: Complete development of the mechanical, electrical, and software interfaces between the Miniature Azimuth Gyrocompass Unit-1 (MAGU-1) and the TLDHS Lightweight Laser Designator/Rangefinder (LLDR). Conduct operational testing of the MAGU-1 to verify that it is suitable for the planned replacement for the AN/GVS-5.
- AGBT: Continue development of refractory materials, coating/liner application processes, metal matrix composites, and integration into two advanced barrel concepts for use on the DD(X) ship.

FY 2005 Plans:

- AGBT: Continue initial work necessary for full scale fabrication of a prototype 155mm gun barrel with advanced interior. Develop more advanced functionally graded material designs and fabricate a composite barrel test section.

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ACCELERATE DEVELOPMENT OF LOW COST SWARM UAV	2,380	0

This effort accelerated the development of Smart Warfighting Array Reconfigurable EO/IR RF modules SWARM for long endurance (UAV).

	FY 2003	FY 2004
ADVANCED DEVELOPMENT AND DEMONSTRATION OF ELECTRIC ACTUATOR TECH	0	1,187

This effort will develop and demonstrate an electronic actuator to replace hydraulic actuators on Navy ships and enable the realization of the all electric ship. The electronic actuator will incorporate technologies to improve heat dissipation, increase motor power density, and optimize compatibility with energy storage devices.

	FY 2003	FY 2004
ADVANCED MULTI-INT EXPLOITATION SYSTEMS (AMIES)	0	2,769

This effort will develop a suite of airborne multi-intelligence sensors (SIGINT and ELINT) along with existing advanced sensors. Develop the required signal processing algorithms and optimize them for real-time sensor fusion.

	FY 2003	FY 2004
CHEMICAL WEAPON DETECTION FOR UAV APPLICATIONS	0	1,384

This effort will develop a standoff (non-contact up to 1000 feet away) passive sensor of chemical weapon agents for use on the Silver Fox expendable UAV or if reconfigured for use as a handheld device. The new sensor will be based on differential absorption radiometer (DAR) technology.

	FY 2003	FY 2004
COMBUSTION LIGHT GAS GUN	0	4,203

This effort will involve the development of the technologies to develop a hyper-velocity weapon based on high-energy electric plasma ignition heating of injected light gas. Effort will include modeling and simulation of light gas ignition and combustion, installation of 45mm light gas gun test bed, and test firings of the gun at full velocity.

	FY 2003	FY 2004
DEVICE INTEGRATION OF WBG SEMICONDUCTORS AND CRYSTALINE OXIDES	0	1,384

This effort will develop techniques and instrumentation to improve passive oxide components for tunable power microwave amplifiers for application to the Advanced Multifunction Radio Frequency System.

	FY 2003	FY 2004
FIRELIDAR	0	1,483

This effort will develop an eyesafe laser imaging system complementary to Infrared (IR) imagers. Firelidar will use a 1.5 micron laser and a highly transmissive narrow band filter to minimize blooming from fire sources, to see through smoke, water, and glass.

	FY 2003	FY 2004
FREE ELECTRON LASER	0	6,923

This effort will develop technologies to support the development of a high average power Free Electron Laser (FEL) system that is applicable to shipboard self defense.

	FY 2003	FY 2004
GALLIUM NITRIDE (GAN) MICROELECTRONICS AND MATERIALS DEVELOPMENT	0	2,967

This effort will develop a reliable Gallium Nitride (GaN) Radio Frequency (RF) Power Technology that is more reliable and affordable by bringing 4 inch wafer processing on line and through the use of High Density Dielectric Passivation (HDDP) processes.

	FY 2003	FY 2004
HIGH EFFICIENCY PIEZOELECTRIC CRYSTALS	1,668	2,076

FY03 - This effort developed piezoelectric devices based on new growth techniques to dither infrared focal plane arrays for extremely high resolution.
FY04 - This effort develop defect-free lead magnesium niobate-lead titanate (PMN-PT) piezoelectric crystal material for significant (2-10) cost and performance improvement in Navy sonar and hydrophones, laser-acoustic modulators, focal plane micro-dither, and electronic beam steering applications.

	FY 2003	FY 2004
HYBRID FIBER OPTIC/WIRELESS SYSTEM FOR SECURE COMMUNICATIONS	952	0

This effort developed a millimeter wave, optical transmitter that will generate the optical and millimeter carriers within a mode-locked microchip laser. The laser operated an eye safe optical wavelength of 1.55mm with a millimeter modulation of 60 GHz for covert communications.

	FY 2003	FY 2004
HYBRID LIDAR-RADAR FOR IMPROVED OPTICAL IMAGING	0	1,682

This effort will develop frequency modulation techniques on 3D laser ranged imaging sensor to mitigate the effects of medium backscatter and stray light interference. These techniques will allow imaging in murky water and through clouds.

	FY 2003	FY 2004
INTEGRATED BIOLOGICAL WARFARE TECHNOLOGY PLATFORM	3,813	5,092

FY03 – This effort supported development of a small, low powered chemical sensor and includes a biological detection capability. (Semi-conducting Metal Oxides (SMO's) are currently used for chemical detection and it is anticipated that this effort will enable molecular beacons to be used for biological weapon detection.)
FY04 – This effort will apply the integrated Biological and Chemical Warfare Defense decision analysis technology software to survey vessels approaching aircraft carriers on the high seas.

	FY 2003	FY 2004
INTEGRATED HIGH PAYOFF ROCKET PROPULSION TECHNOLOGY PROGRAM (IHPRPT)	0	989

This effort will develop technologies that increase the performance of solid propellents used in tactical missiles. Tasks involve synthesis of high energy propellent ingredients and formulations and investigate advanced propulsion technologies to meet the IHPRPT performance goals.

	FY 2003	FY 2004
INTELLIGENT CONTROL SYSTEMS FOR SWARM UNMANNED AERIAL VEHICLES	0	4,203

This effort will develop the algorithms and intelligent control technologies to enable the employment of multiple UAV's for the completion of a variety of operational missions. The FY03 funds are listed under the Plus-up title "Accelerate Development of Low Cost SWARM UAV".

	FY 2003	FY 2004
INTERROGATOR FOR HIGH-SPEED RETRO REFLECTOMETER COVERT COMMUNICATIONS	1,627	1,978

FY 03 – This effort developed a retro-reflector modulator for laser data link that can support megabit per second data rates for hyperspectral electro-optical and infrared sensors and synthetic aperture radar data. Furthermore adapt this technology to small (4') unmanned aerial vehicles to allow exchange of space-time information for geolocation and time sensitive targeting.
FY04 – This effort will increase retro reflector data rate to 10-50 Megabits per second. Develop cats-eye lens for wide intercept angle to minimize laser interrogator pointing accuracy.

	FY 2003	FY 2004
KILL ASSIST ALL-WEATHER TARGETING SYSTEM (KAATS)	0	3,115

This effort will develop technologies to support a system that will provide precision targeting and weapon delivery in adverse weather for time critical missions. Will develop, demonstrate and test a targeting capability using stereo SAR and a data link to provide relative coordinates for the simulated missile.

	FY 2003	FY 2004
LOW COST FUSED REMOTE SENSORS	954	0

This effort developed the feasibility of using fused low cost remote sensing technology sensors such as hyperspectral imaging sensors, Synthetic Aperture Radar (SAR) and Lidar Sensors for the identification of targets for Navy power projection missions.

	FY 2003	FY 2004
MILLIMETER WAVE INFRARED IMAGING	1,620	0

This effort performed work to realize simultaneous infrared (IR) and millimeter wave (MMW) imaging capabilities through a common aperture and to fuse IR and MMW imagery for all-weather and high resolution imaging.

	FY 2003	FY 2004
MINATURIZED HIGH DEFINITION DIGITAL CAMERA	952	0

This effort developed flight worthy, high definition, color video surveillance camera for a small (4 ft) unmanned aerial vehicle.

	FY 2003	FY 2004
NANOCOMPOSITE WARHEADS	0	2,521

This effort will support the manufacturing technology development and production scale up of high density nano material composites used in the construction of advanced warheads for air and surface weapons.

BA: 02 PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: Power Projection Applied Research
PROJECT TITLE: Power Projection Applied Research

	FY 2003	FY 2004
NAVAL PRECISION STRIKE (SAR FOR ALL WEATHER TARGETING)	6,712	0

This effort developed a time critical targeting system using Global Positioning System (GPS) information to provide an all weather precision target location and weapon guidance capability that will significantly increase the accuracy of precision weapons. Developed a prototype relative GPS system for guided weapons and integrated the Stereo Synthetic Aperture Radar (SAR) targeting package into the Lynx targeting system.

	FY 2003	FY 2004
NON-LINEAR DYNAMICS - CONTROL OF CHAOS	0	3,362

This effort initiate a new research institute focused in the broad area of nonlinear dynamics with specific research topical areas such as chaos-excited nondestructive evaluation, micromechanical/microfluidic devices, adaptive antenna arrays, and autonomous vehicle controls.

	FY 2003	FY 2004
PANORAMIC NIGHT IMAGING SYSTEM	3,240	0

This effort developed large area infrared focal plane arrays and associated signal processing, including imaging systems and sensor evaluation.

	FY 2003	FY 2004
PULSE DETONATION ENGINE RISK REDUCTION	1,003	0

This effort designed, fabricated and tested a compound flow nozzle system for a 5 combustor test vehicle. Conducted structural and thermal analysis of alternative engine configurations.

	FY 2003	FY 2004
RADAR INFRARED IMAGING	0	2,076

This effort will develop a new type of passive millimeter wave (MMW) imager based on the imposition of MMW side bands on an optimal carrier. If successful, this approach will significantly improve MMW imaging sensitivity performance.

	FY 2003	FY 2004
REAL WORLD BASED IMMERSIVE IMAGING	1,907	0

This effort developed a low power optimized single instruction multiple data (SIMD) system processor for enhanced real-time hyperspectral image processing on-board a small (4') unmanned aerial vehicle. The processor will also support hyperspectral data compression/de-compression and encryption/decryption.

	FY 2003	FY 2004
THERMAL MANAGEMENT OF ENVIRONMENTALLY ENCLOSED GROUND STATIONS AND COMPUTING SYSTEMS	0	5,191

This effort will evaluate and demonstrate advanced cooling techniques for military processing systems. It will include the cooling of a classified telecommunications processing system which has Special Operations Forces (SOF) deployment requirements. It will also ruddedize high capacity imagery and data fusion processing airborne hardware.

	FY 2003	FY 2004
TUNABLE OXIDE FILM AND CAPACITOR TECH & INTEGRATION OF OXIDE FILM AND WIDE BANDGAP SEMICONDUCTOR TECH FOR THE ADV MULTI FUNCTION RF SYSTEM	1,625	0

This effort developed the feasibility of integrating electro-optic films into semiconductor microwave device structures.

	FY 2003	FY 2004
ULTRA SHORT PULSE LASER MICROMACHINING	1,214	1,384

FY 03 - This effort developed near-term, ultra short laser micromachining for electronics and fuel injectors.
FY 04 - This effort will establish a micromachining testbed to assist the transfer of ultra-short pulse laser machining technology. Develop precise micro-machining with negligible heat affected zones, improved holes in turbine blades, fuel injectors and airframes, semiconductor machining on Infrared focal plan arrays, etc.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0601152N (In-house Laboratory Independent Research)
PE 0601153N (Defense Research Sciences)
PE 0602123N (Force Protection Applied Research)
PE 0602235N (Common Picture Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0603114N (Power Projection Advanced Technology)
PE 0603640M (Marine Corps Advanced Technology Demonstration)
PE 0603790N (NATO Research and Development)

NON-NAVY RELATED RDT&E:
PE 0602303A (Missile Technology)
PE 0602618A (Ballistics Technology)
PE 0602624A (Weapons and Munitions Technology)
PE 0603004A (Weapons and Munitions Advanced Technology)
PE 0602173C (Support Technologies - Applied Research)
PE 0603763E (Marine Technology)
PE 0603739E (Advanced Electronics Technologies)
PE 0602702E (Tactical Technology)
PE 0602203F (Aerospace Propulsion)
PE 0602601F (Space Technology)
PE 0602602F (Conventional Munitions)
PE 0603216F (Aerospace Propulsion and Power Technology)

D. ACQUISITION STRATEGY:
Not Applicable

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

BA: 02 PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: Force Protection 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
Force Protection Applied Research	113,066	112,868	96,269	98,643	125,631	124,475	121,493

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. The goal is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability within Sea Strike. This is accomplished by improvements in platform offensive performance, stealth and self defense. This program supports the Fleet and Force Protection and Missile Defense and Advanced Capability Electric System (ACES) Future Naval Capabilities (FNC).

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	118,413	75,909	98,763
Cong. Rescissions/Adjustments/Undist.Reductions	0	-1,311	0
Congressional Actions	0	38,275	0
Execution Adjustments	-3,220	0	0
FY03 Fed Tech Transfer	-27	0	0
Inflation Savings	0	0	-317
Rate Adjustments	0	-5	-177

SBIR Assessment	-2,100	0	0
Technical Adjustments	0	0	-2,000
FY 2005 President's Budget Submission	113,066	112,868	96,269

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

BA: 02 PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: Force Protection Applied Research

PROJECT TITLE: Force Protection Applied Research

COST: (Dollars in Thousands)

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B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Surface Ship & Submarine Hull Mechanic & Electrical (HM&E)	42,995	44,890	59,934

Efforts include: signature reduction, hull life assurance, hydromechanics, distributed control for automated survivability, and advanced electrical power systems. Signature reduction addresses electromagnetic, infrared and acoustic signature tailoring, both topside and underwater. Hull life assurance addresses development of new structural system approaches for surface ships and submarines, including the management of weapons effects to control structural damage and the improvement of structural materials. Hydromechanics addresses hydrodynamic technologies, including the signature aspects of the hull-propulsor interface. Distributed intelligence for automated survivability addresses both the basic technology of automating damage control systems as well as distributed auxiliary control with self-healing capability. Advanced electrical power system addresses electrical and auxiliary system and component technology to provide improvement in energy and power density operating efficiency and recoverability from casualties. This effort supports the Fleet and

Force Protection, Missile Defense and Advanced Capability Electric System (ACES) Future Naval Capabilities (FNC). Increased funding in FY 2005 will be used to advance technology in the areas of fast-high power switches, capacitors, power and thermal management, fuel cells and advanced power generation.

FY 2003 Accomplishments:

- Completed the preliminary version of Next Generation Infrared (IR) Code. The code is now subject to verification and validation.
- Developed tools to describe failure mechanisms of sandwich composites.
- Finalized component design for dynamic ship protection system.
- Completed Dynamic Behavior of Composite Ship Structures (DYCOSS) joint effort with Dutch Navy.
- Developed a notional payload module for a submarine modular hull application. Continued development of analytical models to further define submarine modular hull concepts.
- Developed technology basis for a family of electromechanical actuators.
- Developed thermal management concepts and components for high powered electrical systems.
- Developed compact, high-powered solid state switching technology for the Electro-Magnetic Aircraft Launching System (EMALS) and other pulsed and steady state applications. Transitioned some hardware, applications, and software system managers to the EMALS program office.
- Investigated potential applications of silicon-carbide in future high voltage and high power applications.
- Designed software for system manager for Universal Control Architecture (UCA).
- Initiated the next generation infrared (IR) scene model for surface ships by development of mitigation strategy supporting low observable infrared platforms, development of supporting physics and prototype measurement techniques.
- Commenced feasibility study of distributed pump-jet propulsion system (DPJP) concept for submarines.
- Initiated evaluation of an Integrated Engineering Plant (IEP) concept to provide improved survivability of auxiliary systems that support combat systems.
- Initiated development of X-Craft experimentation plan and model testing effort.
- Continued advanced numerical acoustic codes (and gridding methods for those codes) for submarines.
- Continued development of analytical models to further define modular submarine hull concepts.
- Continued algorithm/finite element model validation for submarine advanced degaussing/deamping.
- Continued physics based numerical model for electromagnetic scattering of hydrodynamic disturbances for Surface Ships.
- Continued development of surface ship acoustic flow noise model. Performed tank test for surface ship acoustic behavior validation.
- Continued to develop design tool for integrated antenna and composite topside.

- Continued development of reliability based design and structural analysis code development.
- Continued to investigate improved maneuvering simulation capability for submarines.
- Continued analytical and modeling investigation of cavitation, powering and acoustic performance of submarine propellers.
- Continued study of flow noise over submarine control surfaces.

FY 2004 Plans:

- Continue all efforts of FY 2003 less those noted as completed above.
- Fabricate prototype acoustic wireless sensor array for submarines.
- Evaluate Advanced Ducted Electric Propulsion Pod (ADEPP) model hydrodynamic performance in the Large Cavitation Channel (LCC).
- Develop, validate, and apply numerical codes to integrated propulsor/hull for advanced surface ship configurations.
- Validate advanced prediction code for large amplitude non-linear motion of advanced surface ship hulls.

FY 2005 Plans:

- Continue all efforts of FY 2004.
- Complete demonstration of prototype acoustic wireless sensor array system incorporating self powering, radio frequency unit and sensors.
- Deliver next generation IR scene model and next generation IR code.
- Validate prediction methods which relate ship hydrodynamics and ship signatures.
- Develop quiet control surface design tool based on control surface flow noise studies.
- Complete and document reliability based design method for application to ship design.
- Initiate development structural analysis codes describing failure mechanisms of sandwich composites.
- Initiate work to assess cavitation performance of loop-bladed propulsor concept.
- The following efforts reflect the investment in electrical technology:
  - Accelerate ship service fuel cell development leading to at sea demo by FY 2006.
  - Commence development of test vessel and technology to evaluate performance and signature associated with electrically driven waterjets (AWJ-21) and Rim-drive motor (Advanced Hull-form Inshore Demonstrator - AHFID).
  - Initiate multi-year program to directly convert thermal energy to electricity. Such a capability would allow elimination of the steam cycle on an electric warship.
  - Accelerate development of thermal management technology for shipboard power distribution.
  - Accelerate development of pulsed power technology, to include pulsed alternators and capacitors.

	FY 2003	FY 2004	FY 2005
Advanced Energetics	10,116	0	12,416

Advanced Energetics efforts address technology development to provide substantial improvements in energetic material systems and subsystems, primarily in terms of performance, but also addressing safety, reliability, and affordability concerns. Goals include: advanced energetic materials for thermobarics, agent defeat, and reactive material based warhead subsystems for both defensive and offensive applications. Efforts include development of new fuels, oxidizers, and explosive formulations, reliable simulation tools and diagnostics to develop and design superior performance reduced vulnerability systems tailored to specific warfighter missions.

FY 2003 Accomplishments:

- Energetics development of composition synthesis and process for the Thermobaric Warhead Explosive Fill Advance Concept Technology Demonstration (ACTD).
- Conducted a parametric study of candidate explosive systems to determine each component's contribution to internal blast overpressure and impulse. This study will guide future formulation selection and optimization.
- Internal blast performance was determined in a closed chamber bombproof test series. Sub-scale tunnels were used to experimentally determine the performance of internal blast/thermobaric explosives in geometries similar to those expected in operational use.
- Nine candidate explosive formulations were down selected from the small-scale tunnel test phase and tested for performance in a "mid-scale" tunnel test series.
- Small-scale explosive survivability tests were developed and conducted to evaluate their suitability for thermobaric applications under the compression/shear environment that the weapon is expected to encounter in operation.
- Plans were developed for qualification and testing of downselected candidate explosive composition(s) for Insensitive Munitions.
- Continued Advanced Energetics development of composition synthesis and process for the Thermobaric ACTD.

FY 2004 Plans:

- Continue FY 2003 funded work (in next generation reactive materials, diafloramine ingredients and formulations and advanced directed energy warheads) not finished in FY 2003.

- Postpone new work in this PE until FY 2005.

FY 2005 Plans:

- Continue all efforts of FY 2004.
- Initiate work to determine feasibility of achieving insensitive warheads without compromising performance. This work may require development of advanced energetic ingredients and processing concepts.

	FY 2003	FY 2004	FY 2005
Aircraft Technology	6,510	6,242	6,037

The Aircraft Technology activity develops high impact, scaleable Naval air vehicle technologies, such as structures and flight controls for future and legacy air vehicles, integrated avionics, advanced electrical power systems, and aerodynamics, which significantly increase the Naval warfighter's capabilities, effectiveness, readiness and safety, while reducing life cycle cost. This activity directly supports the naval aviation vision, providing a robust and credible forward presence through flexible response and dominate power projection from the sea.

FY 2003 Accomplishments:

- Investigated in-flight, autonomously reconfigurable air vehicles (studies and workshops).
- Developed Computational Fluid Dynamics (CFD) modeling of ship airwake flows to provide higher fidelity simulations.
- Developed Observables technology (classified).
- Performed piloted simulation of intelligent flight control prognostics and reconfiguration algorithms.
- Developed and simulated advanced control laws for shipboard auto-land of unconventional vehicles.
- Developed and simulated automated maneuvering algorithms.
- Developed and verified Figures-of-Merit, validated CFD, and developed wind tunnel techniques to mitigate/eliminate Abrupt Wing Stall (AWS) on current/future fighter/aircraft.
- Continued design for demonstration of an all-composite replacement for dynamically loaded control surfaces for tactical aircraft.

FY 2004 Plans:

- Continue all efforts of FY 2003.
- Develop survivability/reduced observables technology (classified).

- Investigate in-flight, autonomously reconfigurable air vehicles.
- Demonstrate intelligent flight control prognostics and reconfiguration algorithm.
- Initiate Persistent Intelligence, Surveillance, and Reconnaissance (ISR) Unmanned Air Vehicle (UAV) System (PERSIUS): Capability tailored to the Expeditionary Strike Group (ESG), a high endurance sensor and communication capability focused on disparate structurally integrated sensors (Electro-Optic (EO), Infrared (IR), Radio Frequency (RF)), electronic support, and communications packages, low volume high power generation capability, high capacity miniaturized data transmission, and short take off.
- Initiate Joint Transformational Strike (JTS) technology addressing Automatic Target Recognition (ATR) and Combat Identification (CID).

FY 2005 Plans:

- Continue all efforts of FY 2004.

	FY 2003	FY 2004	FY 2005
Missile Defense (MD)	9,215	8,575	11,378

This activity describes two efforts of the Missile Defense Future Naval Capabilities (FNC) program: Distributed Weapons Coordination (DWC) (including sensor coordination), and Littoral Affordability (classified program).

FY 2003 Accomplishments:

- Completed the Tactical Missile System-Penetrator (TACMS-P) Advance Concept Technology Demonstration (ACTD) critical review. (Not a Missile Defense FNC effort).
- Continued Littoral Affordability (classified program).
- Continued development of DWC algorithms for the naval open architecture combat system, common threat evaluation (CTE) and preferred shooter recommendation (PSR) functions. Demonstrated Navy anti-air warfare functionality in a laboratory simulation environment.
- Initiated articulation of requirements and methodology for sensor coordination in support of integrated fire control and theater-wide surveillance/tracking.
- Continued Littoral Affordability (classified program).
- Continued development of DWC algorithms for the naval open architecture combat system, common threat evaluation (CTE) and preferred shooter recommendation (PSR) functions. Demonstrated Navy anti-air warfare functionality in a laboratory simulation environment.

FY 2004 Plans:

• Continue all efforts of FY 2003 less those noted as completed above.

FY 2005 Plans:

• Continue all efforts of FY 2004.
• Initiate early phase conceptual studies and projects to determine the potential application of Low Observable technology to future naval platforms.

	FY 2003	FY 2004	FY 2005
Sensors & Associated (S&A) Processing	12,482	14,000	4,804

Activity focuses on applied research for complementary sensor and processing technologies for platform protection. Current small platforms (both surface and airborne) have little or no situational awareness (S&A) or self-protection against air, surface, and asymmetric threats. The goal of this activity is to provide these platforms with effective self-protection. The technology areas specific to platform protection will develop individual or multi-spectral (Electro-Optic (EO), Infrared (IR), Radio Frequency (RF), electromagnetic (EM), visual and acoustic) sensors and associated processing. To defend platforms from current and advanced threats in at-sea littoral environments and in port these technologies must improve multi-spectral detection and distribution of specific threat information. This activity supports the Fleet and Force Protection Future Naval Capabilities (FNC) and Missile Defense FNC. Budget Activity 2 sensor efforts are co-funded by PE 0602235N and 0602271N. Funding decrease in FY 2005 reflects transfer of sensor effort to PEs 0602235N and 0602271N in FY 2005. Major efforts are summarized below:

For Aircraft -
• The Integrated Defensive Electronic Countermeasures (IDECM) P3I effort adds additional capability to the radio frequency countermeasures (RFCM) system for F/A-18 E/F self-protection. It consists of developing an improved decoy towline and applying wide band-gap semiconductor technology to design a prototype RF solid-state transmitter for the fiber optic towed decoy.
• The Missile Warning System (MWS) effort is designed to develop and demonstrate two-color infrared (IR) missile warning enabling technology that is compatible with the Tactical Aircraft Directed IR Countermeasures (TADIRCM).
• The EO/IR Laser Jammer for TACAIR effort develops and demonstrates advanced laser jammer enabling technology that is compatible with tactical air (TACAIR) signature, radar cross section (RCS), and drag requirements and is effective against surface-to-air missiles (SAM), air-to-air missiles (AAM), and advanced

imaging threats.

For Surface Ships –
• Distributed Aperture System (DAS) development: Develops the data processor and optical augmentation software algorithms for threat classification. This is an international effort. Examines and integrates sensor modules into a single system design to support shipboard combat operations.
• The Shipboard EO/IR Closed Loop Self-protection effort develops and demonstrates an integrated threat detection and closed-loop laser jamming system to counter Electro-Optic (EO)/Infrared (IR) guided anti-ship missile threats.

For Marine Corps –
• The End User Terminal (EUT) effort develops improved personal communications, situational awareness and sniper detection for ground troops.

FY 2003 Accomplishments:

• Missile Warning System - The Integrated Detector-Dewar-Cooler Assembly was delivered to NRL and began design verification testing. Excellent 256x256 40um pitch focal plane arrays (FPAs) were fabricated utilizing passivation (stoichiometric cadmium-telluride) and diode formation procedures (gold doping) developed under this program.
• EO/IR Jammer - The design for the pump laser and optical parametric oscillators (OPO) were validated and completed, and construction of a multi-band mid-wave infrared, solid-state, high power countermeasure laser began.
• EO/IR Closed Loop Self-protection: Completed initial evaluation of a visible-band, high frame-rate sensor and investigated alternate designs of a mid-wave infrared-band sensor for closed-loop processing. Specification and preliminary design of the combined multi-band mid-wave infrared-band/visible-band countermeasure laser was completed and includes an innovative thallium-fiber pump laser to achieve reduced packaging size and improved robustness.
• End User Terminal: Techniques to inject and fuse information from individual soldier-mounted sensors into the network were examined. Preliminary sensor selection for color night vision perimeter defense and sniper counter-fire validation were completed.
• Completed Chemical Sensing in the Marine Environment locating the source of chemical plumes in very shallow waters using sensors on autonomous underwater vehicles. The resulting field tests will demonstrate whether the onboard sensor systems possess the necessary sensitivity and speed to accurately locate unexploded ordnance (UXO).
• Completed Chemical Sensing in the Marine Environment characterization of chemical plume structure in

very shallow water regimes. Optimized search strategies were used onboard autonomous underwater vehicles (AUV) to trace chemical plume from UXO.
• Discontinued development of energy harvesting benthic fuel cells using bioelectrochemical mechanisms at the water-sediment interface.
• Discontinued efforts directed toward using TNT and other explosives sensors as AUV payloads for detection of UXO.
• Completed investigation of tailored acoustic materials for quieter platforms.
• Completed investigation of bio-inspired algorithms for image processing hardware development.
• Completed development of oligonucleotide taggants as molecular barcodes for naval applications.
• Completed development of novel nonporous fouling-resistant enzymatic composite membranes for wastewater treatment.
• Initiated development of stochastic chemical sensors for naval applications to provide single molecule detection.

FY 2004 Plans:

• Continue development of stochastic chemical sensors for naval applications to provide single molecule detection.
• Initiate development of reagentless sensors for Weapons of Mass Destruction.

FY 2005 Plans:

• Complete development of stochastic chemical sensors for naval applications to provide single molecule detection.
• Continue development of reagentless sensors for Weapons of Mass Destruction.
• Initiate development of novel biomimetic propulsion systems for autonomous underwater vehicles.

	FY 2003	FY 2004	FY 2005
Underwater (UW) Platform Self Defense	1,472	1,312	1,700

Activity develops enabling technologies for ultimate shipboard use that will increase the survivability of surface ship and submarine platforms against torpedo threats. These technologies should be developed to minimize shipboard impact and require minimal organizational maintenance. Specific technology includes two efforts. The Next Generation Countermeasure (NGCM): a mobile adaptive acoustic countermeasure with acoustic communication links to enable countermeasure connectivity and group behavior to defeat threat torpedoes. The Anti-Torpedo Torpedo (ATT)/Tripwire Demonstration: Technologies for passive shipboard detection,

classification, and localization (DCL) of incoming torpedoes and an ATT to engage the threat torpedoes. This effort supports the Sea Shield pillar and the Fleet and Force Protection FNC.

FY 2003 Accomplishments:

- Completed Technology Requirements Model (TRM) study to evaluate ATT element based Low Frequency (LF) homing performance.
- Integrated adaptive beamforming technology into ATT TRM salvo simulation; baseline algorithm continues to be evaluated to understand how to incorporate beamforming into the ATT intercept phases of search and homing.
- Analyzed results of full-scale warhead detonation quarry testing to evaluate the impact of detonations on anti-torpedo torpedoes operating in salvo scenarios.
- ATT multi-target passive detection and contact clustering algorithms were defined, developed and integrated into the experimental two-on-two salvo software in TRM for evaluation prior to use in first quarter 2004 in-water experiments.
- Completed in-Water Testing of 1/2 Duplex Receiver Capability for Generation Countermeasure (NGCM), Limited In-Water Testing of Motor/Mobility Capability for NGCM, and Lethality demonstration of the ATT warhead against a specific threat.
- Continued development of technology for NGCM and Anti-Torpedo Torpedo (ATT) component technology in propulsion, Microelectromechanical Systems (MEMS), and Guidance and Control (G&C).

FY 2004 Plans:

- Continue development of technology for NGCM; ATT component technology, MEMS Inertial Measurement Unit (IMU), and G&C.
- Transition of Next Generation Countermeasure (NGCM).

FY 2005 Plans:

- Continue ATT, MEMS IMU and G&C efforts of FY 2004.

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ANTI-CORROSION MODELING SOFTWARE	1,198	0

Developed workable corrosion maintenance guidelines and criteria for high strength steel components, in particular arrestment gear of carrier aircraft. Airframe criteria calling for the repair and/or replacement of all corroded parts in the Fleet are very difficult to implement both with respect to time and resources. The results of this effort will enable maintenance teams to delineate between various aircraft corrosion states, with potential safety impacts and identification of corrosion that is cosmetic.

	FY 2003	FY 2004
BATTERY CHARGING TECHNOLOGY	2,036	2,101

FY03: Completed a prototype battery charger for nickel cadmium and sealed lead acid batteries and delivered the unit to NAVSEA-Crane for 3rd party performance verification. Prototype testing demonstrated that the batteries tested under this tasking can be charged without heating in 20 to 30 minutes, and began life cycle testing. FY04: The technology will be improved to extend battery lifetimes by optimizing the charging algorithms for the chemistries above, and rapid charging capability for other battery chemistries will be demonstrated.

	FY 2003	FY 2004
CENTER FOR ADVANCED POWER SYSTEMS (CAPS)	4,858	3,955

FY03: Initiated testing of the 5MW Superconducting motor developed by American Superconductor, Inc. Purchased test facility equipment as follows: Controlled AC Bus with 5MW four quadrant converter/inverter and controls, and installation of two 2.5MW dynamometers. FY04: Funds will be used to purchase state of the art energy storage devices, DC experimental bus including controls and system integration, and completion of 5MW superconducting motor testing.

	FY 2003	FY 2004
CORROSION MODELING SOFTWARE	0	3,115

This effort will determine the impact corrosion has on a structural component in terms of strain life analysis. Corrosion will be mapped, as defined by a characterizing metric, to corresponding stress concentration factors. This will quantify corrosion maintenance on the same basis that fatigue lives are

specified.

	FY 2003	FY 2004
DEPLOYABLE FIBER OPTIC FORCE PROTECTION SYSTEM	0	989

Develop and demonstrate a smart video camera system and passive fiber optic hydrophone array and processor to provide security against a waterside terrorist threat approaching Navy ships.

	FY 2003	FY 2004
ENDEAVOR	3,238	3,362

FY03: Developed an integrated set of ship design tools, including structural loading and hydrodynamic modeling tools. FY04: Continue development and integration of design tools, and initiate transition of tools to Navy use at NSWC Carderock.

	FY 2003	FY 2004
FIBER REINFORCED POLYMER COMPOSITES RESEARCH	952	0

Initiated testing and analysis to quantify sources of material property variability within composite laminate panels of interest to US Navy ship applications.

	FY 2003	FY 2004
FUSION PROCESSOR AND INTEGRATED CONTEXTUAL REASONING	3,248	6,329

FY03: The effort developed a real-time airborne fusion processor and algorithms for the Navy Hyperspectral/Imaging for Surveillance and Targeting (HISTAR) program. Funding supported the development of a hyper-spectral sensor and signal processing for the Shared Reconnaissance Pod (SHARP) on the F/A-18 aircraft for real-time detection and classification of threat targets. FY04: Process HISTAR data using hyper-spectral target detection and discrimination algorithms in real-time to optimize performance to minimize false alarms.

	FY 2003	FY 2004
HIGH EFFICIENCY QUIET ELECTRIC DRIVE	0	1,384

Develop a quiet, efficient, electric drive to allow transition from mechanical to electric dive in submarines and smaller surface combatants.

	FY 2003	FY 2004
INTEGRATED FUEL PROCESSOR - FUEL CELL SYSTEM	1,737	2,374

FY03: Developed a novel fuel processing system to reform the JP-5 fuel used for naval aircraft. The fuel processor technology is integrated into a turnkey fuel cell system. If successful, the system may provide payoffs of increased efficiency and lower emissions of auxiliary power units used on board aircraft and ocean-going vessels. FY04: Continue development of integrated fuel processor leading to testing of prototype hardware.

	FY 2003	FY 2004
LASER WELDING AND CUTTING	1,909	0

Provided development of laser based fabrication for application in Navy shipbuilding, including welding and cutting technologies. Laser based cutting and welding technologies may enhance shipyard productivity/automation, reduce costs, enhance ship performance/reliability/maintainability, and reduce weld-induced distortion/associated rework costs/ship signature.

	FY 2003	FY 2004
LOW-COST, RAPID PROTOTYPE/PRODUCTION TECHNOLOGY FOR POLYMERIC AIRCRAFT COMPONENTS	0	1,483

Develop and qualify a rapid prototyping and production technology based on Selective Laser Sintering (SLS) which will be used for the design, development and qualification of advanced polymeric aircraft components. The SLS process uses a laser to fuse (sinter) plastic powders into complex shaped plastic parts. A part can be built using only the computer aided design (CAD) model downloaded directly to the laser-sintering machine. This technology will help reduce the weight and manufacturing costs of aircraft components while improving their performance.

	FY 2003	FY 2004
MINIATURE AUTONOMOUS VEHICLES	957	1,187

FY03: This effort developed a distributed communication and control architecture for a cooperating multi-vehicle fleet of autonomous underwater vehicles (AUV). Control architectures were validated by computer simulation. FY04: Modeling and simulation will be validated through in-water testing.

	FY 2003	FY 2004
MODULAR ADVANCED COMPOSITE HULL FORM	952	0

Investigated hybrid (composite to steel) joints for application to hybrid ship hulls and lifting bodies. The research explored joining concepts and developed experimental, theoretical, and analytical methods to assess their reliability under sea loads. The Hybrid Hull concept may facilitate the use of composites in naval combatants to help achieve stealth and survivability.

	FY 2003	FY 2004
NANOSTRUCTURED COMPOSITE MARINE COATINGS	0	2,472

Develop multifunctional, nanostructured materials that can improve corrosion resistance of naval materials. The approach is to explore a composite of polymeric inhibitors matrix embedded with nanoencapsulated chloride ion trap and nanoencapsulated phosphates that can be coated under conventional barrier coatings. These composites will not only enhance the corrosion resistance but also provide self-healing capability.

	FY 2003	FY 2004
SMALL WATERCRAFT DEMONSTRATOR	4,047	0

Initiated development of a small watercraft which attempts to demonstrate improved performance characteristics compared to existing small watercraft. Efforts focused on development of a very high power-to-weight ratio hybrid electric propulsion system, and hull form designs to optimize seakeeping at all speeds.

	FY 2003	FY 2004
SOLID OXIDE REGENERATIVE FUEL CELL	0	2,967

Conduct cycle and long-term operations testing to demonstrate the durability and reliability of a 1 KW regenerative solid oxide fuel cell. Solid oxide fuel cells may offer improved efficiencies and power densities over other options for naval vessel applications.

	FY 2003	FY 2004
STRUCTURAL RELIABILITY OF FRP COMPOSITES	0	1,978

Developing plans for extension of variability/reliability work to include composite sandwich panels.

	FY 2003	FY 2004
UNMANNED SEA SURFACE VEHICLE (USSV)	5,144	4,153

FY03: Initiated development of a surface craft optimized for unmanned missions. Primarily focused on enhanced speed, range, endurance, seakeeping, and payload fraction, considered in the context of potential unmanned vehicle missions. Issues of launch, recovery, and host platform compatibility were explored. FY04: Define operational concept and complete design of prototype unmanned surface vehicles. Initiate construction of one or more prototypes for at-sea testing. Develop launch and recovery testbed.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0601153N (Defense Research Sciences)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602235N (Common Picture Applied Research)
PE 0602271N (RF Systems Applied Research)
PE 0603123N (Force Protection Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603502N (Surface and Shallow Water Mine Countermeasures (MCM))
PE 0603513N (Shipboard System Component Development)

PE 0603553N (Surface Anti-Submarine Warfare)
PE 0603561N (Advanced Submarine Systems Development)
PE 0603573N (Advanced Surface Machinery Systems)
PE 0603609N (Conventional Munitions)
PE 0603640M (Marine Corps Advanced Technology Demonstrations)
PE 0604307N (Surface Combatant Combat System Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0604558N (New Design SSN)
PE 0604561N (SSN-21 Development Program)

NON NAVY RELATED RDT&E:
PE 0602270A (Electronic Warfare Technology)
PE 0602204F (Aerospace Sensors)

D. ACQUISITION STRATEGY:
Not Applicable

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

BA: 02 PROGRAM ELEMENT: 0602131M
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

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
Marine Corps Landing Force Technology	28,247	32,375	35,398	38,707	38,022	39,205	40,014

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Marine Corps is tasked to develop, in conjunction with the Navy, Army, and Air Force, those phases of amphibious operations that pertain to tactics, techniques, and equipment used by the landing force. This Program Element (PE) is organized into six amphibious expeditionary warfighting capability areas. These are: Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR); Maneuver; Logistics; Human Performance, Training and Education; Firepower; and Mine Countermeasures (MCM). The primary objective of this PE is to develop and demonstrate the technologies needed to meet the Marine Corps' unique responsibility of training and equipping the Marine Air/Ground Task Force (MAGTF) for amphibious warfare and subsequent operations ashore. This PE provides the knowledge base to support Advanced DevelopmentTechnology (6.3) and is the technology base for future amphibious/expeditionary warfare capabilities. This PE supports the Expeditionary Force Development System of the Marine Corps Combat Development Command and responds directly to the Marine Corps Science and Technology (S&T) process. The Future Naval Capabilities (FNC) process is supported and funds are programmed accordingly. The core program also supports Discovery and Invention (D&I) and Innovation and Transformation (I&T). Within the Naval Transformation Roadmap, this investment will achieve key transformational capabilities required by Sea Shield as well as enable the Ship to Objective Maneuver (STOM) and Persistent Intelligence, Surveillance and Reconnaissance (ISR) key transformational capabilities within Sea Strike and the enhanced Sea-borne Positioning of Joint Assets within Sea Basing.

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

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

BA: 02 PROGRAM ELEMENT: 0602131M
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	29,568	31,778	35,562
Cong. Rescissions/Adjustments/Undist.Reductions	0	-403	0
Congressional Actions	0	1,000	0
Execution Adjustments	-553	0	0
Inflation Savings	0	0	-114
Rate Adjustments	0	0	-50
SBIR Assessment	-768	0	0
FY 2005 President's Budget Submission	28,247	32,375	35,398

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

BA: 02 PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

PROJECT TITLE: Marine Corps Landing Force Technology

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
Marine Corps Landing Force Technology	28,247	32,375	35,398	38,707	38,022	39,205	40,014

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project is organized into seven activities which are represented as six Expeditionary Warfighting Capability Areas and the Littoral Combat Future Naval Capability (FNC). The six Amphibious Expeditionary Warfighting Areas support the Discovery and Inventions (D&I) and the Innovation and Transformation (I&T) investment. The Littoral Combat FNC supports the Exploitation and Deployment (E&D) investment.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Littoral Combat/Power Projection	15,797	15,000	17,038

This activity provides the capability for the demonstration and transition of technologies developed through the Marine Corps Science and Technology program directly to an acquisition program of record.

FY 2003 Accomplishments:

- Awarded contract for development of Advanced Amphibious Assault Vehicle (AAAV), now referred to as Expeditionary Fighting Vehicle (EFV), collision avoidance system development using Streak Tube Imaging Light Detection and Ranging (LIDAR) technology.
- Developed and demonstrated a proof-of-concept advanced Over-the-Horizon (OTH)/Beyond Line of Sight (BLOS)/On-the-Move (OTM) tactical data network for use by maneuver forces using secure wireless technology.
- Integrated laser range-finding technologies with service radios for achieving interoperability among US/Joint/Coalition close air support platforms.
- Developed, evolved and demonstrated technology solutions that provide tools for Marine ground forces that support the conduct of military decision-making process in the planning, evaluation, and execution of Expeditionary Maneuver Warfare.

- Developed, and demonstrated a proof-of-concept advanced Position Location Information (PLI) system for use at Twenty-Nine Palms, CA. Transitioned to higher funding category for further development and demonstration.
- Completed Ship To Objective Maneuver (STOM) study and architecture development.
- Completed development and demonstration of diver operated tactical hydrographic survey system. Transitioned to United States Marine Corps (USMC) Underwater Reconnaissance Capability program.
- Completed lethality effectiveness study for mortar ammunition and provided results to USMC Expeditionary Fire Support System (EFSS) program.

FY 2004 Plans:

- Continue development of EFV collision avoidance system.
- Continue development of OTH/BLOS/OTM tactical data network system for use by maneuver forces.
- Continue development of advanced target acquisition technologies for achieving interoperability among US/Joint/Coalition close air support platforms.
- Continue development of planning and decision-making tools for Marine ground forces. Test the software and evaluate during training exercises. Feedback from operational units will be incorporated into succeeding software versions.
- Continue development and integration of advanced PLI system with range instrumentation enhancements.
- Initiate development of algorithms to derive maps of water depths, current speed and direction, terrain elevation, and sandbar and obstacle location using digital imagery from airborne Intelligence, Surveillance, and Reconnaissance (ISR) assets to support expeditionary maneuver planning.
- Develop algorithms for use in discriminating between individual Radio Frequency (RF) emitters on the battlefield and determining their locations.
- Develop a software tool to allow Marine Corps Radio Battalions to quickly characterize an RF environment.

FY 2005 Plans:

- Demonstrate EFV collision avoidance system and transition to acquisition.
- Demonstrate OTH/BLOS/OTM tactical data network system during a scheduled training exercise and transition to acquisition.
- Demonstrate target acquisition technologies for achieving interoperability among US/Joint/Coalition close air support platforms and transition to acquisition.
- Continue development of planning and decision-making tools for Marine ground forces. Test the software and evaluate during training exercises.
- Continue development of algorithms to derive maps of water depths, current speed and direction, terrain elevation, and sandbar and obstacle location using digital imagery from airborne ISR assets to support

expeditionary maneuver planning.
- Complete development of algorithms for use in discriminating between individual RF emitters on the battlefield and determining their locations.
- Enhance and refine an automated emitter mapping tool for Radio Battalions.
- Initiate investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield.
- Initiate development of an architecture to network existing expeditionary fires systems.

	FY 2003	FY 2004	FY 2005
Maneuver	1,774	4,086	5,000

This activity supports and enhances the overall maneuver of forces ashore through the development of mobility, survivability, and unmanned ground vehicle technologies.

FY 2003 Accomplishments:

- Initiated Marine Corps Air Ground Task Force (MAGTF) Expeditionary Family of Fighting Vehicles (MEFFV) Technology Investment Strategy study.
- Fabricated prototype Expeditionary Fighting Vehicle (EFV) band tracks and initiated performance and durability testing on an Amphibious Assault Vehicle (AAV).
- Continued lightweight Expeditionary Systems Materials (ESM) development program, conducted down-selection process and awarded Phase 2 contracts.
- Completed MEFFV Lethality and Rate-of-Fire Study.

FY 2004 Plans:

- Continue MEFFV Technology Investment Strategy.
- Conduct EFV band track redesign based on lessons learned and results from Phase I AAV testing. Upon approval, fabricate new tracks and test on higher weight AAV or EFV prototype.
- Continue lightweight ESM efforts to determine feasibility of scaling and producing candidate structural armor.
- Initiated Tactical Unmanned Ground Vehicle (TUGV) technology development and insertion to improve propulsion, sensors, and data fusion capabilities.
- Develop simulation based acquisition tool for conducting future combat vehicle design tradeoffs.

FY 2005 Plans:

- Initiate concepts and designs of the integrated MEFFV System utilizing the simulation based design tool previously developed and results of subsystem developments.
- Initiate S&T efforts addressing MEFFV and USMC future combat system technology investment plan.
- Continue Phase II ESM efforts and prepare for Phase III down selection process.
- Conduct modeling and simulation (M&S) and analysis of detailed MEFFV concepts in accredited USMC and Joint Service scenarios.
- Continue TUGV technology development and insertion to improve propulsion, sensors, and data fusion capabilities.

	FY 2003	FY 2004	FY 2005
HUMAN PERFORMANCE,TRAINING & EDUCATION (HPT&E)	2,610	2,600	3,500

This activity develops advanced training technology and technologies that enhance neural and cognitive aspects of human performance including cognitive task analysis, tactical decision-making, modeling, simulation, range instrumentation and synthetic environment generation.

FY 2003 Accomplishments:

- Evaluated technologies available for the development of an Anti-Terrorism Force Protection (ATFP) Tactical Decision-making Simulation (TDS).
- Developed technologies required to produce a prototype of a Combat Engineering TDS to supplement the program of instruction for the Engineer Officer's Course.
- Developed technologies required to produce a prototype of a Combat Service Support Element (CSSE) TDS to supplement the program of instruction for the Logistics Officer's Course.
- Developed technologies for the development of a Rapid Portable Synthetic Environment Generation capability.
- Developed technologies for Radio Frequency (RF) tracking and video tracking fusion for enhanced situational awareness in a Military Operations in Urban Terrain (MOUT) training environment.

FY 2004 Plans:

- Evaluate technologies available for the development of an Aviation Combat Element (ACE) TDS.
- Develop technologies for an ATFP TDS to include performing a Cognitive Task Analysis (CTA).
- Develop technologies for producing a common three dimensional database format and toolset suitable for use with rapid portable synthetic environment generation technology and tactical decision-making simulation

technology.
- Evaluate suitability of augmented cognition technology to improve human cognition via multiple sensory modalities. This will identify opportunities for integration of augmented cognition technology with the: C4ISR, Maneuver, Firepower, Organic Mine Countermeasure, Logistics, HPT&E and Littoral Combat efforts.
- Develop technologies for ad hoc wireless networks for enhanced situational awareness in a Military Operations in Urban Terrain (MOUT) training environment.
- Develop technologies for Radio Frequency (RF) tracking and video tracking fusion for enhanced situational awareness in a Military Operations in Urban Terrain (MOUT) training environment.

FY 2005 Plans:

- Evaluate technologies available for the development of a Command Element (CE) TDS.
- Develop technologies for an ACE TDS to include performing a CTA.
- Develop technologies for an ATFP TDS.
- Evaluate technologies for integration of live and virtual simulation technologies for a MOUT training environment.
- Evaluate technologies available for instrumentation and enhanced situational awareness in a MOUT training environment.
- Develop augmented cognition technology to improve human cognition via multiple sensory modalities. This will include integration of augmented cognition technology with the: C4ISR, Maneuver, Firepower, Organic Mine Countermeasure, Logistics, HPT&E and Littoral Combat efforts.

	FY 2003	FY 2004	FY 2005
Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR)	2,219	4,100	3,500

This activity provides technologies for secure, robust, self-forming, mobile communications networks (FORCEnet); distributed computing to support information dissemination to all echelons; and sensors, software and data processing to support formation of appropriate common picture. Emphasis for Marine Corps efforts includes power management, low detect ability, size and weight constraints, and interoperability within the joint environment.

FY 2003 Accomplishments:

- Began development of conformal, broadband, Ultra High Frequency-Very High Frequency (UHF-VHF) antennas to be completed FY06.

- Began development of network mobility capabilities for the low-bandwidth, heterogeneous comms environment to be completed FY05.
- Began development of network security technologies for low-bandwidth distributed environments to be completed FY05.
- Continued development of high-density, solid-state data storage devices to be completed FY04.
- Completed Joint Tactical Radio System Standards (JTRS) and Architecture development and JTRS network modeling and methods of employment.

FY 2004 Plans:

- Initiate development of network management capabilities for the low-bandwidth, heterogeneous comms environment to be completed FY06.
- Initiate development of information technologies for management of sensor and intelligence data to be completed FY06.
- Continue development of conformal, broadband, UHF-VHF antennas to be completed FY06.
- Continue development of network mobility capabilities for the low-bandwidth, heterogeneous comms environment to be completed FY05.
- Continue development of network security technologies for low-bandwidth distributed environments to be completed FY05.
- Complete development of high-density, solid-state data storage devices.

FY 2005 Plans:

- Initiate sensor networking technologies for the tactical environment to be completed FY07.
- Continue development of network management capabilities for the low-bandwidth, heterogeneous comms environment to be completed FY06.
- Continue development of information technologies for management of sensor and intelligence data to be completed FY06.
- Continue development of conformal, broadband, UHF-VHF antennas to be completed FY06.
- Complete development of network mobility capabilities for the low-bandwidth, heterogeneous comms environment.
- Complete development of network security technologies for low-bandwidth distributed environments.

	FY 2003	FY 2004	FY 2005

BA: 02 PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology
PROJECT TITLE: Marine Corps Landing Force Technology

	FY 2003	FY 2004	FY 2005
Firepower	1,693	3,000	3,453

This activity develops technologies that enhance effectiveness and expand spectrum of lethality of Marines including non-lethals, and supporting fire control technologies.

FY 2003 Accomplishments:

- Conducted Tactical Weapons Control Station/Dragon Warrior Unmanned Aerial Vehicle software risk reduction assessment and provided results to Naval Air Systems Command.
- Completed Phase 1 of neuromuscular disruption non-lethal weapons technology development involving waveform bio-effects, launcher and projectile concepts, and concepts for multiple target engagement with a single untethered round.
- Commenced Phase 2 development of neuromuscular disruption non-lethal weapons efforts.
- Completed improved signal processing effort involving thermal imaging system in support of M1A1 Firepower Enhancement Program. Technology development included two dimensional interpolation algorithms for improved smoothness of electronic zoom.
- Completed improvements to high performance Forward Looking Infrared Radar sensor in support of M1A1 Firepower Enhancement Program. Technology included advances in pixel density for range performance.

FY 2004 Plans:

- Complete Phase 2 of neuromuscular disruption efforts.
- Improve far target location and extended range performance and detection of camouflaged/hidden targets in support of M1A1 Firepower Enhancement Program.
- Develop concepts for the small arms sensor fusion to enhance the effectiveness of the individual warfighter in conjunction with the Joint Service Small Arms Program.
- Conduct investigation of in-service mortar barrel wear and materials and related processes to enhance the durability of future mortar systems.
- Conduct an assessment of existing and evolving fuze technologies to enhance the reliability and safety of submunitions.
- Complete concept development effort for a mortar reconnaissance round to support warfighter situational awareness.

FY 2005 Plans:

- Develop sensor technologies to improve firepower effectiveness while increasing affordability and decreasing logistical burden in support of Expeditionary Maneuver Warfare.
- Study explosives technologies to improve firepower effectiveness while increasing affordability and decreasing logistical burden in support of Expeditionary Maneuver Warfare.

	FY 2003	FY 2004	FY 2005
Logistics	1,760	2,600	1,500

This activity develops technologies to enhance distribution of material and reduce footprint to end users ashore with emphasis on expeditionary water and bridging.

FY 2003 Accomplishments:

- Leveraged Defense Advanced Research Projects Agency (DARPA's) Water Harvesting program to evaluate the military utility of Water Disinfection Pen that provides the capability for individuals to purify water from fresh water sources.
- Explored development of a Tactical (High Mobility Multi-purpose Wheeled Vehicle (HMMWV) sized) water purification/generation and distribution program.
- Assessed the feasibility of taking composite raw materials (resins) and manufacturing them into interchangeable bridging (assault, tactical, line of communication) components in a field environment.
- Assessed advanced surface coatings and materials technologies to be utilized in Depot level Reliability, Availability, and Maintainability (RAM), and Service Life Improvement Programs.

FY 2004 Plans:

- Continue exploring the feasibility of developing an individual warfighter handheld water purification/desalination device that can purify any source of water (fresh, brackish, salt).
- Continue exploring the feasibility of a lightweight expeditionary bridging capability by assessing alternative bridging techniques, bridge design, and material and manufacturing solutions to include composite, extrusion, casting and forging techniques.

FY 2005 Plans:

- Continue exploring the development and demonstration of water purification and generation technologies to

demonstrate the feasibility of performance improvement.
- Continue exploring a lightweight expeditionary bridging capability.

	FY 2003	FY 2004	FY 2005
Mine Countermeasures (MCM)	2,394	0	1,407

This activity develops technologies to enable land-mine detection, neutralization, breaching, and clearing from beach exit zone to inland objectives. Current Naval MCM efforts address MCM capabilities through the Beach Exit Zone, but do not address a seamless, end-to-end MCM capability. Marine Air-Ground Task Force (MAGTF) MCM must be a functional component of Naval Expeditionary Maneuver Warfare (EMW); to include Ship to Objective Maneuver, Expeditionary Operations from a Sea Base, Sustained Operations Ashore, and Operations Other Than War. In 2001 the Institute for Defense Analyses (IDA)/Office of Naval Research (ONR) "Mine Countermeasures (MCM) for Beach Exit Zone to Objectives Study" comprehensively looked at all on-going MCM programs and technologies, particularly U.S. Army MCM plans. The IDA/ONR MCM Study identified major MAGTF deficiencies (inadequately addressed in current Army, Navy, and Marine Corps programs). The IDA/ONR MCM Study's execution strategy was endorsed by senior Marine Corps leadership.

FY 2003 Accomplishments:

Three S&T MCM initiatives were commenced:
-Lightweight Mechanical Breaching Systems for Marine Corps vehicles against all buried mines regardless of fusing type.
-Advanced Signature Duplication Systems, for land and airborne platforms, to neutralize top-attack, side-attack, anti-helicopter, and bottom-attack landmines.
-Family of Tailored Explosive Systems that can attack specific mine belts or individual mines at standoff distances.

FY 2004 Plans:

-Discovery and Invention (D&I) initiatives initiated in FY 2003 have been deferred one year because of affordability constraints due to high priorities in other activity areas.
-A priority MCM initiative, the congressionally mandated Advanced Mine Detector project, is significantly enhanced this year, in the Marine Advanced Technology Demonstration (ATD) line (PE 0603640M).

FY 2005 Plans:

-Re-institute the three FY 2003 D&I initiatives: (1) Lightweight Mechanical Breaching Systems for Marine Corps vehicles against all buried mines regardless of fusing type; (2) Advanced Signature Duplication (ASD) Systems, for land and airborne platforms, to neutralize top-attack, side-attack, anti-helicopter, and bottom-attack landmines; and (3) Family of Tailored Explosive Systems that can attack specific mine belts or individual mines at standoff distances.

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ADVANCED LEAD ACID BATTERY DEVELOPMENT FOR MILITARY VEHICLES	0	989

This effort will develop lead acid battery technology to increase the life, energy and power output of lead acid batteries used by the Marine Corps and Navy. Novel approaches will be explored including the use of a horizontal plate design, and conductive additives to the electrodes. High performance batteries will have improved performance to their cycle life and energy density, while maintaining high power capabilities which will translate directly into cost reductions, increased efficiency and improved sea basing of naval expeditionary forces.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E: This program adheres to Tri-Service Reliance Agreements in Chemical/Biological Defense; Command, Control and Communications; Conventional Air/Surface Weaponry; Electronic Devices; Ground Vehicles; Ships and Watercraft; Manpower and Personnel; and Training Systems.

PE 0601152N (In-House Laboratory Independent Research)
PE 0601153N (Defense Research Sciences)
PE 0204163N (Fleet Telecommunications (Tactical))
PE 0602235N (Common Picture Applied Research)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0206623M (Marine Corps Ground/Supporting Arms Systems)
PE 0603640M (Marine Corps Advanced Technology Demonstrations)

PE 0603612M (Marine Corps Mine Countermeasures)
PE 0603635M (Marine Corps Ground Combat/Support System)
PE 0206313M (Marine Corps Communications Systems)
PE 0603236N (Warfighter Sustainment Advanced Technology)

NON NAVY RELATED RDT&E:
PE 0603004A (Weapons and Munitions Advanced Technology)
PE 0603005A (Combat Vehicle and Automotive Advanced Technology)
PE 0603606A (Landmine Warfare and Barrier Advanced Technology)
PE 0603607A (Joint Service Small Arms Programs)
PE 0603619A (Landmine Warfare and Barrier Advanced Development)
PE 0603772A (Advanced Tactical Computer Science and Sensor Technology)
PE 0604710A (Night Vision Systems-Engineering Development)
PE 0604808A (Landmine Warfare/Barrier Engineering Development)
PE 0602301E (Computing Systems and Communications Technology)
PE 0602702E (Tactical Technology)

D. ACQUISITION STRATEGY:
Not Applicable

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

BA: 02 PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: Common Picture 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
Common Picture Applied Research	142,203	95,432	60,134	72,612	75,504	76,897	78,462

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Work in this Program Element (PE) addresses technologies that enable the transformation to network centric warfare, which relies on information to connect assets and provide timely and accurate understanding of the environment. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to decisive, precise, desired engagement outcomes. The focus is on a high performance network that achieves a common situational awareness that connects geographically distributed forces into a unified Naval Force. Technologies emphasized provide warfighters with a robust, secure, mission responsive network; integrated information leading automated courses of action; and presentation of knowledge to speed understanding. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower. The program explores and demonstrates technologies that enable options for Knowledge Superiority and Assurance (KSA), Missile Defense (MD), and Fleet and Force Protection (FFP) Future Naval Capabilities (FNC). In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet, "Persistent Intelligence, Surveillance, and Reconnaissance," "Time Sensitive Strike," "Sea Based Information Operations," "Sea Strike" Ship-to-Objective Maneuver, and "Sea Shield" Theater Air and Missile Defense.

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

BA: 02 PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: Common Picture Applied Research

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	148,222	59,022	70,120
Cong. Rescissions/Adjustments/Undist.Reductions	0	-1,164	0
Congressional Actions	0	37,575	0
Execution Adjustments	-2,540	0	0
Inflation Savings	0	0	-226
Rate Adjustments	0	-1	-60
SBIR Assessment	-3,479	0	0
Technical Adjustments	0	0	-9,700
FY 2005 President's Budget Submission	142,203	95,432	60,134

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

BA: 02 PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: Common Picture Applied Research
PROJECT TITLE: Common Picture 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
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B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Network Command, Control and Combat Systems	22,410	18,631	20,857

This initiative explores development of advanced technologies that contribute to integrated decision-making and mission execution to achieve battlespace superiority. The activity emphasizes activity that leverage the power of networks to exploit information and information technology, and maximize the capability of platforms to use information to accomplish missions. This provides a force multiplier effect and supports Joint/coalition combat operations. This activity has six focus areas: (1) information management which

addresses technologies to reduce informational demands; (2) image processing and exploitation, which enables image enhancement, feature extraction, and dissemination; (3) visualization technology, providing improved battlespace views, including augmented virtual reality; (4) battlespace decision aids, which assist with optimized planning, assessing, executing, and monitoring of operations; (5) networked command and control (C2) for combat applications, supporting laboratory testing of network centric concepts; and (6) information network situational awareness, which focuses on secure, seamless information exchange within networked systems (weapons, sensors, etc.).

FY 2003 Accomplishments:

- Continued work on the multi-resolution, multi-scale image registration to address issues in multi-sensor, multi-model, multi-channel image registration/coordination with applications to precision targeting, image enhancement, change detection and fusion. Techniques evaluated included those that are contrast invariant, automatic, and take into account three-dimensional projective transformations from two dimensional images. Visualization technology plans included applying computer graphics algorithms to visualize uncertainty for underwater environmental and target data.
- Conducted a pre-launch flyout deconfliction for the Real Time Deconfliction effort.
- Extended Just-In-Time Real Time Replication (JITRTR) algorithm to work in a dynamic environment, such as a Distributed Collaborative Environment, where it is not possible to know about all data access requirements for the Distributed Real-Time Combat Systems (DRCS) effort. New algorithms used an initial estimate of data access requirements to determine when and where to create replicas of the real-time data. The new algorithms produced replication transactions that made copies of time-critical data in locations where the data was needed. The DRCS effort also conducted a limited objective experiment with Special Operational Forces (SOF) operators to collect valuable operational information needed to develop the algorithms.

FY 2004 Plans:

- Demonstrate multi-modal image registration for multi-resolution and multi-scale image processing effort.
- Develop high accuracy mobile tracking and registration algorithms used in augmented reality systems for military operations in urban terrain (MOUT).
- Demonstrate prioritized real time data replication and dissemination algorithms to prioritize the delivery of real time information from unattended distributed sensors in support of operational missions.
- Compare alternative architectures for the Theater Battlespace Command & Control.
- Design a Quality of Service (QoS) real-time model that enables the expression of time critical concepts and level of QoS. This will be invaluable in FORCEnet and Network Centric Warfare deployments to predict where, when, and why scheduling and network bottlenecks will occur.

- Demonstrate new techniques for providing improved computer network defense and improved situational awareness.
- Conduct laboratory demonstrations of distributed real-time networked data element replication and conduct cross database comparisons Real Time Deconfliction effort.
- Develop advanced algorithms, software tools and decision aids to handle and process large volumes of information.

FY 2005 Plans:

- Continue image registration error analysis for the multi-resolution and multi-scale image processing effort.
- Evaluate value of 3D techniques to enhance visualization technology.
- Conduct worst-case detection and conflict avoidance experimentation for the Real Time Deconfliction effort.
- Augment the real world information with computer-generated information in the Battlefield Augmented Reality System effort. The activity will also design a modular framework to support the system design and enable the insertion of custom scheduling and replication solutions. Other efforts will focus on the middleware layer to support emerging network centric sensor-to shooter systems.

	FY 2003	FY 2004	FY 2005
Knowledge Superiority and Assurance	20,301	15,661	16,000

Knowledge Superiority and Assurance explores fundamental technologies that enhance the Navy's capability to exploit, manage and integrate complex, heterogeneous, multi-source information for the next generation common picture through 1) Common Consistent Knowledge; 2) Dynamically Managed, Interoperable, High-Capacity Connectivity; and 3) Time-Sensitive Decision-making. Common Consistent Knowledge addresses the needs of operating forces for common picture information in the planning, monitoring, and re-planning cycle of operational and tactical force employment. Dynamically Managed, Interoperable, High-Capacity Connectivity addresses wireless network technology critical to the performance and robustness of Naval communications by providing higher data rates, expanded coverage to disadvantaged platforms, and improved bandwidth management. Time-Sensitive Decision-making supports tactical operations where the timeliness and accuracy of decisions is crucial to the successful and efficient application of available forces.

FY 2003 Accomplishments:

- Developed Cryptologic Management Analysis and Support Segment (CMASS) algorithms for Indications and

Warning (I&W), including automatic recognition of reportable events and automatic generation of routine periodic reports.

- Refined Environmental Visualization forecasting algorithms.
- Refined Knowledge Web Technologies by expanding the integration of information from multiple sources.
- Refined the middleware for the Defense Information Infrastructure Common Operating Environment (DII COE) to improve interoperability in-theater by enabling users to share contact information, overlays, fleet message information and displays.
- Developed additional algorithms for the Human Alerting and Interruption Logistics to assist in data management.
- Continued development of the Extensible Tactical Command, Control, Communications, Computers and Intelligence (C4I) Framework (XTCF).
- Continued development of an extensible data management framework to enable stovepiped real-time and near real-time intelligence, surveillance, and reconnaissance (ISR) systems to share data and common services seamlessly, thus increasing the speed of command and span of information access.
- Developed algorithms and tools that guide staffs through doctrine-based planning, improving mission planning cycles.
- Continued development of architecture to improve mission planning by enabling automatic, rapid, and accurate assessments of air activities in preparing strike assets for attack. This activity also initiated the Underwater Surveillance Data-Link Network to develop a reliable, wireless over-the-horizon and line-of-sight bi-directional communication capability between remotely deployed sonobuoys and ships, aircraft and shore data processing stations and the Analytic Support Architecture to reduce the time required to manually discern enemy air defense activities.

FY 2004 Plans:

- Continue development of CMASS software to provide a single repository for intercept data, automatic operator alerting, and voice analysis; conduct operational test.
- Continue refining Environmental Visualization forecasting algorithms to provide information less than an hour old for strike operations.
- Conduct at-sea tests in XTCF to establish and demonstrate a data management framework that enables more rapid and timely technical and developmental exploitation of emerging, complex, and heterogeneous data sources for the Common Picture.
- Continue refinement of Knowledge Web Technologies and conduct demonstrations of the tools and procedures.
- Refine the Analytic Support Architecture to improve location accuracy for air defense threats.
- Refine the Underwater Surveillance Data-Link Network algorithms and conduct a demonstration.

FY 2005 Plans:

• Continue demonstrations of CMASS. Develop capability to automate linkage of Commander's Intent to cryptologic and intelligence system management, posting of information, processing, and use.
• Extend Environmental Visualization capabilities to large deck amphibious assault ships to support meteorological products for multiple users in support of strike operations.
• Continue improving human interfaces including Knowledge Web Technologies to provide integration operational and tactical source information for the common picture through information aggregation techniques, filtering, and data mining, as well as intelligent software agents.
• Refine heterogeneous data fusion techniques in XTCF.
• Focus on integration an0d information sharing across component commands, tactical units, coalition forces, and non-governmental agencies using web-based crisis information management techniques, visualization capabilities, and group planning tools. Emphasize common undersea picture challenges in information understanding.
• Explore rapid course of action development using synthetic semi-automated forces for fast, large-scale, high-fidelity simulations, including models of human cognition and visualization techniques for assessing outcomes and uncertainties.

	FY 2003	FY 2004	FY 2005
Communication and Networks	9,000	8,231	8,611

This initiative develops wireless communications network technologies critical to the performance and robustness of Naval communications for air, ship, submarine, and land platforms. Developments include bandwidth efficient communication techniques; advanced networking techniques for robust, highly dynamic environments; interoperable wireless networks for secure communications and protocols; bandwidth and network management techniques that can effectively manage and allocate bandwidth across tactical and theater levels in support of wireless network centric operations. The exploration payoffs include increased network data rates, improved coalition interoperability, dynamic bandwidth management, greater mobile network connectivity, and efficient waveforms to improve communications with land forces.

FY 2003 Accomplishments:

• Developed the Dynamic Backbone Subnet networking protocol suite for mobility management of heterogeneous networks; integrated it with an IEEE 802.11 Wireless Local Area Network (WLAN) device; field tested it in a small, mobile network to determine if there were improvements in Low Probability of Intercept/Low Probability of Detection (LPI/D) for remote users.

- Developed, adapted to Naval satellite channels, and field tested a dynamic access controller prototype for bandwidth management.
- Conducted a multinational demonstration of interoperable networks in a coalition environment, including mobility, routing, security, and network management with various application services for the Interoperable Networks for Secure Communication (INSC) effort.
- Developed a real-time emulation of tactical phased array networking and scheduling algorithms on a multi-PC networked system, as well as laboratory testing of the emulation. Fabricated and tested digital receiver components. Developed, designed and implemented software for a bandwidth efficient waveform (with advanced modulation, coding, and adaptive equalization) into a prototype modem.
- Developed a medium access control algorithm to allow multiple submarines to share a single satellite communications channel and simulated performance.
- Integrated LPI/D technology with WLAN to provide wireless network access devices for vulnerable assets.
- Designed an optical, tunable, microwave filter for multifunction antennas.

FY 2004 Plans:

- Continue INSC experimentation and results sharing from multinational demonstrations of interoperable networks in a coalition environment and organize a symposium for dissemination and presentation of contributions from each nation.
- Field test tactical phased array networking and scheduling algorithms using a small set of mobile platforms and phased arrays.
- Integrate the digital receiver front-end on a cryocooler for a demonstration of the superconductive digital receiver. This Joint Tactical Radio System (JTRS)-compliant receiver (software programmable) can be used to mitigate several classes of cosite interference problems. A prototype modem will be tested over Line-of-Site (LOS) channels (with bandwidth efficient waveform using advanced modulation, coding and adaptive equalization techniques); the waveform design will be provided to JTRS and the ARC-210 radio programs.
- Integrate LPI/D technology with a secure WLAN to provide wireless network access devices for vulnerable assets and demonstrate this technology. The optical, tunable microwave filter components will be integrated and a fully integrated adaptive microwave filter front-end will be demonstrated for multifunction antennas.
- Evaluate and develop solutions to next generation Internet Protocol (IP) technology to meet Navy/Marine Corps networking challenges particularly mission responsive quality of service; and develop options for addressing existing problems through enhanced capabilities of IPv6 technology.

FY 2005 Plans:

• Continue testing next generation IP software solutions and options on Navy, DoD, and coalition networking test beds; investigate IP version 6 (IPv6) and IP version 4 (IPv4) network coexistence strategies; and provision of IPv6 technology solutions into USN/USMC IP architectures.

	FY 2003	FY 2004	FY 2005
Multi-Source Integration and Combat Identification	7,900	6,981	7,175

Multi-Source Integration (MSI) and Combat Identification (CID) directly supports the Missile Defense Future Naval Capability (FNC) by addressing needs for MSI, fusion, system architecture, automated sensor management and algorithms to fuse, filter and correlate on-board sensor and off-board battlespace information from tactical data links, satellite communications and interoperable cooperative engagement networks.

FY 2003 Accomplishments:

• Continued MSI project development and testing of algorithms to integrate radio frequency (RF) Sensors, Identification Friend or Foe (IFF), Joint Tactical Information Distribution System (JTIDS). Correlate satellite communications (SATCOM) data to the integrated track file of the E-2C mission computer.
• Continued Advanced Sensor Networking Technology (ASNT) development and testing of algorithms for electronic warfare support in data association and Cooperative Engagement Capability (CEC) track correlation.
• Continued Composite Combat Identification (CCID) project development of algorithms to correlate and fuse CEC data with intelligence, surveillance and reconnaissance (ISR) data processed aboard reconnaissance aircraft and Ship Signal Exploitation Equipment (SSEE)-equipped surface ships. Continued CCID project development of common identification (ID) reasoning algorithm for the naval open architecture combat system.

FY 2004 Plans:

• Continue MSI project development and testing of algorithms for the E-2C mission computer.
• Continue MSI project development and testing of algorithms for the CEC program.
• Complete development of CCID algorithms to correlate and fuse CEC data with ISR data processed onboard reconnaissance aircraft and continue development for SSEE-equipped surface ships. Continue development of a common ID reasoning algorithm for the naval open architecture combat system.

FY 2005 Plans:

- Continue MSI algorithm development and testing for the E-2C aircraft and begin efforts to apply these algorithms to other platforms, including the naval open architecture combat system.
- Continue development of ASNT algorithms for integration of electronic surveillance (ES) data into CEC.
- Conduct subsystem integration and systems integration laboratory testing of the CCID common reasoning algorithm. Continue to develop and test algorithms to correlate CEC data with ISR data onboard SSEE-equipped ships.

	FY 2003	FY 2004	FY 2005
Human Computer Interface	8,007	4,174	5,491

This activity focuses on improving platform, task force and battle group operations by developing decision support technology for incorporation into operational systems. The goals are to enhance human performance effectiveness; improve decision support and decision-making collaboration; improve human-centered design; and accelerate insertion of advanced human factors engineering technology into existing and new weapons systems. The payoff is the creation of decision-action cycles that are faster than an enemy's, and reduced workload and staffing requirements. Specific objectives include achieving improved situational awareness and speed of command through a deeper understanding of human capabilities and limitations, as well as accomplishing quality performance in complex, dynamic, high-tempo and uncertain threat environments. These objectives are being pursued in three focus areas: Decision Support and Organizational Design; Collaboration and Knowledge Management; and Human-Computer Interaction/Visualization.

FY 2003 Accomplishments:

- Developed optimization algorithms for Command and Control (C2) applications to enhance execution monitoring and dynamic replanning of Naval tactical missions.
- Developed a collaboration advisor tool that provides guidelines and interventions to optimize team decision-making performance.
- Demonstrated new concepts of shared virtual surfaces for quick-reaction team pattern recognition and decision-making.
- Developed and tested advanced audio technology and interactive audio management user interfaces for sonar workstations. This technology reduces tactical decision times by 10% and head movements by 24%, with no performance tradeoffs.
- Developed a computational cognitive model to describe human-automation interactions with respect to information integration in real-time critical decision-making problems.

- Developed simulated devices for the study of interface design with isomorphic interface control (the ability to swap in and out interface features) and built a detailed computational cognitive model that uses the same simulation as the human to perform the same task.
- Knowledge Web/Desks decision support systems were installed aboard the USS Constellation and Theodore Roosevelt. These systems significantly improved speed of command and efficiency of asset use by the Battle Group staffs.

FY 2004 Plans:

- Develop cognitive computational models of multi-echelon command decision-making to define critical knowledge components for command and control.
- Research to integrate optimization, discrete event and organizational effectiveness models in order to provide computational formalisms for the design of adaptive architectures for command and control.
- Develop user/agent interfaces for knowledge sharing in coalition teams.
- Develop cognitive models for agent-assisted asynchronous collaboration.
- Develop and test attention management tools for improved resumption after interruptions.
- Develop more general advanced audio interface components for multi-modal workstation, incorporate Anti Submarine Warfare (ASW) tasks in design.
- Construct isomorphic interface controls for three simulated devices that will enable the systematic manipulation of the perceptual-motor and cognitive effort required to use each device.
- Test and validate discourse analysis techniques for measuring communication content and flow as a tool for estimating team situational awareness.
- Develop and empirically validate a cognitive process-based model for agent-assisted asynchronous collaboration.

FY 2005 Plans:

- Conduct model-based simulations and experiments to investigate the effectiveness of heterarchical organizational structures in network-centric operational environments in order to evaluate the implementation of FORCEnet concepts.
- Develop reconfigurable organization design structures for culturally diverse decision-making teams.
- Improve designs for integration of audio into Naval watchstations.
- Compare the performance of simulated human users with real users in acquisition of knowledge and performance ability for different interface designs of simulated devices.
- Develop video scene enhancement tools for improved team situational awareness.
- Develop an automated team knowledge elicitation tool for improved shared understanding in intelligence

analysis activities.

	FY 2003	FY 2004	FY 2005
Platform Awareness and Protection Electronic	2,000	2,618	2,000

This activity supports the Fleet and Force Protection (FFP) Future Naval Capability (FNC). Currently, small surface, ground and airborne platforms have little to no situation awareness (SA) or self-protection, which jeopardizes their effectiveness and survivability. The Electronic Warfare Integrated System for Small Platforms (EWISSP) program focuses on closing that gap by developing technologies to provide them with a full spectrum threat warning and countermeasures capability. This capability, when integrated with emitter identification and Low Probability of Intercept (LPI) radar detection systems, provides netted targeting information and cueing that enables self-protection. The Battlefield Ordnance Network Centric Employment (BONCE) effort will design and fabricate a compact, low cost, light weight active/passive electro-optic (EO)/infrared (IR) system for ordnance detection. The Tactical Reactive Command and Control (C2W)/Electronic Attack (EA) Network effort will develop and demonstrate a self-adapting, spatially distributed EA network for C2W.

FY 2003 Accomplishments:

- Conducted Shipboard Laser Acquisition System (SBLAS) 90-degree system design studies.
- Completed mechanical performance requirements for the Bi-Stem flexible countermeasures mast and began work on an Expeditionary Fighting Vehicle (EFV) compatible design.
- Evaluated data compression and transmission schemes and completed development of the detection algorithm framework and real-time processor under the BONCE effort.
- Analyzed and optimized hardware for the proof-of-concept demonstration and identified concept performance and enabling technology factors under the Tactical Reactive C2W/EA Network effort.

FY 2004 Plans:

- Conduct and complete laboratory performance explorations of a lightweight electro-optic/infrared (EO/IR) subsystem in preparation for Unmanned Aerial Vehicle (UAV) employment for BONCE.
- Explore and develop subsystem software interface algorithms for the 90-degree SBLAS system and continue exploration and refinement of the subsystem interface software for the EWISSP effort.

FY 2005 Plans:

- Continue exploration and refinement of the subsystem interface software for the EWISSP effort.

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ADVANCED INTEGRATED RADAR, ELECTRONICS AND PHOTONICS (AIREP, FORMERLY UESA)	12,153	10,631

FY 03: Funds supported the development and demonstration of a non-rotating, electronically scanned radar technology via a series of land based tests at the Mountain Top (MT) range at the Pacific Missile Range Facility (PMRF), Kauai and follow-on flight tests in an appropriate aircraft. FY 04: Work will include establishing a Radar Test Bed at PMRF and conducting demonstrations at the site.

	FY 2003	FY 2004
COMMON SENSOR MODULE - MICROELECTRONIC SENSORS FOR UNATTENDED SURVEILLANCE AT REMOTE SITES	0	1,780

Funds will support the development of small common sensor modules for ground forces. These sensors will be networked to provide total situational awareness for the ground forces and to extend the integrated picture to the rest of the forces. This will develop prototype modules and conduct limited demonstrations.

	FY 2003	FY 2004
EXPEDITIONARY STRIKE GROUP NETWORK (3RD FLEET)	0	4,203

This effort will consist of installation, operator/maintenance training, and sustainment of a Tactical Component Network (TCN) on a selected Expeditionary Strike Group (ESG). ESG funds will provide the basic equipment suite, software operating licenses, and technical representative support for the duration of the installation. TCN installation will be conducted under “temporary alteration” parameters, and a portion of the funds will be set aside to pay for removal of the TCN equipment should that become necessary.

BA: 02 PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: Common Picture Applied Research
PROJECT TITLE: Common Picture Applied Research

	FY 2003	FY 2004
M2C2	12,150	1,978

FY 03: Developed and demonstrated the Mobile Modular Command Center (M2C2) in support of Naval Forces in the Mid-Pacific (MIDPAC) region, specifically at the Pacific Missile Range Facility (PMRF) on Kauai and potentially at the Pohakuloa Army training Range on Hawaii. This program developed and demonstrated: (1) Mobile Modular Command Center (M2C2) leveraging facilities in the Mid-Pacific (MIDPAC) region; (2) Cooperative Engagement Capability (CEC) antenna for Advance Hawkeye; and (3) Long Range Theater Ballistic Missile Defense (TBMD) Surveillance at PMRF. The M2C2 used an Open Network Architecture to integrate Marine communication systems and commercial communications systems into a single integrated picture display which provides real-time situational awareness. M2C2's Network architecture leveraged commercial off-the-shelf hardware for modular implementation.

FY 04: This funding will enable the development and demonstration of M2C2 in support of Naval Forces at the Pacific Missile Range Facility (PMRF) on Kauai and potentially at the Pohakuloa Army training Range on Hawaii. This program will develop and demonstrate Over-the-Horizon (long range), On-the move wide reach back capabilities for command and control functions for ground forces. Products include: (1) a tactical mobile Command and Control (C2) center capable of supporting multi-mission tactical operations-combat, peacekeeping and humanitarian assistance; (2) interface with US Army's Future Combat System (FCS) command and control functionality; and (3) support Ship-to Shore objectives by being transportable in a V-22/H-60 liftable configurations.

	FY 2003	FY 2004
NAIF	0	4,945

The Network Applications Integration Facility (NAIF) will serve as a global hub to support Tactical Component Network (TCN) operations, application development and integration, and expansion of TCN instantiation with the Fleet. The NAIF will support component and protocol standardization, global distribution of data, engagement coordination, and test and integration across land, sea, and air platforms. It will be manned to accommodate the operating parameters dictated by Fleet needs, and will surge to reflect exercise and/or operational contingencies. Contracts for support operations and sustainment will emphasize Hawaiian small businesses to the maximum extent practical.

	FY 2003	FY 2004
NATIONAL CENTER FOR ADVANCED SECURE SYSTEMS RESEARCH (NCASSR)	5,479	7,416

FY 03: Funds were used to develop an information centric (content-based) approach to security to meet the needs of tactical mobile forces operating in a network centric coalition warfare environment. The project addressed scalability, access control of information objects and user identification management. The effort is based upon current Information Technology standards and scalable to multiple applications and domains, including homeland security collaboration at all levels, critical infrastructure protection, and financial and medical information protection. FY 04: Continue the development and demonstration of information assurance research efforts in monitoring, containing and preventing hostile attacks, denial of service and malicious mobile code. Funding will also address continued advancements in comprehensive vulnerability analysis and the development of tamper-resistant hardware and software.

	FY 2003	FY 2004
NAVAL AUTOMATION AND INFORMATION MANAGEMENT TECHNOLOGY	2,380	989

FY 03: Established a formal framework for navigation and coordination of multiple heterogeneous assets operating in real-time; derived a solid foundation for distributed sensing and sensor fusion where information from individual robots was fused and presented to human operators, rather than raw data. FY 04: Improves performance and usability, while reducing cognitive demands of the interface, which leads to fewer operators needed to control the robot team. It supports the design of a modular hardware and software architecture with platform independent components supporting overall system functionality.

	FY 2003	FY 2004
RESEARCH IN AUGMENTED AND VIRTUAL ENVIRONMENT SYSTEMS (RAVES)	2,380	0

Funds were used to develop innovative software, hardware, and prototyping methods for producing effective and robust virtual and augmented reality systems for military applications. Additionally, algorithms and novel methods for technical areas that provide the underpinning of these systems including computer graphics, machine vision for tracking human body movement and image registration, optics for augmented reality displays, and human/computer interaction for navigation through 3D virtual worlds were developed. Strategies for integrating disparate augmented and virtual environments and scenario generation and after action review tools were developed. Algorithms and systems were developed for extracting and understanding information contained

in embedded systems that contain large numbers of diverse sensors and computers. Perception-based, multimodal interaction techniques, such as those using voice, gesture, 3D sound, and haptics, were developed and demonstrated. Evaluation and usability studies were performed to gain new understanding of the scientific underpinnings of all of the above systems and components. Potential applications include augmented reality systems for the dismounted warfighter, virtual reality systems for training and situational awareness, improved human/computer interaction techniques for situational awareness, medical and scientific visualization, and embedded training in military operations in urban terrain facilities.

	FY 2003	FY 2004
SUBMARINE ENABLING AIRBORNE DATA EXCHANGE AND ENHANCEMENT PROGRAM	1,429	0

Funds supported technologies to facilitate timely exchange of tactical data between airborne and submarine platforms.

	FY 2003	FY 2004
TACTICAL COMPONENT NETWORK	28,515	0

Funds supported the integration of the TCN at Pacific Missile Range Facility (PMRF) to support networking for the Navy's cooperative engagement capability demonstrations. Developed integrated modular command posts for various sites at PMRF and integrated range sensors with advanced sensors in development using TCN software. This effort included three tasks: 1) integration of TCN network capability at PMRF and use of 3rd Fleet assets to further demonstrate a single integrated picture; 2) continuation of the 7th fleet ESSEX ARG installation and demonstration through Cobra Gold (this also includes development of training modules for the fleet); and 3) participation in the TCN evaluation in support of Program Executive Office (Theater Surface Combatants) (PEO-TSC) to consider the applicability of an cooperative engagement capability.

	FY 2003	FY 2004
THEATER UNDERSEA WARFARE (TUSW) INITIATIVE	8,099	5,933

FY 03: Worked with the Maui High Performance Computing Center and PMRF to integrate the undersea picture to the single integrated picture using Web Centric ASW as the backbone technology. FY 04: This effort will demonstrate the ability of various platforms to connect with and use the integrated undersea picture via Web Centric ASW, as well as integrating additional data inputs.

	FY 2003	FY 2004
WEB BASED TECHNOLOGY INSERTION FOR THE EWT	0	1,261

This effort will take emerging web based solutions and apply them to an area such as time critical targeting and expeditionary warfare applications, and determine the effectiveness of using enterprise solutions to achieve a prescribed outcome. By use of the web based automated information management tools, this effort will incorporate critical Command and Control (C2) legacy systems into the web environment. Experiments will be conducted to determine efficiency and effectiveness of the architectures, both from a technical evaluation and Fleet Operator input.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:

PE 0601153N (Defense Research Sciences)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602271N (RF Systems Applied Research)
PE 0603123N (Force Protection Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603609N (Conventional Munitions)
PE 0603658N (Cooperative Engagement)
PE 0603640M (USMC Advanced Technology Demonstration)
PE 0604307N (Surface Combatant Combat Systems Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0206313M (Marine Corps Communications Systems)

NON-NAVY RELATED RDT&E:

PE 0602204F (Aerospace Sensors)
PE 0602702F (Command Control and Communications)
PE 0602782A (Command Control and Communications Technology)

D. ACQUISITION STRATEGY:

Not Applicable

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

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

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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
PROJECT TITLE: Warfighter Sustainment Applied Research

	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

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

BA: 02 PROGRAM ELEMENT: 0602271N
PROGRAM ELEMENT TITLE: RF Systems 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
RF Systems Applied Research	69,232	49,244	49,151	54,265	54,045	55,087	56,177

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Radio Frequency (RF) Systems Applied Research Program addresses technology deficiencies associated with naval platform needs for new capabilities in RF surveillance, RF electronic warfare, communications, navigation, RF solid state power amplifiers, vacuum electronics power amplifiers, and supporting RF electronics technologies. The program supports development of technologies to enable capabilities in missile defense, directed energy, platform protection (including electric warship), time critical strike, and information distribution. RF Systems Applied Research developments directly support the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans. Activities within this Program Element (PE) have attributes that focus on enhancing the affordability of warfighting systems. The program also provides for technology efforts to maintain proactive connectivity and collaboration between Department of the Navy (DoN) Science and Technology (S&T) and Joint, Navy, and Marine Corps commands worldwide.

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	74,208	44,019	51,415
Cong. Rescissions/Adjustments/Undist.Reductions	0	-568	0
Congressional Actions	0	5,800	0
Execution Adjustments	-3,725	0	0
Inflation Savings	0	0	-165
Rate Adjustments	0	-7	-99

SBIR Assessment	-1,251	0	0
Technical Adjustments	0	0	-2,000
FY 2005 President's Budget Submission	69,232	49,244	49,151

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

BA: 02 PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF Systems Applied Research
PROJECT TITLE: RF Systems 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
RF Systems Applied Research	69,232	49,244	49,151	54,265	54,045	55,087	56,177

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses technology deficiencies associated with naval platform needs for new capabilities in radar frequency (RF) surveillance, RF electronic warfare, communications, navigation, RF solid state power amplifiers, vacuum electronics power amplifiers, and supporting RF electronics technologies. The project supports development of technologies to enable capabilities in missile defense, directed energy, platform protection (including electric warship), time critical strike, and information distribution. RF Systems Applied Research developments directly support the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans. Projects within this PE have attributes that focus on enhancing the affordability of warfighting systems. The project also provides for technology efforts to maintain proactive connectivity and collaboration between Department of the Navy (DoN) Science and Technology (S&T) and Joint, Navy, and Marine Corps commands worldwide.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
RF Electronic Warfare Technology	13,900	11,671	15,078

Supports the Fleet Force Protection (FFP) Future Naval Capability (FNC) and those technologies that enable the development of affordable, effective and robust Electronic Warfare (EW) systems that will increase the operational effectiveness and survivability of U.S. Naval units. Emphasis is placed on non-optical passive sensors and active and passive Radio Frequency countermeasure (RFCM) systems that exploit and counter a broad range of electromagnetic threats. The focus is on maintaining near perfect real-time knowledge of the enemy; countering the threat of missiles to deployed Naval forces; and precision identification and location of threat emitters.

FY 2003 Accomplishments:

Technology development focused on the areas of Tactical Aircraft, Surface Ships, Submarines, Unmanned Aerial Vehicles (UAVs), and EW Enabling Technology. Some specific accomplishments include:

- Completed design of a solid state millimeter wave (MMW) power amplifier for jamming of MMW-seeker threats and successfully demonstrated the transmission and coherent recovery of a narrowband signal using a wireless link for towed decoy applications as part of technology efforts that will enable increased survivability of tactical aircraft (TACAIR) in hostile environments.
- Field demonstrated off-board countermeasures tactics, evaluated and tested advanced multi-level pseudo-random Electronic Attack (EA) waveforms and techniques, integrated an application specific integrated circuit (ASIC) chip with a digital RF memory for countermeasures against inverse synthetic-aperture radar (ISAR) threats, and completed data analysis for modeling clutter returns from a coherent source as part of technology efforts enabling increased surface ship survivability.
- Successfully demonstrated a near real-time signal processing frequency modulation continuous wave (EMCW) subsystem for detection of Low Probability of Intercept (LPI) radar threats against periscopes.
- Completed effectiveness of EA obscuration techniques via hardware-in-the-loop (HIL) experiments.
- Fabricated and tested ASICs for wideband EW channelizer applications and performed analysis and modeling for verification of a combined azimuth and elevation direction finding antenna concept.

FY 2004 Plans:

Technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, UAVs, and EW Enabling Technology continues. Some specific plans include:

- Demonstrate full radio frequency-to-pulse descriptor word system functionality under the Wideband EW Channelizer effort.
- Conduct lab testing of the near real-time processing of the ultra-wideband chirp subsystem under the Electronic Support (ES) detection of LPI Periscope Detection Radar effort.
- Develop and test the frequency agile prediction algorithm for advanced seekers under the EA Techniques to Counter Advanced Threats effort.
- Perform Electronic Countermeasure (ECM) systems analysis and modeling for both onboard and offboard systems under the countermeasures for Wideband Antiship Threats effort.
- Initate analysis and modeling to develop and refine the detailed direction findings (DF) antenna design for the Hybrid Interferometer Technology Development effort.

FY 2005 Plans:

Technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, UAVs, and EW Enabling Technology continues. Some specific plans include:
• Perform at-sea testing of the ultra-wideband chirp subsystem under the ES detection of LPI Periscope Detection Radar effort.
• Perform shore based field testing against advanced seekers using the advanced techniques generator in the EA Techniques to Counter Advanced Threats effort.
• Conduct vulnerability analysis of seeker discrimination and home-on-jam (HOJ) subsystems to the ECM system as part of the countermeasure (CM) for Wideband Antiship Threats effort.
• Fabricate and perform lab demonstration of the DF antenna for the Hybrid Interferometer Technology Development effort.
• Continue the analysis and modeling to develop and refine the detailed direction findings (DF) antenna design for the Hybrid Interferometer Technology Development effort.

	FY 2003	FY 2004	FY 2005
Supporting Technologies	11,000	10,000	12,709

Provides for the radiation, reception, signal control and processing of very high frequency (VHF), ultra high frequency (UHF), micro wave (MW), and millimeter wave (MMW) power for Navy all-weather radar, surveillance, reconnaissance, Electronic Attack (EA), communications, and smart weapons systems. The technology developed cannot, for the most part, be obtained through commercial off the shelf (COTS) as a result of the requirements placed on power, frequency, linearity, bandwidth, weight, and size.

FY 2003 Accomplishments:

• Continued the development of octave bandwidth linearizers with emphasis placed on circuit design using the results of the architecture study as a basis.
• Continued the wide bandgap transistor reliability effort with insertion of the knowledge gained in FY 2002 into the device technology and subsequent testing to document the improvements in the stability and lifetime of next-generation Silicon Carbide (SiC) and Galium Nitride (GaN) devices.
• Continued the effort to develop high power channelizers by demonstrating the individual band filters and designing combining manifold within size and power requirements.
• Continued the development of high power, wideband, isolators by applications of improved modeling and control of low frequency losses (<2 dB insertion) to a low power isolator with >15dB of isolation operating over the 4-20 GHz frequency range.

• Demonstrated submicron scaling of Indium Phosphide (InP) transistors to 0.8 microns needed for complex circuits operating at clock speeds to 20 GHz for application to a direct digital synthesizer (DDS) frequency source with programmable integral modulation capabilities.
• Demonstrated packaging of microwave frequency DDS with integral modulator in integrated circuit form for use in an electronically scanned array operating to 4.5 GHz.
• Fabricated and demonstrated radio frequency (RF) microelectronic mechanical systems (MEMS) tunable filter elements and modules that will demonstrate size and RF performance requirements in a 5 bit tunable filter assembly.
• Demonstrated expected ultra-low phase noise performance of free running oscillator over the short time scales and developed the phase locking circuit to provide, over long time scales, the same noise performance required to accurately beam steer a phased array.
• Developed monolithic wide bandgap low noise receiver amplifiers with increased survivability under RF drive, enhanced linearity, and high temperature operation.
• Demonstrated Silicon Carbide (SiC) Bipolar Junction Transistors (BJTs) and PiN diodes with Ion=25A and Vb=1200 for application to a 40-100 kW motor drive.

FY 2004 Plans:

• Fabricate and test linearizers with 2 GHz of bandwidth.
• Perform full RF life tests of SiC discrete devices and Monolithic Microwave Integrated Circuits (MMICs).
• Broaden the database for addressing infant mortality issues in GaN discrete devices and begin to establish approaches to RF life testing of GaN High Electron Mobility Transistors (HEMTs).
• Demonstrate the power handling channelizer in the laboratory.
• Demonstrate increased power handling (up to 20 Watts) and reduced losses (<1 dB) of the high power, wideband, isolators.
• Increase the performance and yield of devices used in the DDS frequency source.
• Demonstrate a superconducting analog-to-digital converter (ADC) with a 5 GHz center frequency and programmable bandwidth in the 20-400 MHz range.
• Optimize the wide bandgap low noise receiver amplifier designs by targeting specific spectral bands and explore approaches to the utilization of these amplifiers with reduced limiter protection.
• Explore cost reduction technical approaches critical to the development of digitally programmable RF electronics components for electronically scanned arrays.

FY 2005 Plans:

• Fabricate and test linearizers with 4 GHz of bandwidth.

- Continue the effort to improve DDS device performance and yield for InP transistors.
- Transfer results of initial SiC RF life tests into the manufacturing technology and initiate a second iteration of testing.
- Perform initial RF life testing of discrete GaN devices and establish approaches to RF life testing of GaN based MMICs.
- Initiate development of specifications for next generation high power channelizer.
- Continue development of high power, wideband isolator technology by focusing on size reduction and geometry to fit the 20 GHz array spacing.
- Continue the effort to improve InP device performance and yield for application to the 20 GHz DDS and incorporate True Time Delay (TTD) into the DDS to facilitate RF microwave beamsteering in a single packaged monolithic integrated circuit.
- Continue to investigate cost reduction technical approaches critical to the development of digitally programmable RF electronics components for use in electronically scanned arrays.

	FY 2003	FY 2004	FY 2005
RF Surveillance Technology	7,200	5,200	6,447

Emphasizes non-optical advanced sensor and sensor processing systems for continuous high volume theater-wide air and surface surveillance, battle group surveillance, real time reconnaissance and ship defense. Major technology goals include long-range target detection and discrimination, target identification (ID) and fire control quality target tracking in adverse weather, background clutter and electronic countermeasure environments.

FY 2003 Accomplishments:

- Continued development of the Digital Array Radar (DAR) technology with emphasis placed on element level and sub-array wideband digital beam-forming techniques to enable rapid steering and precision control of multiple beams.
- Continued development of Radio Frequency (RF) sensor waveforms, operating characteristics and signal processing for maritime situational awareness.
- Expanded the study of Non-Cooperative Target Recognition (NCTR) technology to encompass harbor (short range) as well as long range all weather target identification.
- Continued the development of component prototyping for the Horizon Extension Sensor System (HESS) with emphasis on technologies for light weight integrated active arrays for deployment from surface combatants.
- Continued development and integration of the Common Affordable Radar Processor (CARP) Data Distribution Module (DDM) by incorporating and evaluating the performance of multiple parallel DDMs integrated into a

simulated multi-channel radar front end.
• Conducted airborne demonstrations on the AN/APY-6 radar Inverse Synthetic Aperture (ISAR) and Micro-doppler modes against small sea surface targets and against slow moving ground targets.

FY 2004 Plans:

• Continue the development of DAR technology with hardware demonstrations at the individual array element and sub-array levels.
• Continue development and characterization of advanced NCTR algorithms in congested harbor environments.
• Demonstrate critical enabling high power amplifier technology capable of supporting the Horizon Extension Sensor System (HESS).
• Demonstrate synchronization of multiple DDMs in a CARP architecture with asynchronous network topologies.
• Initate the development to demonstrate signal processing, waveform generation and one dimensional active phased array apertures for Harbor Surveillance and situational awareness.

FY 2005 Plans:

• Continue development of system level hardware for DAR and characterize its performance at the element, sub-array and system levels.
• Continue demonstrations of advanced NCTR algorithms in congested harbor environments.
• Continue the HESS project integration of High Power Amplifier (HPA) and digital beamforming X-band sub-arrays.
• Continue the development to demonstrate signal processing, waveform generation and one dimensional active phased array apertures for Harbor Surveillance and situational awareness.

	FY 2003	FY 2004	FY 2005
RF Communications Technology	8,160	3,500	5,269

Addresses critical Navy communications technology deficiencies and needs that are not addressed by the commercial technology sector. The activity emphasis is on reliable interoperable communications between U.S and coalition forces, at all levels of command, and rapid and reliable utilization of government and commercial telecommunications assets worldwide that are efficient and responsive to warfighting needs.

FY 2003 Accomplishments:

• Completed the X/Ku band phased array system design optimization and prepared a transition plan for

development of an advanced technology demonstration to take place within PE 0603271N.
• Completed characterization of a prototype K/Ka/Q band phased array with emphasis on simultaneous multi-beam operation, this effort will be continued in FY 2004 and beyond in PE 0603271N.
• Completed development of the Defense Advance Research Projects Agency (DARPA)/Office of Naval Research (ONR) developed Ultra Small Aperture Terminal (USAT) K/Ka Band Phased Array technology to be incorporated into K/Ka/Q band phased array development within PE 0603721N.
• Completed final design for Next Generation Buoyant Cable Antenna (NGBCA) for incorporation into the KSA FNC apertures program for advanced technology demonstration unit to be developed within PE603271N.
• Continued developed of the Naval Battle-Force Network (NBN).
• Incorporated the tactical communications payload for Vertical Take-Off Unmanned Air Vehicles (VTUAV) into the NBN architecture and implemented queuing management technology in Navy Line of Sight (LOS) networking radios.
• Continued to augment the Quality of Service (QoS) strategy for the Automated Digital Network System (ADNS).
• Investigated multi-function communications systems architectures to enable integration into the Navy's Advanced Multi-Function Radio Frequency Concept (AMRF-C) technology test bed.

FY 2004 Plans:

• Complete development and demonstration of the NBN technologies and transition to acquisition programs at Space and Naval Warfare Systems Command (SPAWAR).
• Continue development of standardized interfaces and Information Protocol (IP) standards for multi-function communications systems architectures to enable integration into the Navy's, to facilitate integration and efficient management and control of multiple data link and satellite communications functions into the Navy's AMRF-C technology test bed.
• Continue to augment the Quality of Service (QoS) strategy for the Automated Digital Network System (ADNS).

FY 2005 Plans:

• Integrate multi-function communication system functions into the Navy’s AMRFC technology test bed and evaluate resource management and control processes.
• Investigate technologies and tactics to minimize electromagnetic compatibility and interference issues with other AMRF-C functions such as Electronic Support (ES) and Electronic Attack (EA).
• Continue to augment the Quality of Service (QoS) strategy for the Automated Digital Network System (ADNS).

	FY 2003	FY 2004	FY 2005
RF Solid State Power Amplifiers	3,500	3,000	3,500

Provides for the generation of Very High Frequency (VHF), Ultra High Frequency (UHF), Microwave (MW), and Millimeter Wave (MMW) power amplifiers for Navy all-weather radar, surveillance, reconnaissance, electronic attack, communications, and smart weapons systems. The technology developed cannot, for the most part, be obtained through Commercial-Off-the-Shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, linearity, bandwidth, weight, and size.

FY 2003 Accomplishments:

- Continued development of SiC bipolar transistors and extended their frequency of operation to L-band.
- Continued development of millimeter wave (MMW) Aluminum Gallium Nitride/Gallium Nitride (AlGaN/GaN) wide bandgap High Electron Mobility Transistor (HEMT) technology with an emphasis on output signal quality and linearity.
- Continued development of multi-octave wide bandgap power amplifiers with broadband EW applications addressed as demonstration vehicles for the current technology with emphasis placed on the 4-18 GHz band.
- Continued development of the AlGaN HEMT broadband amplifiers for electronic warfare decoy applications.

FY 2004 Plans:

- Demonstrate silicon carbide (SiC) transistors with 300 W of output power at L-band.
- Continue development of MMW AlGaN/GaN wide bandgap HEMTs.
- Develop advanced transistor materials and structures to enhance amplifier efficiency with the emphasis to include development of complete monolithic integrated circuits.
- Continue development of AlGaN HEMT broadband amplifiers for electronic warfare decoys with output powers up to 10 times that achieved with conventional solid state amplifiers.

FY 2005 Plans:

- Continue the development of MMW AlGaN/GaN wide bandgap HEMTs.
- Develop AlGaN HEMT broadband amplifiers with over 20W output power over the full band for electronic warfare decoys.

	FY 2003	FY 2004	FY 2005
RF Vacuum Electronics Power Amplifiers	4,700	3,000	3,500

Provides for the development of microwave (MW), millimeter wave (MMW), and submillimeter wave power amplifiers for use in naval all-weather radar, surveillance, reconnaissance, electronic attack, and communications systems. The technology developed cannot, for the most part, be obtained through commercial off the shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, bandwidth, weight, and size. Responding to strong interests from the various user communities, efforts are focused on the development of technologies for high-data-rate communications and high-power high-frequency radar applications. Technologies include multiple-beam amplifiers, notably the multi-beam klystron (MBK), modeling and simulation, and field emitter arrays.

FY 2003 Accomplishments:

• Designed high dynamic range helix Traveling Wave Tube (TWT) experiments and tested TWTs to improve digital signal error performance.
• Completed time-dependent block model for helix TWTs with memory effects included.
• Designed cavities for multi-beam amplifiers with eight electron beams.
• Completed beta version of the two dimensional/three dimensional (2D/3D) coupled cavity traveling wave tube (CC-TWT) design code with the addition of a model to handle reflections at internal matching elements.
• Developed 3D models for alternating current (AC) space charge for both helix and coupled-cavity TWTs. A hybrid mesh capability (hexahedra and tetrahedra) was introduced into the MICHELLE gun code.
• Developed techniques to address non-axial symmetry in 3D stability analysis for helix TWT design codes.
• Continued the investigation of high brightness scandate cathodes using Pulsed Laser Deposition (PLD) techniques.
• Investigated the optimum chemical composition required for high-current-density scandate emission for cathodes formed by PLD.
• Continued the large-signal time-dependent code GATOR incorporating the reflection models developed earlier for beta testing.

FY 2004 Plans:

• Continue the development of physics-based models and demonstration of low-distortion TWTs, using C-band as a demonstration communication band.
• Validate the time-dependent block models for digital signal amplification in helix TWTs and release to the domestic vacuum electronics industry.

• Perform a radio frequency (RF) optimization for multi-beam klystrons using telegrapher's equation solution for linear amplifiers (TESLA).
• Release to the U.S. vacuum electronics industry the large-signal time-dependent code GATOR incorporating the reflection models developed earlier for beta testing.
• Release MICHELLE v3.0 and TESLA v2.0 to the domestic vacuum electronics industry for beta testing.

FY 2005 Plans:

• Use two-and three-cavity narrow-band S-band multi-beam klystron experiments to validate the multi-beam design tools.
• Develop parallelization techniques for TESLA as the design tool tailored for multiple-beam klystron development.
• Demonstrate a high-data-rate (> 1 Gbps) TWT using 16 bit quadrature amplitude modulation (QAM).

	FY 2003	FY 2004	FY 2005
RF Navigation Technology	2,000	1,700	2,648

Develops key navigation technologies for Naval Battle Groups, Aircraft, Unmanned Air Vehicles (UAVs), Unmanned Underwater Vehicles (UUVs), Ships, Submarines and other Navy vehicles and platforms. This activity applies leading-edge Science and Technology (S&T) to enhance Global Positioning System (GPS) capabilities in order to make GPS more resistant to noise and jamming. Much of the near-term effort concerns the development of antennas with special features.

FY 2003 Accomplishments:

• Demonstrated an antenna, feed network and nulling electronics all integrated into a compact prototype unit within the Miniature Controlled-Radiation-Pattern-Antenna (M-CRPA) antenna effort.
• Completed the Non-linear Array Antenna effort (Defense Advanced Research Projects Agency (DARPA) will manage a follow-on effort).
• Developed the Submarine Mast-Mounted controlled CRPA for the GPS that will fit into the 4.75" diameter area of the OE-538 Submarine Mast Identification Friend or Foe (IFF)/GPS Radome/Antenna Subsystem. This effort included computer modeling, brass boarding, and fabrication of the elements, the array, and the matching network to prove the concept.
• Pursued a multistage Space Time Adaptive Processing (STAP) approach using nonlinear filtering methods for jammer-resistant code tracking. In addition, STAP and code tracking were merged for improved timing acquisition in the presence of wideband jamming.

FY 2004 Plans:

• Conduct laboratory testing to determine the effectiveness of its nulling functions of the Submarine Mast-mounted CRPA for the Global Positioning System.
• Develop additional, high ranking, techniques of those initially investigated STAP for GPS Antenna effort. Implementation issues will continue to address concerns for computational speed and performance reliability.

FY 2005 Plans:

• Conduct field testing of the Submarine Mast-mounted Controlled Radiation Pattern Antenna to determine if the laboratory performance can be achieved in a more realistic environment.
• Integrate STAP for GPS Antennas to one of the receiver-antenna systems developed in this activity or to a system recommended by the GPS-Joint Program Office (GPS-JPO). Specific jammer types will be also addressed in this effort.

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ADVANCED MICROWAVE FERRITE RESEARCH	0	1,483

Preparation and characterization of advanced ferrite materials for microwave radar circuit tuning will be investigated.

	FY 2003	FY 2004
ADVANCED SEMICONDUCTOR MATERIAL RESEARCH	1,429	1,384

FY03: Advanced the performance and capability of monolithic multifunctional crystalline oxide on semiconductor films for high power amplifiers. FY04: The capability of deposition and characterization of functional oxides will be advanced and microwave tuning performance investigated.

	FY 2003	FY 2004
HIGH BRIGHTNESS ELECTRON SOURCES	2,003	2,076

FY03: Field emitters were fabricated and tested using the results of the FY 2002 efforts as a basis. FY04:

Demonstrate prototype field emission electron source for application to 50 W, 10 GHz vacuum electronic amplifier with 10 dB gain.

	FY 2003	FY 2004
HIGHLY MOBILE TACTICAL COMMUNICATIONS (HTMC)	952	0

Explored the feasibility of integrating Iridium satellite communications with current Expeditionary Maneuvering Warfare Line-of-Sight terrestrial tactical communication systems.

	FY 2003	FY 2004
MARITIME SYNTHETIC RANGE	4,861	4,252

FY03: Expanded the Pacific Missile Range Facility (PMRF) capabilities integrating synthetic systems with live systems to provide a war gamming setting with multiple training range integration. FY04: These systems will be synchronized to increase the complexity of training, testing to provide a realistic setting for joint-to-unit training with coordinated operational forces.

	FY 2003	FY 2004
NANOSCALE SCIENCE AND TECHNOLOGY	1,429	0

Focused on development of prototype electronic piezoelectric and optical devices made with new materials, including nanoscale magnetoresistive sensors, piezoelectric sensors, and neuromorphic networks.

	FY 2003	FY 2004
SILICON CARBIDE HIGH POWERED DIODE DEVELOPMENT	1,666	0

Investigated silicon carbide thin film and bulk growth with the goal of controlling defects and doping to the level required to achieve diode structures with high power performance.

	FY 2003	FY 2004
VACUUM ELECTRONICS	4,766	0

Provided enhanced design codes for modeling vacuum tubes to be used in radars, communications, and millimeter

wave countermeasure systems against millimeter wave sensing missiles using vacuum tubes.

	FY 2003	FY 2004
VESSEL AND PORT SECURITY DEMONSTRATION	0	989

The program will examine and demonstrate the algorithms for sea clutter reduction in a scanning doppler radar system to improve detection and track shipping vessels.

	FY 2003	FY 2004
WIDE BANDGAP SILICON CARBIDE SEMICONDUCTOR RESEARCH INITIATIVE	1,666	989

FY03: Bulk crystal growth and wafering of SiC for high power electronics were developed. FY04: Improve the process to investigate the perfection of SiC for high power electronic applications.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0601153N (Defense Research Sciences)
PE 0602114N (Power Projection Applied Research)
PE 0602123N (Force Protection Applied Research)
PE 0603271N (RF Systems Advanced Technology)
PE 0603114N (Power Projection Advanced Technology)
PE 0603123N (Force Protection Advanced Technology)

NON NAVY RELATED RDT&E:
PE 0601102A (Defense Research Sciences)
PE 0601102F (Defense Research Sciences)
PE 0602204F (Aerospace Sensors)
PE 0602702F (Command, Control, and Communications)

D. ACQUISITION STRATEGY:
Not applicable

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

BA: 02 PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: Ocean Warfighting Environment 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
Ocean Warfighting Environment Applied Research	66,431	62,305	48,482	56,525	55,031	51,464	52,445

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program provides the unique, fundamental programmatic instrument by which basic research on the natural environment is transformed into technology developments that provide new or enhanced warfare capabilities for the BattleSpace Environment (BSE). The objectives of this program are met through measuring, analyzing, modeling and simulating, and applying environmental factors affecting Naval material and operations in the BSE. This program provides for BSE technology developments that contribute to meeting top joint warfare capabilities established by the Joint Chiefs of Staff, with primary emphasis on Joint Littoral Warfare and Joint Strike Warfare.

This program fully supports the Director of Defense Research and Engineering's Science and Technology Strategy and is coordinated with other DoD Components through the Defense Science and Technology Reliance process. Work in this program is related to and fully coordinated with efforts in accordance with the ongoing Reliance joint planning process. There is close coordination with the US Air Force and US Army under the Reliance program in the Battlespace Environment categories of Lower Atmosphere, Ocean Environments, Space & Upper Atmosphere, and Terrestrial Environments. Within the Naval Transformation Roadmap, the investment will contribute toward achieving each of the "key transformational capabilities" required by Sea Strike, Sea Shield, and Sea Basing. Moreover, environmental information, environmental models and environmental tactical decision aids that emerge from this investment will form one of the essential components of FORCEnet (which is the architecture for a highly adaptive, human-centric, comprehensive maritime system that operates from seabed to space). The Navy program includes efforts that focus on, or have attributes that enhance, the affordability of warfighting systems.

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

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

BA: 02 PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: Ocean Warfighting Environment Applied Research

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	71,027	48,785	63,729
Cong. Rescissions/Adjustments/Undist.Reductions	0	-705	0
Congressional Actions	0	14,225	0
Execution Adjustments	-3,509	0	0
Inflation Savings	0	0	-190
Rate Adjustments	0	0	-57
SBIR Assessment	-1,087	0	0
Technical Adjustments	0	0	-15,000
FY 2005 President's Budget Submission	66,431	62,305	48,482

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

BA: 02 PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: Ocean Warfighting Environment Applied Research

PROJECT TITLE: Ocean Warfighting Environment 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
Ocean Warfighting Environment Applied Research	66,431	62,305	48,482	56,525	55,031	51,464	52,445

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project provides technologies that form the natural environment technical base on which all systems development and advanced technology depend. Further, this technical base provides developments that may be utilized in the Future Naval Capabilities (FNC) programs: Organic Mine Countermeasures, and Autonomous Operations. This project contains the National Oceanographic Partnership Program (NOPP) (Title II, subtitle E, of Public Law 104-201).

Major efforts of this project are devoted to (1) gaining real-time knowledge of the Battlespace Environment (BSE), (2) determining the natural environment needs of regional warfare, (3) providing the on-scene commander with the capability to exploit the environment to tactical advantage, and (4) developing atmospheric research related to detection of sea-skimming missiles and strike warfare. This project provides natural environment applied research for all fleet operations and for current or emerging systems. Major developments are routinely transitioned to the Fleet Numerical Meteorology and Oceanography Center and to the Naval Oceanographic Office where they are used to provide timely information about the natural environment for all fleet operations.

Joint Littoral Warfare efforts address issues in undersea, surface, and air battlespace. Efforts include ocean and atmospheric prediction for real-time description of the operational environment, shallow water acoustics and multiple-influence sensors for undersea surveillance and weapon systems, and influences of the natural environment on Mine CounterMeasure (MCM) and Anti-Submarine Warfare (ASW) systems. Joint Strike Warfare efforts address issues in air battlespace dominance. Efforts include influences of the natural environment on air operations, electromagnetic (EM)/electro-optic (EO) systems used in intelligence, surveillance, reconnaissance, targeting, bomb damage assessment, and detection of missile weapon systems. They also include improvements in tactical information management about the BSE.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Battlespace Environment (BSE) Sensors and Data	7,366	6,736	7,797

This activity encompasses efforts to develop new, or enhance existing, shipboard, airborne, and spaceborne sensors and appropriate inversion techniques and data handling techniques to obtain/store/manage environmental data. Data on a variety of processes in the environment are essential for several reasons: the data can serve as input to computer prediction schemes, data can be used to provide characterizations of processes for use in other developments, and data can be used in testing/validating the current understanding of ocean and atmospheric behavior. Consideration is routinely given to the basic research available in Sensors and Data to determine if new opportunities exist that can be exploited to rapidly advance toward the goals of the BSE Sensors and Data activity. Consideration is also routinely given to the nature of the technical efforts to ensure that they represent the most effective means of achieving progress. Efforts include use of organic sensors to characterize the operational environment in real-time for input into performance prediction of warfighting systems. Developments in the BSE Sensors and Data activity are of importance to littoral oceanography, amphibious warfare, mine countermeasures, and anti-submarine warfare. A main emphasis of work in this area remains the littoral ocean which continues to be seen as the primary battlespace of future conflicts. The BSE Sensors and Data activity supports the Navy Transformation Roadmap strategy by providing required data that can be applied to battlespace characterization in near real-time and also employed in intelligence, surveillance, and reconnaissance.

FY 2003 Accomplishments:
- Continued development in: Global Ocean Data Assimilation Experiment (GODAE), bioluminescence sensor, field data for physics-based models for hyperspectral imaging sensors, Naval impact of natural environmental processes (especially for the Littoral Zone (LZ)). Continued developments in Autonomous Underwater Vehicle (AUV) sensors and technology for oceanography, mine countermeasures, and prediction of mine burial.
- Continued North Atlantic Treaty Organization (NATO) Adriatic circulation experiment: field tested a new bottom sensor system, and used data for Rapid Environmental Assessment (REA).

FY 2004 Plans:
- Continue efforts to transition small, low-power, lightweight bioluminescence sensors, which are of importance to Special Operations Forces.
- Continue efforts to use space-based optical sensors as input for both active and passive optical mine countermeasure sensors.
- Continue to perform field data analysis of physics-based models for hyperspectral imaging of the ocean

surface/near-surface to establish what information can be deduced about the ocean's upper layers.
- Continue development of a shipborne Light Detection and Ranging (LIDAR) system for measurement of winds and the near-surface Electromagnetic/Electro-Optic (EM/EO) propagation environment.
- Continue efforts, where feasible, to develop ocean sensors for use on AUVs and the development of acoustic communication capabilities to transfer data to facilities in the field.
- Continue efforts to utilize organic sensors for REA.
- Continue research into ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs in this area over the past decade, and advanced techniques such as the Higher Order Spectral Model.

FY 2005 Plans:
- Continue bioluminescence sensor effort with emphasis on needs of the Special Warfare (SPECWAR) forces, survey capabilities, and use of the bioluminescence sensors in joint field measurements with ocean sensors to determine persistence of the bioluminescence signal and the ocean factors controlling the persistence.
- Continue efforts to develop ocean sensors for use on AUVs and to develop acoustic communication capabilities to transfer data to facilities in the field. Utilize joint field work with other AUV technology developers and users as a routine aspect of the program.
- Continue research into ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs over the past decade. Ocean waves constitute a key process in the LZ with the ability to affect many Naval operations and we seek as robust a predictive capability as possible.
- Complete analysis of data of the upper ocean structure collected from hyperspectral imaging sensors.
- Conduct a field test of a shipborne LIDAR system for near-surface environmental characterization.

	FY 2003	FY 2004	FY 2005
Battlespace Environment (BSE) Concept Enablers	20,051	19,065	19,091

This activity focuses on concept enablers for the BattleSpace Environment (BSE) which represent technology developments that are expected to provide revolutionary enabling capabilities, but require a long period of development. Consideration is routinely given to the goals of this work to ensure that they are adequate for the presumed Naval warfare needs as reflected in higher level Navy Science and Technology strategy. This particular activity is most sensitive to opportunities as presented by breakthroughs in the basic research domain which may represent new opportunities for achieving goals of the BSE Concept Enablers activity. The ever recurring theme of the BSE Concept Enablers activity is to advance technologies that offer the warfighter the greatest capabilities for gaining "advantage" over the natural environment, both to increase his warfighting ability and to deny an adversary any "home field" advantage. The aims of this activity are fully

consistent with the Navy Transformation Roadmap strategy.

FY 2003 Accomplishments:
- Continued research into geoclutter, as a means of developing better insights into how the sub-sediment seafloor may contribute to acoustic clutter.
- Continued development of methods for capturing uncertainty in environmental prediction estimates with the ultimate goal of ensuring the user of the reliability of these predictions. There is a crucial need for this capability, especially in the littoral zone where so much variability in the environment may occur.
- Continued development and analysis of air-sea interaction measurements and theory. Efforts are expected to have an impact on improved ocean and atmospheric models as well as better understanding of how aerosols are injected into the lower atmosphere where they have a decisive influence on electromagnetic and electro-optic propagation.
- Continued efforts in marine mammal research and noise mitigation, which poses a variety of challenges to Naval operations.
- Continued support of the National Oceanographic Partnership Program (NOPP).
- Continued Support of "Ocean.US" Office, which is a component of NOPP that represents the US component of a global ocean observing system.
- Developed new possibilities in biosensor technology.

FY 2004 Plans:
- Continue developments, through theory and field measurement, in the air-sea interaction research effort, as a means of improving both ocean and atmospheric forecasts.
- Continue marine mammal noise mitigation efforts to develop tools to detect and mitigate effects of noise on marine mammals, especially the noise generated by Naval activities.
- Continue the following NOPP efforts begun in earlier years: Real-Time Forecasting System of Winds, Waves, and Surge in Tropical Cyclones; The Partnership for Advancing Interdisciplinary Global Modeling (PARADIGM), a Partnership for Modeling the Marine Environment of Puget Sound, Washington, Ocean Data Assimilation Experiment (GODAE), and Multi-Disciplinary Ocean Sensors for Environmental Analyses and Networks.
- Continue development of new possibilities in biosensor technology.
- Complete effort in capturing uncertainty in environmental predictions as a means of giving the user an idea of the reliability of those predictions.
- Complete geoclutter effort to elucidate how the sub-sediment seafloor contributes to acoustic clutter and the importance of this environmental effect in anti-submarine warfare. Determine how variability of the sub-sediment seafloor may contribute to false targets and whether a means can be developed to reduce such false targets.
- Complete the following NOPP efforts: Development and Verification of a Comprehensive Community Model for

Physical Processes in the Nearshore Ocean, Hybrid Coordinate Ocean Model (HYCOM).

FY 2005 Plans:
- Continue marine mammal program on noise mitigation.
- Continue to support efforts in GODAE as a contribution to data assimilation for global ocean prediction capability through collaboration between the Navy's Fleet Numerical Meteorological and Oceanography Center and the NOAA Pacific Marine Environmental Laboratory, as well as others.
- Continue to solicit efforts from the national oceanographic community that will advance the NOPP program towards its goal of an integrated ocean observing and prediction system.
- Continue development of new possibilities in biosensor technology.
- Complete the following NOPP efforts: A Consortium for Data Assimilative Ocean Modeling, a Consortium for Ocean Circulation and Climate Estimation. Continue NOPP efforts begun in earlier years.

	FY 2003	FY 2004	FY 2005
Ocean and Atmospheric Modeling/Prediction and Effects	11,745	10,585	10,985

The battlespace environment represents a critical factor in Naval warfare and in any Naval operation, often resulting in a "go" or "no-go" decision for any contemplated action. The extent to which this environment can be modeled, through computational models used in making predictions of characteristics of the environment, provides an important means by which Naval forces can gain mastery over the environment and deny an adversary "home field" advantage. Consideration is routinely given to the nature of developments in Ocean and Atmospheric Modeling/Prediction and Effects to ensure that the technical efforts take appropriate account of developments in basic research and represent the most effective means of achieving progress toward the goals of the Ocean and Atmospheric Modeling/Prediction activity. Consideration is also routinely given to basic research developments in this active technology area that are ready for incorporation into this applied research program. This activity will enable Naval forces to have unprecedented knowledge of the battlespace and its environmental conditions, which is fully consistent with the SEA POWER 21 strategy.

FY 2003 Accomplishments:
- Continued development of ocean model nowcast/forecast at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models.
- Continued development of advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander.
- Continued model testing and validation. Transitioned the Navy Coastal Ocean Model (NCOM) for operational test/evaluation at the Naval Oceanographic Office (NAVO), and initiated an effort to incorporate an upgraded Polar Ice Prediction System (PIPS3) into NCOM to extend its applicability.
- Conducted research on the atmospheric effects on electromagnetics and electro-optics. This is important because electromagnetic and electro-optic propagation affects many modern warfare systems.
- Continued construction of an end-to-end observation/analysis/prediction system for coastal aerosol and dust which continues to be an important focus of activities in atmospheric effects as demonstrated in the Persian Gulf conflict and, most recently, in Operation Enduring Freedom.
- Continued transition to NAVO and Navy SEAL forces the laptop-based nearshore forecast system that makes use of Autonomous Underwater Vehicle (AUV) collected data.

FY 2004 Plans:
- Continue developments in ocean model nowcast/forecast at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models.
- Continue to employ ocean models to complete 3-D acoustic simulations of space-time coherence of the acoustic field, which is a primary characteristic related to detection performance of acoustic systems.
- Continue efforts in nested models to allow for a larger domain ocean model to set boundary conditions for a smaller domain model. Incorporate high-resolution regional nests into the NCOM.
- Continue development in advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander.
- Pursue further developments in atmospheric effects on electromagnetics and electro-optics. Develop methods for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect electromagnetic/electro-optic propagation.
- Construct an end-to-end observation/analysis/prediction system for coastal aerosol and dust.
- Complete transition to NAVO and Navy SEAL forces the laptop-based nearshore forecast system that makes use of Autonomous Underwater Vehicle (AUV) collected data.

FY 2005 Plans:
- Advance efforts in ocean model nowcast/forecast at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models dependent on other priorities in this area.
- Continue developments in nested models dependent on other priorities in this area to allow for a larger

domain ocean model to set boundary conditions for a smaller domain model.
- Continue development in advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander.
- Continue developments in atmospheric effects on electromagnetics and electro-optics because of the central importance of electromagnetic and electro-optic propagation to so many modern warfare systems.
-Continue to develop methods for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect electromagnetic/electro-optic propagation.
- Complete first tests of coupled global and regional aerosol prediction system. Efforts aim to build on recent successes of the application of atmospheric modeling demonstrated in Operation Enduring Freedom.

	FY 2003	FY 2004	FY 2005
Naval Warfare System-Focused Efforts	10,608	9,380	10,609

This program element is the only applied research program element dedicated to determination of the impact of the natural environment on Naval warfare and Naval operations. As such, many questions about the impact of the natural environment on either operational systems or on Naval warfare systems under development and their performance become technical issues for this program element. The Littoral Zone (LZ) has been the natural environment of greatest interest. Aspects of this environment that greatly impact Naval warfare are the generally shallow waters of the LZ, the consequent closeness and physical significance of the ocean bottom, and the complexities inherent to potentially rapid changes of the ocean structure as well as the ocean bottom. Continual evaluation is given to the state of Naval warfare systems to ensure that technology development in the Naval Warfare System-Focused Efforts activity reflects the optimum choices for greatest impact of the work on Naval systems. This activity, through its focus on impact of the natural environment on Naval warfare systems, supports the Navy Transformation Roadmap strategy by exploiting knowledge of the environment to gain advantage over potential adversaries.

FY 2003 Accomplishments:
- Measured and modeled ship wake acoustics for anti-torpedo torpedo acoustic performance prediction.
- Incorporated improved shock physics and numerics into an explosive mine neutralization model.
- Developed remote sensing techniques, especially hyperspectral imaging technology, for the LZ because of their very promising potential to allow inference of littoral ocean characteristics and overcome the problem of "denied" waters.
- Developed several aspects of underwater acoustics because of their general importance to acoustic systems: validated models of horizontal acoustic coherence through oceanographic reconstructions for environmental impact on acoustics, modified the primitive equation solution model for the Yellow Sea and transitioned the capability for solution internal wave packet predictions, and determined acoustic focusing and the

predictability of acoustic energy fluctuations due to the internal wave/coastal front influences on acoustic propagation.
- Continue developments in environmentally-sensitive, physics-based decision tools and measures of effectiveness in predictive systems as a means for providing the fleet useful environmental tactical decision aids for antisubmarine warfare as well as mine warfare.

FY 2004 Plans:
- Continue developments in the area of utilization of acoustic processing techniques to perform acoustic or geoacoustic inversion for environmental parameters, develop techniques for discrimination between environmental scatterers and target, and through-the-sensor measurements and adaptation of sensors to the environment.
- Continue development in remote sensing techniques, which include passive/active optical, electromagnetic, and acoustic techniques.
- Pursue techniques to allow determination of sediment microfabric and geotechnical properties and their exploitation in Naval warfare, especially where related to mine burial and prediction.
- Continue developments in the area of underwater acoustics and the impact of ocean dynamics on underwater acoustics because of their general importance to acoustic systems.
- Continue developments in environmentally-sensitive, physics-based decision tools and measures of effectiveness in predictive systems as a means for providing the fleet useful environmental tactical decision aids for antisubmarine warfare as well as mine warfare.
- Continue to measure/model ship wake acoustics for anti-torpedo torpedo acoustic performance prediction.
- Continue improvements in shock physics and numerics for an explosive mine neutralization model.

FY 2005 Plans:
- Continue developments in the area of utilization of acoustic processing techniques.
- Continue development in remote sensing techniques, especially the hyperspectral techniques in the LZ which offer new possibilities for exploitation based on previous investigation.
- Continue development of techniques to allow determination of sediment geoacoustic and geotechnical properties and their exploitation in Naval warfare.
- Continue developments in the area of underwater acoustics and the impact of ocean dynamics on underwater acoustics on a very selective basis. Important objectives are the integration of environmental knowledge into acoustic signal processing, underwater noise prediction and characterization, and noise models.
- Continue developments to account for the environmental impact of ocean processes on acoustics and improvements in noise models as a new means for detection of submarines in acoustic recordings.
- Continue developments in environmentally sensitive, physics-based decision tools, and measures of effectiveness in predictive systems.

- Make initial estimates, based on previous year's measurements, of acoustic performance prediction of the anti-torpedo torpedo.
- Optimize explosive placement pattern for air-dropped mine countermeasures weapon systems using improved sediment shock physics models.

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
BIOLUMINESCENCE TRUTH DATA AND SIGNATURE DETECTION	954	989

Advances in basic research over several years on bioluminescence in the ocean have enabled the development of a fundamental understanding of the phenomena and the Navy operations that may be affected. This effort funds research into the development of affordable, compact, efficient sensors that will allow ease of deployment and permit the rapid measurement of bioluminescence in the world's oceans in order to create a database for future research.

	FY 2003	FY 2004
CENTER FOR MARITIME SYSTEMS	0	2,769

The Center for Maritime Systems (CMS) is focusing on two key areas in the emerging needs for the design of small vessels capable of operating in coastal regions in a wide range of weather and ocean conditions: establishing an environment where engineering disciplines associated with hull design and ship automation can be brought together, and utilizing this unique education and research environment to identify new areas for research and invent new tools to meet the Navy's needs.

	FY 2003	FY 2004
EXTENDED CAPABILITY UNDERWATER IMAGING	1,910	2,225

This effort supports research into the development of smaller, more energy efficient sensors for autonomous underwater vehicles with an enhanced ability to detect and identify man-made objects in support of mine and undersea warfare.

	FY 2003	FY 2004
HYDROGRAPHY RESEARCH	1,671	0

This effort funded initial experimentation into tools to provide the Warfighter with high-resolution hydrographic data in near-coastal denied regions.

	FY 2003	FY 2004
OCEANOGRAPHIC SENSORS FOR MCM	4,871	4,623

This effort funds research into the development of small, low-power sensors to use on small autonomous underwater vehicles designed for covert characterization of denied areas, thereby giving the Navy a new capability in mine countermeasure operations.

	FY 2003	FY 2004
SOUTH FLORIDA OCEAN MEASUREMENT CENTER	954	0

Supported the South Florida Ocean Measurement Center, which is a consortium of universities and agencies with oceanographic expertise centered in South Florida and has an extensive range of oceanographic capabilities and facilities.

	FY 2003	FY 2004
SOUTHEAST ATLANTIC COASTAL OCEAN OBSERVING SYSTEM (SEACOOS)	5,349	5,933

SEACOOS represents a regional partnership that will initiate an integrated coastal ocean observing system for a four-state region of southeast coastal U.S. (NC, SC, GA, FL). Widespread access of data will significantly improve our understanding of atmospheric, oceanic and coupled behaviors in the southeastern U.S., Bahamas, northern Caribbean basin and in the surrounding larger-scale systems. This effort has importance for Homeland Security as well as for Naval oceanography in general.

	FY 2003	FY 2004
SOUTHERN COASTAL OCEAN OBSERVATION PROGRAM (SCOOP)	952	0

Supported the Southern Coastal Ocean Observation Program (SCOOP) which improves oceanographic knowledge, data, tools, and other products emerging from an appropriate infrastructure that would support numerous future Naval operations and enable the Navy to increase its participation in the on-going National Oceanographic Partnership Program (NOPP).

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
- PE 0601153N (Defense Research Sciences)
- PE 0602114N (Power Projection Applied Research)
- PE 0602123N (Force Protection Applied Research)
- PE 0602235N (Common Picture Applied Research)
- PE 0602271N (RF Systems Applied Research)
- PE 0602747N (Undersea Warfare Applied Research)
- PE 0602782N (Mine and Expeditionary Warfare Applied Research)
- PE 0603207N (Air/Ocean Tactical Applications)
- PE 0603271N (RF Systems Advanced Technology)
- PE 0603747N (Undersea Warfare Advanced Technology)
- PE 0603782N (Mine & Expeditionary Warfare Advanced Technology)
- PE 0604218N (Air/Ocean Equipment Engineering)

NON-NAVY RELATED RDT&E:
- PE 0602601F (Space Technology)
- PE 0602784A (Military Engineering Technology)
- PE 0603401F (Advanced Spacecraft Technology)

D. ACQUISITION STRATEGY: Not Applicable.

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

BA: 02 PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: Undersea Warfare 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
Undersea Warfare Applied Research	85,424	76,788	64,060	63,244	63,797	65,054	66,399

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Navy applied research in undersea target detection, classification, localization, tracking and neutralization is funded through this Program Element (PE). Technologies being developed within this PE are aimed at enabling Sea Shield, one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new anti-submarine warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship and air ASW assets.

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	84,496	62,583	66,353
Cong. Rescissions/Adjustments/Undist.Reductions	0	-944	0
Congressional Actions	0	15,150	0
Execution Adjustments	2,314	0	0
Inflation Savings	0	0	-214
Rate Adjustments	0	-1	-79
SBIR Assessment	-1,386	0	0
Technical Adjustments	0	0	-2,000
FY 2005 President's Budget Submission	85,424	76,788	64,060

BA: 02 PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: Undersea Warfare Applied Research

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

BA: 02 PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: Undersea Warfare Applied Research

PROJECT TITLE: Undersea Warfare 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
Undersea Warfare Applied Research	85,424	76,788	64,060	63,244	63,797	65,054	66,399

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Navy applied research in undersea target detection, classification, localization, tracking and neutralization is funded through this project. Technologies being developed within this project are aimed at enabling Sea Shield, one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new anti-submarine warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship and air ASW assets.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Wide Area Anti-Submarine (ASW) Surveillance	17,359	16,457	18,708

Wide Area ASW Surveillance is focused on dramatically improving the capability to sanitize large areas relative to the capabilities of legacy ASW sensors. Efforts include the development of affordable off-board systems with associated processing and robust, high bandwidth communications links. The cornerstone of Wide Area ASW Surveillance is the ability to rapidly distribute acoustic and non-acoustic sensors from air, surface and sub-surface platforms as well as to develop long-endurance sensors and unmanned ASW vehicles. This activity represents a shift from traditional fixed surveillance systems to autonomous, networked-components, multi-static operation, and supported by passive/active signal processing all with the objective of increased detection capabilities.

FY 2003 Accomplishments:

- Completed component-level developments that enable deployable, ultra-lightweight, ultra-low power, Matched

Field Tracking arrays for barrier/area surveillance applications.
- Completed development of an enhanced acoustic sparker source for environmental sensing and air-deployed ASW sensor applications.
- Completed acquisition of scale-model threat target scattering databases and assessed robustness of target scattering features to environmental distortion.
- Completed at-sea testing of a low frequency, submarine-deployed autonomous acoustic source.
- Completed analysis of FY 02 multi-static source sea-test data.
- Transitioned the forward scattering echo detection algorithms to Naval Air Systems Command (NAVAIR) Extended Echo Ranging (EER).
- Completed evaluation of a "non-traditional scattering" concept as applied to multi-static sonar.
- Continued feasibility assessment of using ASW acoustic intensity sensors as active receivers.
- Continued development of Telesonar technologies to enable deployable system acoustic communications.
- Continued development of signal processing algorithms aimed at reducing clutter-generated false alerts.
- Continued development/improvement of multi-static signal processing techniques for systems employing coherent/explosive sound sources.
- Continued development and at-sea testing of Compact Deployable Multi-static Receiver (CDMR) hardware and software.
- Continued development and testing of a series of incremental software builds for in-buoy signal processing.
- Continued development of smaller, cheaper low-frequency active transducers for multi-static sonar systems.
- Initiated development of ultra-low power electronics to support ASW advanced remote sensing devices.
- Initiated development of "intelligent" algorithms aimed at optimizing distributed multi-static sources/receivers.
- Initiated development of deployable volumetric arrays capable of tactically significant gains.
- Initiated research to optimize in-situ multi-static active sonar performance based on broadband, physics-based scattering models and environmental feedback algorithms.

FY 2004 Plans:

- Complete feasibility assessment of using ASW acoustic intensity sensors as active receivers.
- Complete development/improvement of multi-static signal processing techniques for systems employing explosive sound sources.
- Complete development and at-sea testing of Compact Deployable Multi-static Receiver (CDMR) hardware and software.
- Complete development of ultra-low power electronics to support advanced ASW maritime remote sensing devices.
- Complete development of deployable volumetric arrays capable of tactically significant gains.
- Continue development of Telesonar technologies to enable deployable system acoustic communications.

- Continue development of signal processing algorithms aimed at reducing clutter-generated false alerts.
- Continue development/improvement of multi-static signal processing techniques for systems employing coherent sound sources.
- Continue development and testing of a series of incremental software builds for in-buoy signal processing.
- Continue development of smaller, cheaper low-frequency active transducers for multi-static sonar systems.
- Continue development of "intelligent" algorithms aimed at optimizing distributed multi-static sources/receivers.
- Continue research to optimize in-situ multi-static active sonar performance based on broadband, physics-based scattering models and environmental feedback algorithms.
- Initiate development of "field-level" processing for large numbers of CMDRs.
- Initiate development of an advanced node design for survivable sensors.
- Initiate development of a non-traditional tracking system for deployment on large-scale Unmanned Undersea Vehicles (UUVs).
- Initiate development of multi-static signal processing algorithms with controllable transmit waveform type and ping schedule to enable improved detection and tracking of threat submarines.
- Initiate at-sea testing of the multi-static system components (CDMR, signal processing software, and "field-level" processing).

FY 2005 Plans:

- Complete development and testing of a series of incremental software builds for in-buoy signal processing.
- Complete development of smaller, cheaper low-frequency active transducers for multi-static sonar systems.
- Complete analysis of FY 2004 multi-static sea test data.
- Continue development of Telesonar technologies to enable deployable system acoustic communications.
- Continue development of signal processing algorithms aimed at reducing clutter-generated false alerts.
- Continue development/improvement of multi-static signal processing techniques for systems employing coherent sound sources.
- Continue development of "intelligent" algorithms aimed at optimizing distributed multi-static sources/receivers.
- Continue research to optimize in-situ multi-static active sonar performance based on broadband, physics-based scattering models and environmental feedback algorithms.
- Continue at-sea testing of the multi-static system components (CDMR, signal processing software, and "field-level" processing).
- Continue development of an advanced node design for survivable sensors.
- Continue development of a non-traditional tracking system for deployment on large-scale Unmanned Undersea Vehicles (UUVs).

- Continue development of multi-static signal processing algorithms with controllable transmit waveform type and ping schedule to enable improved detection and tracking of threat submarines.

	FY 2003	FY 2004	FY 2005
Battlegroup Anti-Submarine Warfare (ASW) Defense	27,291	27,672	28,610

Battlegroup ASW Defense technology focuses on the development of platform-based sources and receivers aimed at denying submarines the ability to target grey ships. This technology area is primarily concerned with detections inside 10 nm. Battlegroup ASW Defense integrates next-generation technologies, automatic target recognition, sensors that adjust to complex acoustic environments, and environmentally adaptive processing techniques. Battlegroup ASW Defense will enable smaller, lighter, and cheaper acoustic/non-acoustic arrays, large multi-line arrays, and submarine flank arrays all with environmental adaptation capabilities.

FY 2003 Accomplishments:

- Completed performance/sea testing of optical standoff sensor systems.
- Completed development of signal processing techniques that combine multiple waveforms from echo returns before tracks are formed to improve sonar system detection performance and holding times.
- Completed fabrication and field-testing of the performance of a complete polymer coated fiber array.
- Completed development of in-situ calibration techniques to monitor large conformal arrays.
- Completed the writing of the Sonar Automation technology development plan.
- Completed development of technical approaches for automatically configuring the AN/SQS-53C sonar systems based on environmental conditions.
- Completed testing of environmentally adaptive signal processing techniques as applied to the AN/SQS-53C sonar.
- Completed development of EA AN/SQQ-89 signal processing techniques.
- Completed development of High Frequency Broadband (HFBB) outboard power electronics and controls for conformal arrays.
- Completed testing of prototype candidate transducer arrays for down-select to a prototype array contract. The HFBB effort was terminated in FY03 due to budget reductions.
- Initiated development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Initiated development and testing of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Initiated design and development of underwater projectors utilizing structural magnetostrictive material.
- Initiated development of baffled ring transducer technology.
- Initiated development of improved techniques to distinguish submarine echoes from those produced by ocean

bottom features.
- Initiated development and evaluation of advanced sonar signal classification algorithms, using "support vector machines," that enable improved sonar operator performance.
- Initiated development of a geo-acoustic inversion capability for submarines utilizing the submarine's passive towed array data.
- Initiated development of signal processing and system control algorithms for the AN/WSQ-11 "Tripwire" torpedo protection system.
- Initiated development of an AN/WSQ-11 "Tripwire" test-bed for algorithm testing.
- Continued development of Reduced Diameter fiber optic sensors to improve towed array reliability.
- Continued development of sensors and algorithms to compensate for towed array performance degradation during maneuvers/turns.
- Continued development and testing of a low-cost Fishline fiber optic array for platform-based deployment.
- Continued development of conformal hull array designs of significantly greater aperture and dramatically reduced volume and weight for application to the High Frequency (HF) sail array designs for 688- and Virginia-class submarines.
- Continued development of structural magnetostrictive materials to enable more rugged transducer designs.
- Continued development of very thin, compact HF cymbal transducers for conformal arrays.
- Continued development of PZT (Lead Zirconate Titanate) materials for High-Frequency Broadband Transducers & Arrays for submarines.
- Continued development of signal processing improvements for coherent tactical active sonar systems aimed at improving Detection, Classification and Localization (D/C/L)of small, slow moving submarines in shallow water.
- Continued investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Continued investigations into time-reversal techniques to improve the performance of active sonar systems.
- Continued assembly and laboratory measurements of a large aperture virtual sonar array.
- Continued fabrication and calibration of HF fiber optic sensors as well as in-lab testing and a field demonstration of the HF acoustic array.
- Continued development and demonstration of signal processing algorithms designed to automatically detect and classify acoustic signatures of threat submarines.
- Continued characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance sonar systems.
- Continued system requirements definition for the AN/WSQ-11 "Tripwire" system that will protect surface ships from torpedo salvo attacks.
- Continued hardware risk-reduction efforts for the AN/WSQ-11 "Tripwire" to protect surface ships from torpedo salvo attacks.
- Continued passive acoustic array test-bed design and hardware component procurement to support future

passive sonar system designs.

FY 2004 Plans:

- Conduct Multi-Mode Magnetic Detection System (MMMDS) effort under Littoral ASW Future Naval Capability (FNC).
- Complete development and evaluation of advanced sonar signal classification algorithms, using "support vector machines," that enable improved sonar operator performance.
- Complete development and testing of a low-cost Fishline fiber optic array for platform-based deployment.
- Complete development of conformal hull array designs of significantly greater aperture and dramatically reduced volume and weight for application to the High Frequency (HF) sail array designs for 688- and Virginia-class submarines--transition to the Advanced Systems Technology Office (ASTO), SEA-93, and Program Element 0603561N. (Transduction)
- Complete development of very thin, compact HF cymbal transducers for conformal arrays.
- Terminate development of PZT (Lead Zirconate Titanate) materials for High-Frequency Broadband Transducers & Arrays for submarines.
- Complete assembly and laboratory measurements of a large aperture virtual sonar array.
- Complete fabrication and calibration of HF fiber optic sensors as well as in-lab testing and a field demonstration of the HF acoustic array.
- Complete system requirements definition for the AN/WSQ-11 "Tripwire" system that will protect surface ships from torpedo salvo attacks.
- Complete hardware risk-reduction efforts for the AN/WSQ-11 "Tripwire" to protect surface ships from torpedo salvo attacks.
- Continue development of Reduced Diameter fiber optic sensors to improve towed array reliability.
- Continue development of sensors and algorithms to compensate for towed array performance degradation during maneuvers/turns.
- Continue development of structural magnetostrictive materials to enable more rugged transducer designs.
- Continue development of signal processing improvements for coherent tactical active sonar systems aimed at improving D/C/L of small, slow moving submarines in shallow water.
- Continue investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Continue investigations into time-reversal techniques to improve the performance of active sonar systems.
- Continue development and demonstration of signal processing algorithms designed to automatically detect and classify acoustic signatures of threat submarines.
- Continue characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance sonar systems.

- Continue passive acoustic array test-bed design and hardware component procurement to support future passive sonar system designs.
- Continue development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Continue development and complete testing of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Continue design and development of underwater projectors using structural magnetostrictive materials.
- Continue development of baffled ring transducer technology.
- Continue development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features.
- Continue development of a geo-acoustic inversion capability for submarines utilizing the submarine's passive towed array data.
- Continue development of signal processing and system control algorithms for the AN/WSQ-11 "Tripwire" torpedo protection system.
- Continue development of an AN/WSQ-11 "Tripwire" test-bed for the testing of algorithms.
- Initiate development of an acoustic/magnetic hybrid sensor.
- Initiate development of surface ship active sonar signal processing techniques to enable Detection/Classification/Localization of torpedoes and autonomous underwater vehicles (AUVs).
- Initiate the development of a concept that automatically guides sonar operators through the complicated, threat submarine detection, classification and tracking process.
- Initiate preliminary MMMDS design and component-level development of AUV-based magnetometer sensor technologies.
- Initiate MMMDS development and installation of real-time noise reduction, detection, and tracking algorithms on a simulator to enable data collection and performance evaluation.

FY 2005 Plans:

- Complete evaluation of Reduced Diameter fiber-optic sensor to improve towed array reliability. Transition to the NAVSEA Advanced Systems Technology Office (ASTO), Program Element 0603561N.
- Complete development of sensors and algorithms to compensate for towed array performance degradation during maneuvers/turns. Transition to the NAVSEA Advanced Systems Technology Office (ASTO), Program Element 0603561N.
- Complete investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Complete investigations into time-reversal techniques to improve the performance of active sonar systems.
- Complete passive acoustic array test-bed design and hardware component procurement to support future passive sonar system designs.

- Complete development of a hybrid sensor to detect both acoustic and magnetic signatures.
- Complete development of surface ship active sonar signal processing techniques to enable detection, classification, and localization of torpedoes and autonomous underwater vehicles (AUVs).
- Complete the development of a concept that automatically guides sonar operators through the complicated, threat submarine detection, classification and tracking process.
- Complete design and development of underwater projectors using structural magnetostrictive materials.
- Continue development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Continue development and complete testing of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Continue development of baffled ring transducer technology.
- Continue development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features.
- Continue development of a geo-acoustic inversion capability for submarines utilizing the submarine’s passive towed array data.
- Continue development of signal processing and system control algorithms for the AN/WSQ-11 “Tripwire” torpedo protection system.
- Continue development of an AN/WSQ-11 “Tripwire” test-bed for the testing of algorithms.
- Continue development of structural magnetostrictive materials to enable more rugged transducer designs.
- Continue development of signal processing improvements for coherent tactical active sonar systems aimed at improving D/C/L of small, slow moving submarines in shallow water.
- Continue development and demonstration of signal processing algorithms designed to automatically detect and classify acoustic signatures of threat submarines.
- Continue characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance sonar systems.
- Continue preliminary MMMDS design and component-level development of AUV-based magnetometer sensor technologies.
- Continue MMMDS development and installation of real-time noise reduction, detection, and tracking algorithms on a simulator to enable data collection and performance evaluation.
- Initiate development of an integrated solution to environmentally adaptive signal processing, incorporating environmental sensing, adaptive transmit waveforms, and receive signal processing.
- Initiate development of low cost, compact, combined acoustic sensor.
- Initiate focused research program to establish fundamental limits of passive sonar performance in shallow water using the passive acoustic array test-bed.
- Initiate collection and analysis of MMMDS performance data.
- Initiate evaluation of proposed MMMDS processing approaches and down-select to one approach.

	FY 2003	FY 2004	FY 2005
Cooperative Anti-Submarine Warfare (ASW)	0	1,250	1,250

Cooperative ASW technology developments enable ASW platforms to work together effectively to detect, classify and localize very quiet undersea targets. Many of the tools required to achieve this objective were being developed as components of the LASW FNC under the heading of Integrated Anti-Submarine Warfare (IASW) in Program Element (PE) 0603235N. Those IASW efforts have been terminated due to budget reductions. A portion of those efforts will continue in this PE as Cooperative ASW starting in FY 2004. The focus of this effort is to leverage those concepts and technologies previously investigated under IASW in order to develop technologies that enable the exchange and fusion of ASW sensor data among the technologies developed under Battlegroup ASW Defense, Wide Area ASW Surveillance, and Neutralization program areas.

FY 2003 Accomplishments:

Not Applicable

FY 2004 Plans:

- Initiate investigation into a flexible information/knowledge management architecture that can support several sonar systems including land/air-based sensors.
- Initiate investigation into technologies to automatically fuse tactical sensor information to form and maintain an improved ASW portion of the Common Tactical Undersea Picture.

FY 2005 Plans:

- Complete investigation into a flexible information/knowledge management architecture that can support several sonar systems and include land/air-based sensors.
- Complete investigation into technologies to automatically fuse tactical sensor information to form and maintain an improved ASW portion of the Common Tactical Undersea Picture.
- Initiate development of technologies to automatically fuse tactical ASW sensor information to enhance the ASW portion of the Common Tactical Undersea Picture.

	FY 2003	FY 2004	FY 2005
Neutralization	23,457	16,428	15,492

Neutralization focuses on technologies for undersea weapons to counter threat submarines by increasing the Probability of Kill (Pk). Weapon technology focus areas include: Counterweapons/Countermeasures (CW/CM), Explosives and Warheads, Guidance and Control (G&C), Multidisciplinary Systems Design & Optimization (MSDO) (comprising Simulation Based Design, Silencing and Propulsion), Power Sources, and Supercavitation. Demonstration projects include Anti-Torpedo Torpedo (ATT), Adaptable High-Speed Underwater Munitions (ASHUM), Next Generation Countermeasures (NGCM) and Torpedo Bridging Technologies (TBT) for torpedo defense. The ultimate goal is to develop reduced sized advanced undersea weapons with revolutionary capabilities and fill Sea Shield mission capability gaps.

FY 2003 Accomplishments:

- Completed a series of three elastic tests to determine Containerized Countermeasure Anti-torpedo Torpedo (CCAT) system CW/CM vulnerability and ATT hard-kill lethality.
- Completed nearly 150 simulated ASHUM terminal defense engagements between a single wake homing torpedo and a straight running ship. The average number of shots taken, hits achieved and penetrations of the warhead were computed for these simulated engagements.
- Completed analysis of Undersea Warhead directed blast cavity. Single stage test showed desired performance, and dual stage test showed cavity pinch-off limits enhancement.
- Completed transition of Explosive and Undersea Warheads effort Enhanced Ship Survivability Modeling Codes (using DYSMAS Hydro-Code) to Naval Shipyards.
- Completed development of Weapon Silencing active-passive mounts for reducing weapon machinery noise and implementation of Weapon Silencing active controller hardware into Active Fiber Composites effort.
- Completed Computational Fluid Dynamics (CFD) codes for Supercavitation vehicle simulation.
- Completed Undersea Warhead and G&C sections design using MSDO tools.
- Completed Weapon/Platform Connectivity dual band frequency agile signal processor development to improve torpedo single-ping detection, classification and homing performance. Transitioned algorithms to acquisition via the Advanced Processor Build for Torpedoes (APB-T) process.
- Continued development of CW/CM (ATT, NGCM, ASHUM) technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons.
- Continued development of Weapon Silencing affordable noise control concepts for machinery and propulsor radiated noise.
- Continued optimization of undersea weapons system design using MSDO with respect to construction and performance.

- Continued development of the Low Acoustic Signature Motor/Propulsor for Electronically Powered (LAMPrEy) undersea vehicle to further enhance Torpedo Stealth efforts.
- Continued development of TBT Weapons G&C innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification and localization.
- Continued development of TBT to capitalize on connectivity between a HWT and submarine platform combat control including sensors.
- Initiated development of improved modeling and simulation capabilities, including improved threat models, torpedo system models and acoustic environment simulation using Torpedo Enterprise Advanced Modeling and Simulation (TEAMS).

FY 2004 Plans:

- Continue development of CW/CM (ATT, NGCM, ASHUM) technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons.
- Continue development of improved threat and torpedo system modeling and simulation capabilities (TEAMS).
- Continue development of Weapon Silencing affordable noise control concepts for machinery and propulsor radiated noise.
- Continue optimization of undersea weapons system design using MSDO with respect to construction and performance.
- Continue development of the Low Acoustic Signature Motor/Propulsor for Electronically Powered (LAMPrEy) undersea vehicle to further enhance Torpedo Stealth efforts.
- Continue development of TBT Weapons G&C innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification and localization.
- Continue development of TBT to capitalize on connectivity between a HWT and submarine platform combat control including sensors.
- Initiate effort to conduct full ship validation effort for Explosion Response simulation code (using DYSMAS Hydro-Code).
- Initiate development of Explosive and Undersea Warheads Microelectromechanical Systems (MEMS) Inertial Measuring Unit (IMU) into the warhead Safety & Arming (S&A) sub-system.
- Initiate implementation of MSDO tools in hybrid propulsion and Weapons Silencing systems development.
- Initiate application of MSDO tools probabilistic methods and uncertainty analysis for Light-Weight Torpedo (LWT) design.
- Initiate development of supercavitation controller and autopilot, and integration with control surfaces and devices.
- Initiate supercavitation homing sensor development using single crystal and piezoelectric and piezoceramic materials.

- Initiate TBT high fidelity simulation based evaluation of weapon signal processing and Heavy-Weight Torpedo (HWT) tactical control technologies.

FY 2005 Plans:

- Complete development and in-water testing of the Weapon Silencing integrated motor/propulsor - LAMPrEy.
- Complete development of a high fidelity Simulation Based Design (SBD) evaluation of weapon signal processing and HWT tactical control technologies.
- Complete development of technologies to enable a HWT and a shooting platform to be effectively employed as a fully linked weapon system.
- Continue development of CW/CM (ATT, NGCM, ASHUM) technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons.
- Continue development of improved threat and torpedo system modeling and simulation capabilities (TEAMS).
- Continue full ship validation effort for Explosion Response simulation code (using DYSMAS Hydro-Code).
- Continue development of Explosive and Undersea Warheads MEMS IMU into the warhead Safety & Arming (S&A) sub-system.
- Continue development of Weapon Silencing affordable noise control concepts for machinery and propulsor radiated noise.
- Continue optimization of undersea weapons system design using MSDO with respect to construction and performance.
- Continue development of TBT Weapons G&C innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification and localization.
- Continue implementation of MSDO tools in hybrid propulsion and Weapons Silencing systems development.
- Continue application of MSDO tools probabilistic methods and uncertainty analysis for Light-Weight Torpedo (LWT) design.
- Continue development of supercavitation controller and autopilot, and integration with control surfaces and devices.
- Continue supercavitation homing sensor development using single crystal and piezoelectric and piezoceramic materials.
- Initiate development of a Supercavitating 6.75-inch (or full-scale) vehicle with vehicle control devices and homing sensors.

	FY 2003	FY 2004	FY 2005
Project Morgan	2,865	0	0

Classified Program. FY04 efforts are funded in PE 0603747N and FY05 efforts are funded in PE 0603734N (BA4).

FY 2004 Plans:

Not Applicable

FY 2005 Plans:

Not Applicable

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ACOUSTIC TEMPERATURE PROFILER	2,436	0

Improved the Acoustic Temperature Profiler (ATP) measurement sensitivity across a wider range of depths, thereby increasing the accuracy of the Sound Velocity profile. The ATP is a technique that allows the temperature profile of the ocean to be measured nearly continuously. The Sound Velocity Profile (SVP) is a critical environmental parameter used for estimating and predicting sonar system performance. Phase III improved ATP measurement sensitivity across a wider range of depths, thereby increasing the accuracy of the SVP.

	FY 2003	FY 2004
AN/SQS-53C MINE DETECTION AND CLASSIFICATION ENHANCEMENTS	0	1,682

Initiate development and testing of signal processing algorithms to classify small objects as mine-like/non-mine-like with a false alarm rate lower than that of legacy systems.

	FY 2003	FY 2004
ATT (6.75-inch dia) Multi-Mission Undersea Weapon	1,142	2,521

FY03 (previously titled Undersea Defensive Warfare Systems (6.25” ATT Technology)): Developed additional ATT guidance sonar channels, which will enable the 6.25” Anti-Torpedo Torpedo (ATT) to operate with increased effectiveness in intercepting threat torpedoes at shallow depths and in the wake of a surface ship. Design

and development of the hardware to support the in-water evaluation of this technology was completed. Engine subsystems for the advanced, extended range ATT engine were integrated into the engine architecture. FY04 new title: ATT Multi-Mission Undersea Weapon. Optimize signal processing and tactics used in ATT for offensive applications; update the multi-mission ATT performance assessment software tools to address air dropped compact rapid attack weapon concept; and collect in-water data to evaluate proposed multi-mission guidance and control technologies.

	FY 2003	FY 2004
HIGH POWERED ULTRASONICS SHIPBORNE WASTE TREATMENT SYSTEM	0	1,483

Perform feasibility and efficacy studies using terfenol magnetostrictive materials for several Navy environmental waste treatment applications.

	FY 2003	FY 2004
LITHIUM CARBON MONOFLUORIDE BATTERY	954	989

FY03: Completed delivery of fifteen AA size wound cells; Improved cell performance through optimization of the cathode and electrolyte formulations, and the use of new grommets and separator materials; and Evaluated carbon precursors based on structural parameters and correlated to performance. FY04: Deliver fifteen proof-of-concept AA wound cells with thin electrodes. Define the optimal cell design to be incorporated into future D and DD size cells for Navy buoy applications. Conduct investigation of density, pellet thickness, electrolyte absorption, and cathode swelling properties as related to discharge performance. Initiate development of a model to predict cathode behavior during discharge; Initiate a feasibility study of various cathode technologies.

	FY 2003	FY 2004
LOW ACOUSTIC SIGNATURE MOTORS	2,001	1,730

FY03: Provided applied research to Low Acoustic Signature Motor/Propulsor for Electrically Powered Undersea Vehicles (LAMPREY) technology development. Manufactured modified propulsor/control surfaces/after body component hardware for LAMPREY water tunnel test vehicle and at-sea test vehicle. Bench-scale motor component test data were collected and analyzed to ascertain noise sources and noise levels for comparison to planned water tunnel measurements and performance predictions. FY04: Complete fabrication and integration of modified component hardware into water tunnel test vehicle. Instrument water tunnel test vehicle to measure

propulsor shaft speed, motor operating conditions, and vibration of the propulsor and vehicle hull. Collect and analyze water tunnel test data on motor performance and acoustics. Complete integration of modified hardware into at-sea test vehicle and perform Tow Tank and At-Sea vehicle runs.

	FY 2003	FY 2004
MAGNETORESTRICTIVE TRANSDUCTION	5,158	3,115

Initiated: the following in FY03: Investigation and development of iron gallium alloys to determine their magnetostriction and mechanical strength; Investigation of three cost reduction methods for the production of TERFENOL-D magnetostrictive alloys; and Development of transducer design incorporating iron gallium alloys. FY04: Complete investigation of three cost reduction methods for the production of TERFENOL-D. Continue investigation and development of iron gallium alloys; Continue development of transducer design incorporating iron gallium alloys.

	FY 2003	FY 2004
MEMS-IMU TORPEDO DEFENSE APPLICATIONS	0	3,461

Develop advanced manufacturing processes for the Microelectromechanical System (MEMS) based Safe and Arm (S&A) Inertial Measurement Unit (IMU) and to integrate it into the MEMS S&A system intended for use in the Navy's Containerized Countermeasure Anti-torpedo Torpedo (CCAT) defensive weapon.

	FY 2003	FY 2004
Semi-Autonomous Underwater Vehicle for Intervention Missions (SAUVIM)	1,619	0

The objective of this project was to develop and demonstrate the control methodologies and algorithms necessary to perform complex tasks using a robotic arm attached to an underwater vehicle. The problem was enhanced by strong underwater currents, force feedback, object recognition, and object dimensioning.

	FY 2003	FY 2004
UNDERSEA DEFENSIVE WARFARE SYSTEMS (RAPID RESPONSE ATT WEAPON)	1,142	0

Expanded the capabilities of the 6.25" Anti-Torpedo Torpedo (ATT) technology, enabling a submarine-launched quick reaction response weapon for use against torpedoes and other close aboard targets.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0601153N (Defense Research Sciences)
PE 0602114N (Power Projection Applied Research)
PE 0602123N (Force Protection Applied Research)
PE 0602435N (Ocean Warfighting Environment Applied Research)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603114N (Power Projection Advanced Technology)
PE 0603123N (Force Protection Advanced Technology)
PE 0603506N (Surface Ship Torpedo Defense)
PE 0603553N (Surface ASW)
PE 0603561N (Advanced Submarine System Development)
PE 0603747N (Undersea Warfare Advanced Technology)
PE 0603758N (Navy Warfighting Experiments and Demonstrations)
PE 0604221N (P-3 Modernization Program)
PE 0604261N (Acoustic Search Sensors (ENG))
PE 0604784N (Distributed Surveillance Systems)

NON-NAVY RELATED RDT&E:
PE 0603763E (Marine Technology)
PE 0603739E (Advanced Electronics Technologies)
PE 0602702E (Tactical Technology)
PE 0602173C (Support Technologies - Applied Research)

D. ACQUISITION STRATEGY:
Not Applicable

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

BA: 02 PROGRAM ELEMENT: 0602782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare 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
Mine and Expeditionary Warfare Applied Research	49,363	47,929	48,016	47,176	49,777	50,698	51,733

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Provides technologies for Naval Mine Countermeasures (MCM), U.S. Naval sea mines, Naval Special Warfare (NSW), and Department of Defense (DOD) Explosive Ordnance Disposal (EOD). It is strongly aligned with the Joint Chiefs of Staff Joint Warfighting Capability Objectives through the development of technologies to achieve military objectives with minimal casualties and collateral damage. Within the Naval Transformation Roadmap, this investment will achieve one of three "key transformational capabilities" required by "Sea Shield" as well as technically enable the Ship to Objective Maneuver (STOM) key transformational capability within "Sea Strike" by focusing on technologies that will provide the Naval Force with the capability to dominate the battlespace, project power from the sea, and support forces ashore with particular emphasis on rapid MCM operations. The MCM efforts concentrate on the development and transition of technologies for the Organic Mine Countermeasures Future Naval Capability (OMCM FNC) supporting STOM. These include technologies for clandestine minefield surveillance and reconnaissance, organic ship self-protection, organic minehunting, neutralization/breaching and clearance. The sea mining efforts emphasize technologies for future sea mines. The NSW and EOD technology effort concentrates on the development of technologies for near-shore mine/obstacle detection and clearance, mobility and survivability, as well as explosive ordnance disposal.

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

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

BA: 02 PROGRAM ELEMENT: 0602782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Applied Research

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	55,531	47,490	48,315
Cong. Rescissions/Adjustments/Undist.Reductions	0	-561	0
Congressional Actions	0	1,000	0
Execution Adjustments	-5,315	0	0
Inflation Savings	0	0	-154
Rate Adjustments	0	0	-145
SBIR Assessment	-853	0	0
FY 2005 President's Budget Submission	49,363	47,929	48,016

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

BA: 02 PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Applied Research

PROJECT TITLE: Mine and Expeditionary Warfare 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
Mine and Expeditionary Warfare Applied Research	49,363	47,929	48,016	47,176	49,777	50,698	51,733

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project focuses on reducing the time involved in conducting Mine Countermeasures (MCM) operations and removing personnel from minefields. The MCM project develops and transitions technologies for organic mine countermeasures and Future Naval Capabilities supporting Ship to Objective Maneuver (STOM). These include technologies for clandestine minefield surveillance and reconnaissance, organic ship self-protection, organic minehunting, neutralization/breaching and clearance. The sea mining effort emphasizes technologies for future sea mines. The Naval Special Warfare and Explosive Ordnance (EOD) technology effort concentrates on the development of technologies for near-shore mine/obstacle detection and clearance, mobility and survivability, as well as Explosive Ordnance Disposal (EOD).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Mine/Obstacle Detection	31,362	27,144	28,664

This activity focuses on applied research to enable longer detection ranges and precise mine location with fewer false alarms in a variety of challenging environments. For acoustic sensors, efforts in Synthetic Aperture Sonar (SAS) technologies, sensor integration onto Autonomous Underwater Vehicles (AUVs) and buried mine classification are being addressed. Electro-optic (E-O) sensor research develops algorithms to enable image processing for rapid overt reconnaissance from an Unmanned Aerial Vehicle (UAV). Other processing, classification and data fusion techniques to reduce operator workload, and a mine burial prediction "expert system" are also being developed.

FY 2003 Accomplishments:

-Completed integration of non-imaging SAS hardware onto an AUV.

-Initiated at-sea testing to begin to quantify performance and collect data to refine non-imaging SAS

processing techniques.
-Continued development of AUV obstacle avoidance sonar and real-time path-planning algorithms.
-Continued development and performance assessment of long-range SAS motion compensation and beamforming techniques using existing SAS field data.
-Continued SAS algorithm development for long-range, multi-path environment.
-Continued development of buried mine classification sensors and began to address AUV integration issues.
-Updated E-O mine/minefield detection system performance models for UAV sensor.
-Continued the refinement of real-time E-O image processing algorithms for UAV multi-spectral minefield detection.
-Performed a significant 3D Light Detection and Ranging (LIDAR) data collection in the Surf Zone (SZ) for UAV sensor algorithm development.
-Initiated a first order UAV optical Surf Zone Index (SZI) passive E-O imaging database to predict system performance in SZ.
-Completed and validated underwater electro-optic identification (EOID) system performance models.
-Completed refinement of automated underwater mine identification algorithms to AQS-20A mine countermeasures program.
-Continued the development of underwater sensor prediction tools to support development, system design, and Tactical Decision Aid (TDA) efforts.
-Began development of long-range, automated, physics-based target recognition algorithms for underwater SAS.
-Began integration of enhanced mine burial predictive sub-models into a mine burial expert system and conducted limited demonstration of the expert system.

FY 2004 Plans:
-Continue data collection to refine non-imaging SAS processing techniques.
-Continue development of compact non-imaging SAS projector, receiver, and post mission analysis tool for AUV system integration.
-Continue development of AUV obstacle avoidance sonar and continue to develop path-planning algorithms.
-Complete development of long-range SAS motion compensation and beamforming techniques.
-Continue SAS algorithm development for long-range, multi-path environment.
-Continue development and integration of buried mine classification sensors into an AUV.
-Demonstrate autonomous reconnaissance and mine hunting technologies focused on multiple cooperating UUVs during Fleet exercises.
-Initiate development of multi-static techniques for multiple, cooperating AUVs.
-Continue the development of UAV Rapid Overt Airborne Reconnaissance (ROAR) active/passive electro-optic image processing and modeling.
-Develop a reconfigurable 3D LIDAR test bed for data collection for UAV sensor algorithm development.

-Continue development of a UAV SZI to predict sensor performance for both active and passive E-O systems.
-Demonstrate utility of underwater EOID system performance models and diver visibility models during a fleet exercise.
-Continue development of SAS long-range, automated, physics-based target recognition algorithms.
-Continue the development of underwater sensor prediction tools to support development, system design, and Tactical Decision Aid (TDA) efforts.
-Begin to optimize the data input-output capabilities of the mine burial expert system to provide predictions in an acceptable operational format and begin evaluating its operational utility during selected fleet exercises.
-Begin the development of a Computer-Aided Detection/Computer-Aided Classification (CAD/CAC) evaluation framework to use in the development and testing of various algorithms.

FY 2005 Plans:
-Complete development of a compact broadband projector, an improved broadband SAS receiver and post mission analysis tool for evaluating AUV system integration of broadband projector and receiver.
-Complete data collection to refine non-imaging SAS processing techniques.
-Complete development of a compact non-imaging SAS projector, an improved non-imaging SAS receiver and post mission analysis tool for evaluating AUV system integration of non-imaging projector and receiver.
-Complete development of real-time path planning algorithms for AUVs.
-Complete development of SAS algorithm for long-range, multi-path environment.
-Continue development of AUV obstacle avoidance sonar.
-Continue development of multi-static AUV-based minehunting integrating navigation, communication and sensor elements.
-Complete integration of buried mine classification sensors into AUV and demonstrate during field trials.
-Demonstrate autonomous reconnaissance and minehunting technologies, specifically non-imaging SAS, during fleet exercises.
-Initiate evaluation of technological capabilities for ROAR UAV sensor buried mine detection in the Beach Zone.
-Continue development of UAV SZI and 3D LIDAR technology test bed for data collection and demonstration of airborne detection of minefields in the VSW and SZ.
-Transition underwater EOID system performance models and sensors for on-scene assessment of diver visibility.
-Continue the development of underwater sensor prediction tools to support development, system design, and TDA efforts.
-Continue development of SAS long-range, automated, physics-based target recognition algorithms.
-Continue the development of a CAD/CAC evaluation framework to use in the development and testing of various algorithms.

-Continue to optimize the data input-output capabilities of the mine burial expert system and participate in a fleet exercise to demonstrate the utility of the mine burial expert system.
-Transition mine burial expert system to the Naval Oceanographic Office.
-Begin the development of survey sensor suites for manned and unmanned platforms.
-Initiate effort to fuse data from underwater magnetic and acoustic sensors to enhance Probability of classification (Pc) and reduce false alarm rate for buried minehunting.

	FY 2003	FY 2004	FY 2005
Special Warfare/EOD	7,832	8,655	10,239

Naval Special Warfare (NSW) missions primarily support covert near-shore naval operations. The goal is to develop technology to increase the combat range and effectiveness of Special Warfare units. A major focus is to develop technologies to enhance the Sea-Air-Land mission of pre-invasion detection for clearance/avoidance of mines and obstacles in the very shallow water (VSW) and surf zone (SZ) amphibious landing areas. Explosive Ordnance Disposal (EOD) operations typically occur in deep, poor-visibility water, with high background noise, and in areas contaminated by a variety of unexploded ordnance (UXO). Advanced technologies are needed to gain access to areas contaminated by area-denial sensors and/or booby traps. These technologies will transition to the Joint Service EOD Program, the Naval EOD Program, or the DOD Technical Response Group. This activity includes applied research in sensor technology for NSW and EOD autonomous and handheld sonar systems to increase detection range and accuracy in harsh environments. Other efforts include mission support technology improvements for Autonomous Underwater Vehicles (AUVs) and human divers – such as communications, navigation and life support.

FY 2003 Accomplishments:
-Completed development of technologies to enable coordinated behavior and mission execution by unmanned underwater vehicles (UUV).
-Completed development of underwater imaging polarimeter.
-Completed development of a pulsed neutron elemental analysis system for identification of filler material in improvised explosive devices.
-Completed development of small Synthetic Aperture Sonar (SAS) for AUV deployment.
-Performed field tests on dual frequency lens sonar.
-Completed development of virtual environment-based training.
-Continued development of digital beamformer architecture for high frequency imaging sonar.
-Continued development of hyperspectral polarimeter prototype.
-Continued development of short range sensors for UUV reconnaissance of surf zone.

-Initiated development of technology to detect, monitor, and disrupt operation of Explosive Safe and Arming (ESA) devices.
-Initiated development of standoff detection and classification sensors for surface and buried UXO using multi-dimensional electro-magnetic (EM) methods.
-Continued development of robotic manipulators, actuators and control algorithms based on artificial muscle materials.
-Continued development of life support equipment technologies, a miniature CO2 sensor, and a passively controlled rebreather.
-Continued development of extended lifetime underwater adhesives.
-Initiated investigation of technology alternatives for next generation Seal Delivery Vehicle.
-Initiated development of Low Probability of Intercept/Low Probability of Detection (LPI/LPD) underwater communications.
-Initiated development of UUV technologies for autonomous inspection of ship hulls.

FY 2004 Plans:
-Complete development of digital beamformer architecture for high frequency imaging sonar.
-Complete development of hyperspectral polarimeter prototype.
-Complete extended lifetime underwater adhesive development.
-Continue development of short range sensors for UUV reconnaissance of SZ.
-Continue development of technology to detect, monitor, and disrupt operation of ESA devices.
-Continue development of standoff detection and classification sensor for surface and buried UXO using multi-dimensional EM methods.
-Continue development of robotic manipulators, actuators and control algorithms based on artificial muscle materials.
-Complete development of passively controlled rebreather.
-Continue development of a miniature CO2 sensor.
-Continue effort for next generation Seal Delivery Vehicle - develop design alternatives.
-Continue development of LPI/LPD underwater communications.
-Continue development of UUV technologies for autonomous inspection of ship hulls.
-Initiate development of hand-held scannerless range imaging sensor.
-Initiate development of a diver heating system for Swimmer Delivery Vehicle (SDV) deployment.
-Initiate development of a composite garment to provide diver insulation.

FY 2005 Plans:
-Complete development of short range sensors for UUV reconnaissance of SZ.
-Continue development of technology to detect, monitor, and disrupt operation of ESA devices.

-Continue development of standoff detection and classification sensors for surface and buried UXO using multi-dimensional EM methods.
-Continue development of hand-held scannerless range imaging sensor.
-Complete development of CO2 sensor.
-Continue development of LPI/LPD underwater communications.
-Continue development of UUV technologies for autonomous inspection of ship hulls.
-Continue development of a diver heating system for SDV deployment.
-Continue development of a composite garment to provide diver insulation.
-Initiate analysis of Naval Special Warfare (NSW) equipment signatures.
-Initiate development of buried ordnance identification sensor.

	FY 2003	FY 2004	FY 2005
Mine/Obstacle Neutralization	9,969	4,941	8,913

Activity includes applied research in technologies for rapid mine and obstacle neutralization and sea mine jamming techniques to increase surface ship safe standoff from threat mines. It includes various lethality, vulnerability and dispensing computational tools, as well as models and assessments to support the various far-term Surf Zone (SZ) and beach zone (BZ) mine and obstacle breaching concepts in PE 0603782N.

FY 2003 Accomplishments:
-Completed analysis of the effectiveness and development of segmented rod warhead against light and medium beach obstacles.
-Initiated development of computational tools and engineering level models for prediction of dart dispenser performance.
-Continued development of dart and fragment sand penetration model.
-Expanded mine vulnerability database to include damage from reactive and chemical darts against SZ mines.
-Continued assessment of dart lethality against SZ and BZ mines with an emphasis on chemical, reactive, and explosive fills.
-Continued assessment of mine jamming concepts utilizing ship-degaussing coils.

FY 2004 Plans:
-Complete development of dart and fragment sand penetration model.
-Continue development of computational tools and engineering level models to assess dart dispenser concepts.
-Continue development of mine vulnerability database - emphasis on kinetic damage, shock, blast and thermal effects.

-Continue assessment of mine jamming concepts utilizing ship-degaussing coils on steel hulled vessels.
-Continue development of advanced computational model to simulate guided bombs in the BZ and SZ against mines and obstacles.

FY 2005 Plans:
-Continue assessment of dart dispenser concepts using advanced computational tools and engineering level models.
-Continue development of the mine vulnerability database for kinetic damage, shock, blast and thermal effects.
-Conduct demonstration and assessment of mine jamming utilizing ship-degaussing coils during a fleet exercise.
-Complete development of an advanced computational model to simulate guided bombs in the BZ and SZ against mines and obstacles.
-Initiate development of a mine vulnerability code for SZ and BZ mines.
-Initiate assessment of precision-guided bombs for mine neutralization in Very Shallow Water (VSW).

	FY 2003	FY 2004	FY 2005
Mine Technology	200	200	200

This activity assesses advanced sea mine technologies to maintain expertise in this Naval Warfare area.

FY 2003 Accomplishments:
-Completed development of mining assessment tools.
-Initiated assessment of advanced sea mine technologies focusing on remote control and warhead concepts.

FY 2004 Plans:
-Continue assessment of advanced sea mine technologies.

FY 2005 Plans:
-Continue assessment of advanced sea mine technologies, focusing on remote control and warhead concepts for increased effectiveness.

	FY 2003	FY 2004	FY 2005
Assault Breaching System	0	6,000	0

Assault Breaching System concepts will lead to a future mine and obstacle breaching capability. The employment of air and surface strike weapon systems will minimize exposure to service personnel, enable amphibious landing forces to maintain an unencumbered operational tempo from the sea to the objectives ashore, and reduce total ownership costs and logistics requirements. It supports the future naval warfare directions of power projection, operational maneuver from the sea, Ship-to-Objective Maneuver, and sea-based logistics.

FY 2003 Accomplishments:
Not applicable.

FY 2004 Plans:
-Accelerate the development and demonstration of a reconnaissance system for detecting minefields on the beach.
-Develop a systems level model to support the planned tradeoff analysis of Assault Breaching Systems. The 6-Degrees of Freedom (DoF) model will integrate system/platform level guidance algorithms, accurate aerodynamics, and dispenser concepts to assess the performance of countermine dart delivery concepts.

FY 2005 Plans:
Not applicable.

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
MOBILE UNDERWATER COASTAL SURVEILLANCE SYSTEM	0	989

The objective of this effort is to develop control algorithms to effect cooperative behavior among multiple autonomous underwater vehicles in specific, extended duration mission scenarios. Duration will be achieved through the use of vehicles capable of harvesting solar energy from the environment.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0601153N (Defense Research Sciences)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602435N (Ocean Warfighting Environment Applied Research)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))
PE 0603654N (Joint Service Explosive Ordnance Development)
PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
PE 0604654N (Joint Service Explosive Ordnance Development)

NON-NAVY RELATED RDT&E:
PE 0602712A (Countermine Systems)
PE 0603606A (Landmine WF and Barrier Advanced Technology)
PE 1160401BB (Special Operations Technology Development)
PE 1160402BB (Special Operations Advanced Technology Development)

D. ACQUISITION STRATEGY:

Not Applicable.

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

BA: 03 PROGRAM ELEMENT: 0603114N
PROGRAM ELEMENT TITLE: Power Projection Advanced Technology

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
R2487 DP-2 Thrust Vectoring Program	4,763	4,945	0	0	0	0	0
R2721 Vectored Thrust Ducted Propeller (VTDP)	3,334	0	0	0	0	0	0
R2821 Integrated Hypersonic Aeromechanics Tool (IHAT)	3,574	3,461	0	0	0	0	0
R2823 Precision Strike Navigator (PSN)	961	989	0	0	0	0	0
R2911 Power Projection Advanced Technology/Integrated High Payoff Rocket Propulsion Technology Program (IHPRPT)	72,816	198,188	86,179	67,107	65,237	46,609	47,556
R3006 Affordable Weapons	20,431	0	0	0	0	0	0
R3022 Joint Non Lethal Weapons	0	0	6,180	2,394	1,397	10,790	10,806
R9008 High Energy Laser-Low Aspect Target Tracking (HEL-LATT)	4,451	2,076	0	0	0	0	0
R9010 Variable Engine Nozzle	1,436	1,483	0	0	0	0	0
R9012 Magdalena Ridge Observatory	20,129	10,383	0	0	0	0	0
R9013 Littoral Support Craft-Experimental (LSC(X))	8,702	0	0	0	0	0	0
R9133 Advance Camouflage Coating	6,976	0	0	0	0	0	0
R9134 High Speed Anti-Radiation Demonstration (HSAD)							

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

BA: 03 PROGRAM ELEMENT: 0603114N
PROGRAM ELEMENT TITLE: Power Projection Advanced Technology

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
	7,352	5,044	0	0	0	0	0
R9135 High Speed Anti-Radiation Missile Demonstrator (AARGM)							
	6,062	0	0	0	0	0	0
R9136 Advanced Lifting Body Research Program/High Speed, Heavy-Lift, Shallow Draft-Capable Watercraft Demonstration							
	5,651	12,510	0	0	0	0	0
R9137 Littoral Support Craft LSC (X))-Lifting Body							
	9,698	0	0	0	0	0	0
R9292 Advanced Thin Film Coatings							
	0	4,945	0	0	0	0	0
R9295 Large Area Multi-Spectral Sapphire Windows For Airborne Reconnaissance							
	0	1,682	0	0	0	0	0
R9296 Laser Radar							
	0	2,967	0	0	0	0	0
R9297 Low Power Mega-Performance UAV Processing Engines							
	0	1,483	0	0	0	0	0
R9298 Low-Cost Guided Imaging Rocket (LOGIR)							
	0	2,967	0	0	0	0	0
R9299 Printed Wiring Boards (PWB)							
	0	4,203	0	0	0	0	0
R9302 Uncooled High Resolution Infrared Sensors							
	0	3,362	0	0	0	0	0
Totals	176,336	260,688	92,359	69,501	66,634	57,399	58,362

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program develops and demonstrates advanced technologies, including Directed Energy, for naval weapon systems, and Electric Warship. This Program Element (PE) includes elements of the following Future Naval Capabilities (FNCs): Time Critical Strike (TCS), Autonomous Operations (AO), and Total Ownership Cost (TOC). Within the Naval Transformation Roadmap, this investment will achieve one of four key transformational capabilities required by Sea Strike as well as

technically enable elements of both Sea Shield and Force Net.
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	167,191	177,006	190,411
Cong. Rescissions/Adjustments/Undist.Reductions	0	-3,006	0
Congressional Actions	0	86,700	0
*Execution Adjustments	11,012	0	0
Inflation Savings	0	0	-627
Joint Non-Lethal Weapons Program	0	0	6,200
J-UCAS Transfer to DARPA	0	0	-107,000
Rate Adjustments	0	-12	155
SBIR Assessment	-1,867	0	0
Technical Adjustments	0	0	3,220
FY 2005 President's Budget Submission	176,336	260,688	92,359

*Includes $14.9M ATR for Affordable Weapons.

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

BA: 03 PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: Power Projection Advanced Technology
PROJECT NUMBER: R2911 PROJECT TITLE: Power Proj Adv Tech / IHPRPT

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
R2911 Power Proj Adv Tech / IHPRPT	72,816	198,188	86,179	67,107	65,237	46,609	47,556

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Project includes elements of the following Future Naval Capabilities (FNCs): Time Critical Strike (TCS); Autonomous Operations (AO); and Total Ownership Cost (TOC).

Note: Integrated High Payoff Rocket Propulsion Technology Program (IHPRPT) (FY 2004 $988) is discussed in the Congressional Plus-Up section.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Joint Unmanned Combat Air System	21,000	117,865	0

ONR supports the DARPA (Defense Advanced Research Project Agency)-led Joint Unmanned Combat Air Systems (J-UCAS) effort (formerly UCAV-N), in conjunction with Air Force, to develop and demonstrate technical feasibility, military utility and operational value for a networked system of high performance, weaponized unmanned air vehicles to effectively and affordably prosecute 21st century combat missions – including Suppression of Enemy Air Defenses (SEAD), collaborative electronic attack, penetrating surveillance, and deep strike – within the emerging global command and control architecture. Multi-year funding in this project will provide for two robust flight demonstrations to encourage innovation, fully explore the potential, and develop options for reduced risk transition to acquisition.

The technical challenges of J-UCAS include: (1) suitability of an advanced low observable air vehicle for carrier based launch and recovery, (2) integrated manned/unmanned air and deck operations, and (3) associated mission control system (MCS) carrier integration. Two full flight demonstrations are planned to include simulation and surrogate buildups, carrier air operations, catapult launch and arrested landing, deck and mission operations.

FY 2003 Accomplishments:

- Initiated Phase IIB Flight demonstration phase with two contractors under the J-UCAS effort. Continued system design and planning for mission and deck operations simulations. Simulated carrier air traffic area operations demonstrations. Conducted flight test of X-47A Pegasus.

FY 2004 Plans:

- Continue FY03 design and planning tasks. Initiate detailed air vehicle, surrogate, and MCS software design and air vehicle fabrication. Perform mission control at sea demonstration and preliminary, midterm and critical design reviews. This effort transitions to DARPA in FY05.

	FY 2003	FY 2004	FY 2005
TIME CRITICAL STRIKE	37,566	65,432	72,153

The specific mission of Time Critical Strike (TCS) integrates surveillance, indications and warnings, target identification, targeting, fire order generation and dissemination, engagement and kill mechanisms, and damage assessment processes to address critical mobile targets, urban targets, short dwell targets and deeply buried targets. TCS technologies reduce the time to conduct strike in all functional areas of the kill chain. Technologies in this functional area also include those associated with High Speed Strike Weapons.

FY 2003 Accomplishments:

- Mission Responsive Ordnance (MRO) technology: Developed targetable submunition warhead variant for Tomahawk focusing on kill vehicle definition and operation and support structure. This task was terminated at the end of FY03 due to lack of transition support.
- Image Video Analysis (IVA): Conducted an algorithm survey and developed algorithms for target exploitation in image and video streams. Task terminated at the end of FY03 due to loss of transition support.
- Affordable Weapons System (AWS): Conducted solid rocket motor and turbojet qualification, multiple flight tests, launcher development and test, and shipboard integration. This program transitions to 6.4 in FY04.
- Advanced Gun-Barrel Technology (AGT): Initiated design concepts and scaled material testing for advanced gun projectile propulsion technology and associated gun-barrel technology.
- Real Time Execution Decision Support System (REDS): Continued design and development of software for collaborative planning, options generation, and mission target folder generation.
- Cruise Missile Real Time Retargeting (CMRTR): Completed test and evaluation of V.2 sensor, continued development of V.3 sensor, spec V.4 low cost terminal seeker.

- Precision Strike Navigator (PSN): Continued development of chemical and mechanical processes, accuracy and stability testing for low cost Fiber Optic Gyroscope (FOG) inertial measurement unit (IMU).
- High-Speed Anti-Radiation Missile (HSARM): Continued integrated studies and initiated development of an advanced dual mode anti-radiation missile seeker for a ramjet-powered missile airframe.
- Hyper-spectral Imaging System (HSI): Completed rugged, high through-put near and far Infra-Red Spectrometers, and enhanced detect algorithms for real time processor.
- TCS Exploitation and Deployment efforts: HyFly program began fabrication of prototype components (i.e. formed inlet cowl, inlet housing, gas generator housing, and combustor nozzle).

FY 2004 Plans:

- AGT: Continue development and scaled testing of propulsion.
- REDS: Complete software implementation and system and unit level test.
- CMRTR: Continue development of V.3 and V.4 sensors for low cost terminal seeker, and test subcomponents of V.3 sensor.
- PSN: Continue development of chemical and mechanical processes for low cost precision FOG IMU, and provide low accuracy unit for evaluation.
- HSARM: Continue development and subsystem test of an advanced dual mode anti-radiation missile seeker incorporating advanced seeker, aperture, guidance and control technologies for a ramjet-powered missile airframe.
- HSI: Integrate visible sub-system with near and far Infra-Red Spectrometers, optical train, select position/pointing system reference, and enhance detect algorithms for real time processor. Program completes in 2004.
- TCS Exploitation and Deployment efforts: HyFly program completes fabrication of prototype components, flight tests of separation test vehicle (STV), wind tunnel tests of freejet engine and assembly of first HyFly flight test vehicle and associated live energetic systems.
- National Aerospace Initiative Revolutionary Approach To Time-critical Long Range Strike (NAI RATTLRS): Begin studies to identify potential concepts that address performance of the first flight demonstration vehicle, and depict the evolution into weaponized configurations. Initiate engine preliminary design of the RATTLRS candidates under cooperative effort with the Air Force Research Laboratory Propulsion Research Technology (AFRL PRT) as part of the Joint Expendable Turbine Engine Concepts (JETEC) program. Complete preliminary flight demo vehicle design.

FY 2005 Plans:

- AGT: Continue FY03 and FY04 efforts and begin large scale gun prototyping with materials selected.

- CMRTR: Perform full system test of V.3 sensor, continue development of V.4 sensor for low cost terminal seeker, integrate V.2, V.3 sensors with V.4, and perform V.4 subsystem tests.
- PSN: Continue development of low cost precision FOG IMU and deliver updated high accuracy unit ready for evaluation.
- HSARM: Complete development, subsystem, and system level flight test demonstration of an advanced dual mode anti-radiation missile seeker for a ramjet-powered missile airframe.
- TCS Exploitation and Deployment efforts: HyFly efforts assemble and deliver 2nd and 3rd flight test vehicles to test site. Conduct free flight tests of all three flight test vehicles and submit a report for each flight test.
- NAI RATTLRS: Initiate inlet/engine/nozzle integration and component testing. Initiate fabrication of long lead flowpath hardware and ground testing of airframe configurations and fabrication of flight vehicle sub-systems.
- Landing Support Craft-Experimental (LSC(X)): Initiate development of a lifting body design for X-Craft. The lifting body will be used to provide low speed stability for the craft, allowing an increase in the operational envelope for helicopter operations and potentially for small craft deployment and retrieval. Develop a fluid drag reduction system leading to the improvement of ship speed, improved fuel economy, and reduced air pollution.

	FY 2003	FY 2004	FY 2005
Autonomous Operations (AO)	14,250	13,903	14,026

The Autonomous Operations (AO) Future Naval Capability (FNC) activity aims to enhance the mission capability and operational utility of Naval forces by developing technologies that will dramatically increase the autonomy, performance, and affordability of Naval organic unmanned vehicle (UV) systems. By defining and focusing risk reduction overarching Intelligent Autonomy (IA) Science and Technology (S&T) principles, transitional products will be developed in four areas: Unmanned Air Vehicles (UAV) Technology, which includes intelligent autonomy reasoning, technologies to enhance “see and avoid” capabilities, object identification, vehicle awareness, and vehicle and mission management; Unmanned Undersea Vehicles (UUV), which will demonstrate the technical feasibility for a UUV system to effectively search, detect, track and trail undersea threats while maintaining a robust communications link to enable appropriate command, control and transmission of collected data; Unmanned Ground Vehicles (UGV), which focuses on the increasing utility of UGV systems in urban and littoral terrain to Marine Corps units; and UAV Propulsion, which will develop innovative propulsion and power technologies unique to Naval UAVs operating from surface combatants.

FY 2003 Accomplishments:

- IA Task: Developed and tested technologies for UV dynamic replanning, autonomous vehicle control, alert management, maritime situation awareness, and multi-vehicle distributed cooperation for unmanned air, ground, surface, and undersea vehicles. Completed simulation testing of tightly coupled path replanning and mapping.
- UAV Technology: Continued the development of self-awareness sensor software and decision development of sub-system self-awareness sensors to enable adaptation and independent action for detection (threats, terrain), and display for Situational Awareness (SA). Continued the development of multi-modal interface for humans to control autonomous vehicles using combination of control inputs for communications and network, as well as the ability for a single human to control multiple vehicles using a mixed-initiative model.
- UUV: Continued development and demonstration of undersea, autonomous operations for Maritime Reconnaissance (MR) utilizing a submarine launched capable vehicle and Undersea Search and Survey and Communications/Navigation Aid (USS/CNA) utilizing a network of multiple, mobile nodes.
- UGV: Continued design and development of mobility UGV test bed for platform, sensor, and command & control sub-systems.
- UAV Propulsion: Continued the development of naval-unique propulsion and power technologies for future UAV systems and integrated these technologies into an enhanced next-generation commercial core for test.

FY 2004 Plans:

- IA Task: Continue testing and demonstrating intelligent vehicle technologies. Complete in-water demonstration of tightly integrated path replanning and on-board mapping with AO UUV development effort.
- UAV Technology: Continue developing and performing simulation testing of sensors and sensor software and the development of multi-modal interface control. Demonstrate UAV networking and communication with loaned Joint Tactical Radio System (JTRS) prototype radios for demonstration in the FIRESCOUT.
- UUV: Continue work developing and demonstrating undersea operations for MR.
- UGV: Complete work on mobility UGV test bed. Transitioning to Marine Corps for System Development Design (SDD).
- UAV Propulsion: Continue development of naval-unique future UAV propulsion systems. Conduct ground test of the enhanced next-generation commercial gas generator core.

FY 2005 Plans:

- IA Task: Continue development of single operator/multi-vehicle control technologies. Complete design of real time autonomous vehicle replanning capability.
- UAV Technology: Continue work developing and performing simulation testing of sensors and sensor software and the development of multi-modal interface control. Develop and conduct testing of self-awareness sensor software and sub-system self-awareness sensors.

- UUV: Continue work developing and demonstrating undersea operations for MR.
- UAV Propulsion: Conduct ground test of the XTE-67/A1 UAV demonstrator engine with naval-unique technologies and integrate with the enhanced next-generation commercial core and a Mach 3.5 capable expendable turbine engine for missile applications. This meets Integrated High Performance Turbine Engine Technology (IHPTET) phase III Joint Expendable Turbine Engine Concept (JETEC) goals and is a foundation for the Versatile Affordable Advanced Turbine Engine (VAATE) program.

C. OTHER PROGRAM FUNDING SUMMARY:

Navy RELATED RDT&E:

PE 0601153N Defense Research Sciences
PE 0602114N Power Projection Applied Research
PE 0602236N Warfighter Sustainment Applied Research
PE 0603123N Force Protection Advanced Technology
PE 0603782N Mine and Expeditionary Warfare Advanced Technology
PE 0603236N Warfighter Sustainment Advanced Technology
PE 0603790N NATO Research and Development
PE 0305204N Tactical Unmanned Aerial Vehicles
PE 0603502N Surface and Shallow Water Mine Countermeasures
PE 0603654N Joint Service Explosive Ordnance Development
PE 0602131M Marine Corps Landing Force Technology

NON-NAVY RELATED RDT&E: These PEs adhere to Defense S&T Reliance agreements with oversight provided by the JDL.

PE 0603285E ASP-01 Advanced Aerospace Systems
PE 0603709D Joint Robotics Program
PE 0604709D Joint Robotics Program - EMD
PE 0602203F Aerospace Propulsion
PE 0603202F Aerospace Propulsion Subsystems Integration
PE 0603216F Aerospace Propulsion and Power Technology
PE 0603205F Flight Vehicle Technology
PE 0603245F Flight Technology Integration

D. ACQUISITION STRATEGY:

Not Applicable.

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

Exhibit R-2a

BA: 03 PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: Power Projection Advanced Technology

PROJECT NUMBER: R2911 PROJECT TITLE: Power Proj Adv Tech / IHPRPT

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

BA: 03 PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: Power Projection Advanced Technology
PROJECT NUMBER: R3022 PROJECT TITLE: Joint Non Lethal Weapons

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
R3022 Joint Non Lethal Weapons	0	0	6,180	2,394	1,397	10,790	10,806

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFCATION:
This effort establishes a program for Joint Non-Lethal Weapons (NLW) research in which the Marine Corps is the Executive Agent. The programs are a result of the lessons learned in Operation Iraqi Freedom.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Joint Non-Lethal Weapons (NLW) Program	0	0	6,180

This project covers the development of next-generation Non-Lethal Weapons (NLWs) and includes efforts to ensure optimum weaponization and use of these NLWs. Next-generation NLW systems focus on long-range localized NL effects to identified threat individuals (or groups of individuals) and/or their threat weapons systems operating in complicated environments such as urban areas, crowds, buildings, vehicles, boats and also in close proximity to high-value civilian establishments.

FY 2005 Plans:

- Initiate program to conduct feasibility assessments and demonstrations of promising non-lethal technologies and system concepts. Initial efforts will assess the general utility, effect, and effectiveness of technologies for incapacitating personnel, clearing facilities, stopping vehicles and vessels, and denying enemy access to protected areas.

C. OTHER PROGRAM FUNDING SUMMARY:
Related RDT&E:
PE 0602131M Marine Corps Landing Force Technology
PE 0603640M USMC Advanced Technology Demonstration

D. ACQUISITION STRATEGY:
Not Applicable.

CONGRESSIONAL PLUS-UPS:

R2487	FY 2003	FY 2004
DP-2 THRUST VECTORING PROGRAM	4,763	4,818

FY 03 - This effort involved the development and evaluation of the half scale DP2 vertical takeoff aircraft. Completed demonstration of tethered hover test.
FY 04 - Current plans are to demonstrate vertical lift with sustained control via tethered and untethered hover.

R2721	FY 2003	FY 2004
VECTORED THRUST DUCTED PROPELLER (VTDP)	3,334	0

This effort was a multi-functional component that replaced a conventional tail rotor system in a helicopter. The VTDP provided anti-torque/yaw control capability with propulsion and effort vectoring control. Continued design, analysis and engineering support of the aircraft systems. Continued aircraft modifications and drive system testing at the Helicopter Transmission Testing Facility (HTTF).

R2821	FY 2003	FY 2004
INTEGRATED HYPERSONIC AEROMECHANICS TOOL PROGRAM (IHAT)	3,574	3,461

FY 03 - This effort developed a multi-disciplinary optimization analysis tool for Navy use in design and evaluation of a hypersonic weapon system. Completed design and validation of Build One.
FY 04 - This effort will defined requirements of next incremental Build.

R2823	FY 2003	FY 2004
PRECISION STRIKE NAVIGATOR (PSN)	961	989

This effort fabricated a pre-production transceiver device using the PSN prototype facility at Army Missile Command. Current effort will continue process developement for low cost manufacture of the unique PSN devices and their applications.

BA: 03 PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: Power Projection Advanced Technology
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R2911	FY 2003	FY 2004
INTEGRATED HIGH PAYOFF ROCKET PROPULSION TECHNOLOGY PROGRAM (IHPRPT)	0	988

This effort will develop and demonstrate advanced propulsion technologies that will increase the kinematic performance of weapons systems while meeting the goals of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program.

R3006	FY 2003	FY 2004
AFFORDABLE WEAPON	20,431	0

This effort flight-tested the Affordable Weapon from a short rail launcher using a new more powerful engine. Conducted flight duration tests of up to 6 hours. Tested the GPS targeting system and demonstrated it on a target range.

R9008	FY 2003	FY 2004
HEL-LOW ASPECT TARGET TRACKING (HEL-LATT)	4,451	2,076

FY 03 - This effort investigated tracking techniques for target acquisition, background discrimination, and aim-point maintenance using the laser and beam director at the High Energy Laser Systems Test Facility (HELSTF) in New Mexico. In FY03 several small missiles were tracked by SeaLite Beam Director (SLBD) and Tactical High Energy Laser (THEL) and engaged with THEL. In addition, upgrades to the SLBD and the development of a new tracking processing unit was begun.
FY04 - This effort upgrades to SLBD tracking system will be completed. New cameras, optical systems will be installed. Multiple High Power Laser tests against targets will be conducted.

R9010	FY 2003	FY 2004
VARIABLE ENGINE NOZZLE	1,436	1,483

FY 03 - This effort completed Phase I design and began fabrication of a Variable Displacement Van Pump (VDVP).
FY 04- This effort will conduct a lab demonstration of a VDVP and initiate Phase II integration of the VDVP with a demonstration engine.

BA: 03 PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: Power Projection Advanced Technology
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9012	FY 2003	FY 2004
MAGDALENA RIDGE OBSERVATORY	20,129	10,383

This effort will build a testbed to explore how optical interferometry sensitivity can be improved, with techniques to include combining adaptive optics with medium size telescopes; provide next generation design technology for Navy optical interferometry; and develop significant academic resources to draw on for the Navy's future needs.

R9013	FY 2003	FY 2004
LITTORAL SUPPORT CRAFT-EXPERIMENTAL (LSC (X))	8,702	0

This effort designed and built a high speed vessel for full scale testing of high speed hydrodynamics, lifting body, drag reduction and low speed stability technologies for a multi-hulled catamaran (estimated start date FEB 03, estimated deliver date AUG 04)
*Previous year funding and planning discussed under PE 0603123N Project R9013.

R9133	FY 2003	FY 2004
ADVANCED CAMOUFLAGE COATING DEMONSTRATION	6,976	0

This effort manufactured camouflage materials and applied them to unmanned aerial vehicles for expanded flight test evaluation, assessment and qualification. Developed palettes of these materials requiring different schemes due to various operational environments. These materials have the potential of reducing costs due to repair and replacement of the coatings.

R9134	FY 2003	FY 2004
HIGH SPEED ANTI-RADIATION MISSILE DEMONSTRATION (HSAD)	7,382	5,044

FY03 - This effort developed a producible Digital Control Actuator System (CAS) for the missile aft steering system of the High Speed Anti-Radiation Demonstration (HSAD) airframe. Military value derives from the increase in performance of next generation Anti-Radiation Missiles (ARM). Completed project development plan and performed initial requirements analysis and drafted specification documents.
FY04 - This effort will develop design concepts and build multiple proof of concept subcomponent prototypes.

R9135	FY 2003	FY 2004

R9135	FY 2003	FY 2004
HIGH SPEED ANTI-RADIATION MISSILE DEMONSTRATION- AARGM	6,032	0

This effort funded the seeker modifications and additional seekers to support the High Speed Anti-radiation Demonstration (HSAD) at higher operational speeds and longer ranges than the existing AARGM. Military value derives from the increased speed, accuracy, lethality and flexibility of the next generation Anti-Radiation Missile (ARM). The next generation ARM will be used for both suppression of enemy air defenses (SEAD) and Destruction of Enemy Air Defenses (DEAD) missions.

R9136	FY 2003	FY 2004
ADVANCED LIFTING BODY RESEARCH PROGRAM	5,651	4,945

FY03 - This effort designed, developed and demonstrated an advanced lifting body catamaran by converting the Surface Effect Ship 200 (SES-200) and incorporating an advanced lifting body to improve dynamic lift, payload capacity and small craft seakeeping.
FY04 - This effort will complete initial at-sea testing and data collection. Will also expand the at-sea testing of the advanced lifting body to more fully explore the seakeeping, stability and ride-control capabilities of the advanced lifting body through more extensive data collection and analysis.

R9136	FY 2003	FY 2004
HIGH SPEED, HEAVY-LIFT, SHALLOW DRAFT-CAPABLE WATERCRAFT DEMONSTRATION	0	7,565

This effort will develop a design for a dual-use, SWATH-like craft. Commercial use is as a ferry in regions of high tidal variations. Military use would be as a half-scale demonstrator of beachable, littoral transport.

R9137	FY 2003	FY 2004
LITTORAL SUPPORT CRAFT(LSC (X))-LIFTING BODY	9,698	0

This effort conducted underlying Science and Technology to support design and construction of a Lifting Body for the Littoral Support Craft-Experimental (a full scale vessel). *Previous year funding and planning discussed under PE 0603123N Project R2912.

R9292	FY 2003	FY 2004

R9292	FY 2003	FY 2004
ADVANCED THIN FILM COATINGS	0	4,945

This effort will develop and demonstrate Advanced Thin Film Coatings for Naval applications. These coatings include light-weight paint pigments for Naval Aviation paints, thin film paint replacement materials for reducing aircraft life cycle costs, and thin light-weight flexible Organic Light Emitting Diode (OLED) films for display and landing light applications. The planned program will develop and qualify these thin film based technologies for potential Naval Aviation applications on MV-22, Unmanned Air Vehicles (UAVs), and Joint Strike Fighter (JSF).

R9295	FY 2003	FY 2004
LARGE AREA MULTI-SPECTRAL SAPPHIRE WINDOWS FOR AIRBORNE RECONNAISSANCE	0	1,682

This effort will develop large area, high transmission, low cost, high durability entrance windows for integrated electro-optic and infrared sensors for Navy, Marine Corps and Army platforms.

R9296	FY 2003	FY 2004
LASER RADAR – "AUTONOMOUS TARGETING AND DESTRUCTION"	0	2,967

This effort will develop an improved missile seeker to search larger areas at faster speed to improve performance against occluded targets. Current funds will be used to develop improvements to the ladar electronics that will reduce system noise and improve performance of the seeker.

R9297	FY 2003	FY 2004
LOW POWER MEGA-PERFORMANCE UAV	0	1,483

This effort will develop microcode for 3D synthetic aperture radar on existing 64 node 23 GFLOP sequential instructions multiple data (SIMD) processing chip. Layout real-time 256 node chip to achieve 104 GFLOPS.

R9298	FY 2003	FY 2004
LOW-COST GUIDED IMAGING ROCKET (LOGIR)	0	2,967

This effort will develop a low cost rocket system that uses an imaging seeker and can be used against a wide

variety of targets. Funds provided will develop a simulation environment to support requirements analysis and preliminary design. Initial develop of a fully compliant Inertial Measurement Unit (IMU) will also be initiated.

R9299	FY 2003	FY 2004
PRINTED WIRING BOARDS (PWB)	0	4,203

This effort will develop vertical interconnect technology for silicon wafer scale circuitry onto printed wiring boards (PWBs). Advance multilayer PWB ultrasonic analysis by employing direct sequence spread spectrum technology.

R9302	FY 2003	FY 2004
UNCOOLED HIGH RESOLUTION INFRARED SENSORS	0	3,362

This effort will develop uncooled infrared sensors based on advanced metal doped, ion-implanted, organic polymer based materials. This effort will produce high resolution 640x480 IR sensors. Experimental devices have demonstrated higher performance, ease in fabrication, higher uniformity, and substantially lower fabrication costs than current inorganic material sensors.

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

BA: 03 PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: Force Protection Advanced Technology

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
R2706 Project M	2,024	4,945	0	0	0	0	0
R2711 Superconducting DC Homopolar Motor	2,666	5,537	0	0	0	0	0
R2826 Ship Service Fuel Cell	2,857	0	0	0	0	0	0
R2828 Advanced Water Jet 21 (AWJ-21)	0	1,978	0	0	0	0	0
R2831 High Temperature Superconducting AC Synchronous Propulsion Motor and Generator	4,763	5,933	0	0	0	0	0
R2912 Force Protection Adv Tech	55,940	50,038	73,524	52,740	53,768	59,089	59,919
R3049 Force Protection	3,972	5,102	8,606	3,104	3,534	3,606	3,683
R9013 Littoral Support Craft-Experimental	0	13,844	0	0	0	0	0
R9014 Precision Fabrication of Large Curved Steel Ship Structures	0	2,472	0	0	0	0	0
R9015 Deployable Smart Link Communications Upgrade	1,429	0	0	0	0	0	0
R9017 Wireless Sensor Network	0	989	0	0	0	0	0
R9019 Wave Power Demonstration Project	1,905	3,362	0	0	0	0	0
R9120 High Speed Cargo Craft	715	0	0	0	0	0	0

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

BA: 03 PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: Force Protection Advanced Technology

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
R9138 Center for Maritime Systems	1,335	0	0	0	0	0	0
R9139 Graphite Fiber Sandwich Composite for Adv Warship Design	952	0	0	0	0	0	0
R9140 High Performance Lightweight Generator	3,334	3,560	0	0	0	0	0
R9141 Marine Direct Ship Service Fuel Cell Technology Validation Trainer	1,141	0	0	0	0	0	0
R9142 Smart Microsensor Arrays For Shipboard Damage Control	5,048	0	0	0	0	0	0
R9143 Smart Sensor Web	1,004	0	0	0	0	0	0
R9303 Agile Port and High Speed Ship Technology	0	4,945	0	0	0	0	0
R9304 Aviation Ground Navigation Systems (AGNAS)	0	1,682	0	0	0	0	0
R9305 Composite Special Operations Craft	0	989	0	0	0	0	0
R9306 DockShock	0	989	0	0	0	0	0
R9307 E-2C Infrared Search and Track (IRST) Technology Experimentation	0	1,359	0	0	0	0	0
R9308 Global Personal Locator Beacon (PLB)	0	1,730	0	0	0	0	0
R9309 Large Unmanned Undersea Vehicle (LUUV) Test Bed	0	1,187	0	0	0	0	0
R9310 Laser Welding and Cutting	0	3,461	0	0	0	0	0

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

BA: 03 PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: Force Protection Advanced Technology

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
R9311 Quad Hull Security Caisson Technical Demonstration	0	2,472	0	0	0	0	0
R9312 Remote Continuous Energetic Material Manufacturing Pyrotechnic IR Decoys	0	1,187	0	0	0	0	0
R9313 Technologies for Future Naval Capabilities (FNC)	0	1,088	0	0	0	0	0
R9314 Wireless Programmable Logic Controllers	0	989	0	0	0	0	0
Totals	89,085	119,838	82,130	55,844	57,302	62,695	63,602

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Includes funds to develop and demonstrate advanced technologies that support naval platform self-protection and theatre wide missile defense of naval forces. The new capabilities include the areas of all-weather, day/night protection of naval platforms and forces against all weapon threats, counter-stealth and countermeasures. These new capabilities also include affordable technologies for platform structural systems as well as platform systems, sub-systems and components and aircraft vectoring technologies. Demonstrated capabilities support the ability to prevent or control platform damage while preserving operational capability. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability within Sea Strike by virtue of improvements in platform offensive performance, stealth and self defense. Program supports the Fleet Force and Platform Protection, Advanced Capability Electric Systems, Total Ownership Cost and Missile Defense Future Naval Capabilities (FNCs).

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

BA: 03 PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: Force Protection Advanced Technology

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	86,270	55,780	82,554
Cong. Rescissions/Adjustments/Undist.Reductions	0	-1,365	0
Congressional Actions	0	65,425	0
Execution Adjustments	3,616	0	0
FY03 Fed Tech Transfer	-27	0	0
Inflation Savings	0	0	-266
Rate Adjustments	0	-2	-113
SBIR Assessment	-774	0	0
Technical Adjustments	0	0	-45
FY 2005 President's Budget Submission	89,085	119,838	82,130

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

BA: 03 PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: Force Protection Advanced Technology
PROJECT NUMBER: R2912 PROJECT TITLE: Force Protection Adv Tech

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
R2912 Force Protection Adv Tech	55,940	50,038	73,524	52,740	53,768	59,089	59,919

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. This project supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. It supports the Fleet Force and Platform Protection, Electric Warship, Total Ownership Cost and Missile Defense Future Naval Capabilities (FNCs). The goal of this project is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Surface Ship & Submarine Hull Mechanical & Electrical (HM&E)	33,468	26,831	42,737

Activity includes: Signature Reduction, Hull Life Assurance, Distributed Intelligence for Automated Survivability and Advanced Capability Electric Systems. Signature Reduction addresses Electromagnetic (EM), infrared (IR) and acoustic signature tailoring, both topside and underwater. Hull Life Assurance addresses development of new structural system approaches for surface ships and submarines, including the management of weapon effects to control structural damage and the improvement of structural materials. Distributed Intelligence for Automated Survivability addresses both the basic technology of automating damage control systems, as well as, distributed auxiliary control with self-healing capability. Advanced Capability Electric Systems area addresses electrical and auxiliary system and component technology to provide improvement in system energy and power density, system operating efficiency and recoverability from casualties. Additional funding was added in FY 05 by OSD Program Decision Memorandum II (PDM II). This funding will be invested in development of electromagnetic gun technology.

FY 2003 Accomplishments:

- Suspended work on surface ship near field de-amping boundary element and physical model development (includes stable algorithm).
- Suspended work on large-scale truss development for Advanced Machinery Support System (AMSS).
- Performed proving ground testing of Reconnaissance, Surveillance, Targeting Vehicle (RSTV).
- Developed design for advanced main propulsion superconducting motor.
- Developed advanced power electronics for Electromagnetic Aircraft Launch System (EMALS) and ship main propulsion systems.
- Continue development of Ship Service Fuel Cell (625kW) including diesel fuel reforming technology for molten carbonate and proton exchange membrane (PEM) fuel cells.
- Began development of Quiet Electric Drive (QED)/secondary propulsion unit (SPU).

FY 2004 Plans:

- Complete fabrication and test of Proton Exchange Membrane (PEM) diesel fuel cell reformer.
- Continue all efforts of FY03 less those noted as completed above.
- Continue development of advanced main propulsion superconducting motor. Begin design and construction of 36.5 MW prototype motor.
- Initiate development of electromagnetic gun technology, including focus on rail wear issues, energy storage, and pulsed power switching.
- Initiate development of technologies for future Marine Corps Battlefield Power System.

FY 2005 Plans:

- Complete Quiet Electric Drive/submarine secondary propulsion unit (SPU).
- Complete laboratory evaluation of 625kW molten carbonate fuel cell and reformer.
- Continue all efforts of FY04 less those noted as completed above.
- Funding from PDM II will be applied to further development of electromagnetic gun technology, including focus on rail wear issues, energy storage, and pulsed power switching.
- Initiate development of advanced energy storage technology.

	FY 2003	FY 2004	FY 2005
Advanced Energetics	0	2,706	0

Advanced Energetics efforts address technology development to provide substantial improvements in energetic

material systems and subsystems, primarily in terms of performance, but also addressing safety, reliability, and affordability. This work includes the development of advanced energetic materials for thermobaric applications. Efforts include development and evaluation of new explosive formulations, reliable simulation tools and diagnostics to develop and design superior performance systems tailored to specific warfighter missions.

FY 2003 Accomplishments:

• Completed applied research (BA 2) portion of Advanced Energetics effort in Thermobaric Weapon Advanced Concept Technology Demonstration (ACTD) in PE 0602123N. PE 0602123N took the effort through subscale payload testing. Follow-on work was picked up in Advanced Energetics under PE 0603123N in FY04.

FY 2004 Plans:

• Advanced energetics effort will complete the payload development of the Thermobaric Weapon ACTD with explosive fill optimization, scale up, full scale performance validation, and qualification.

FY 2005 Plans:

No effort planned in this PE in FY05.

	FY 2003	FY 2004	FY 2005
Sensors & Associated (S&A) Processing	7,064	8,187	6,495

Activity develops complementary sensor and processing technologies for 21st century warfighting success and platform protection. Current small platforms (both surface and airborne) have little or no situational awareness (SA) or self-protection against air, surface, and asymmetric threats. The goal of this activity is to provide tactical aircraft (TACAIR) and these platforms with effective threat warning and self-protection. The technology areas specific to platform protection will develop individual or multi-spectral [Electro-Optic (EO), Infra-Red (IR), Radio Frequency (RF), Electromagnetic (EM), visual and acoustic] sensors and associated processing. To defend platforms from current and advanced threats in at-sea littoral environments and in port, these technologies must improve multi-spectral detection and distribution of specific threat information. Major efforts are summarized below:

For Aircraft -

• The Integrated Defensive Electronic Countermeasures (IDECM) Pre-planned Product Improvement (P3I) effort

provides the F/A-18E/F aircraft with increased self protection capability.
• The Missile Warning System (MWS) effort is designed to develop and demonstrate two-color infrared (IR) missile warning enabling technology that is compatible with the Tactical Aircraft Directed IR Countermeasures (TADIRCM).
• The EO/IR Laser Jammer for TACAIR effort develops and demonstrates advanced laser jammer enabling technology that is compatible with tactical air (TACAIR) signature, radar cross section (RCS), and drag requirements and is effective against surface-to-air missiles (SAM), air-to-air missiles (AAM), and advanced imaging threats.

For Surface Ships –
• Distributed Aperture System (DAS) development: Develops the data processor and optical augmentation software algorithms for threat classification. This is an international effort. Examines and integrates sensor modules into a single system design to support shipboard combat operations.
• The Shipboard EO/IR Closed Loop Self-protection effort is designed to increase surface ship survivability by the detection, classification and jamming of EO/IR guided anti-ship missile threats.

For Marine Corps –
• The End User Terminal (EUT) effort develops improved personal communications, situational awareness and sniper detection for ground troops.

FY 2003 Accomplishments:

• The Missile Warning System (MWS) and EO/IR Laser Jammer for TACAIR efforts conducted laboratory common jam code demonstrations and pointer/tracker functional demonstrations. Missile signature data was collected during live fire tests of opportunity. The jam head for the pointer-tracker has been assembled and has begun testing.
• DAS - Developed and packaged prototype sensor module for the Infrared Search and Track (IRST) Program.
• Shipboard EO/IR Closed Loop Self-protection: Conducted a functional demonstration of a multi-band mid-wave IR solid-state countermeasure laser. Closed-loop Infrared Countermeasures (IRCM) system demonstrations using hardware-in-the-loop techniques were conducted in the laboratory and will continue in FY04.
• EUT: Completed demonstration of the “ruggedized” 6-inch Organic Light Emitting Diode (OLED) display and proceeded with the design of an integrated antenna for the Dismounted Digital Automated Computing Terminal (D-DACT). Completed testing of the 3.5" Single Board computer with Xscale processor.

FY 2004 Plans:

- Continue all efforts of FY03 less those noted as completed above.
- IDECM Pre-planned Product Improvement (P3I) will perform tests on a short sample of a new high temperature towline required to operate throughout the entire F/A-18 E/F flight envelope including maximum afterburner.
- DAS: Efforts are focused on design, development and testing of systems, subsystems, and components for integration of sensor modules and components into a DAS capability demonstration model.

FY 2005 Plans:

- Continue all efforts described in FY04.

	FY 2003	FY 2004	FY 2005
Missile Defense (MD)	6,010	5,484	7,189

This activity describes S&T projects of the Missile Defense Future Naval Capabilities (FNC) program. Budget Activity 3 missile defense efforts are co-funded by PE 0603271N. Focus areas include:
- Advanced Area Defense Interceptor (AADI)
- Distributed Weapons Coordination (DWC)
- Littoral Affordability (classified program)
- Reactive Warhead

FY 2003 Accomplishments:

- Completed Reactive Warhead efforts on the physics-based damage prediction model and effectiveness analyses of a mass-focused reactive material warhead for STANDARD Missile.
- Completed development and flight demonstration of Vertical Extremely Short Take Off and Landing (ESTOL) Control Tailless Operation Research (VECTOR) air platform. (Not a Missile Defense FNC effort)
- Continued the Advanced Area Defense Interceptor (AADI) planning and coordination effort for a Navy - Marine Corps Air-Directed Surface-to-Air Missile (ADSAM) live firing demonstration in FY 2007.

FY 2004 Plans:

- Initiated BA 3 aspects of the Littoral Affordability effort begun in FY2002 in PE0602123N (classified program)

• Continued the Advanced Area Defense Interceptor (AADI) planning and coordination effort for a Navy - Marine Corps Air-Directed Surface-to-Air Missile (ADSAM) live firing demonstration in FY 2007.

FY 2005 Plans:

• Continue Littoral Affordability (classified program).
• Continue the AADI planning and coordination effort for an ADSAM demonstration in FY2007.
• Initiate advanced combat system integration of Distributed Weapons Coordination (DWC) algorithms for Common Threat Evaluation (CTE), and Preferred Shooter Recommendation (PSR), developed under PE 0602123N, into a distributed computing environment for transition to Naval Open Architecture combat systems.

	FY 2003	FY 2004	FY 2005
Underwater (UW) Platform Self Defense	2,395	2,320	6,859

This activity develops enabling technologies that will increase the survivability of surface ship and submarine platforms against torpedo threats. Proposed technologies focus on defeating high priority threats including torpedoes (i.e. straight running, wake homing, acoustic homing, air dropped torpedoes, and salvoes of torpedoes). The long-term goal of the UW Platform Self Defense activity is to develop technologies that will ultimately be placed onboard ship. Technologies should be developed to minimize shipboard impact, and require no organizational maintenance. Two major efforts are: The Next Generation Countermeasure (NGCM): A mobile adaptive acoustic countermeasure with acoustic communication links to enable countermeasure connectivity and group behavior to defeat threat torpedoes. The Anti-Torpedo Torpedo (ATT)/Tripwire Demonstration: Technologies that improve passive shipboard detection, classification, and localization (DCL) of incoming torpedoes and an ATT to engage the threat torpedoes.

FY 2003 Accomplishments:

• Completed design and development of the hardware necessary to support the 1Q FY04 in-water test series; expect completion in time to ship to NUWC/Keyport for the October 2003 HF/LF Shallow Wake Operations test.
• Developed a finite element model of the engine condenser shell under bending load, analyzed the condenser shell prior to final design and fabrication of the low-cost boilers.
• Modified the advanced engine transient boiler Computerized Fluid Dynamic (CFD) Model and developed pilot-scale alternate start charge concepts involving the use of Teflon.
• Continued transition of counter-torpedo technologies to Naval Sea Systems Command (NAVSEA) Tripwire Torpedo Defense System (AN/WSQ-11).

• **FY 2004 Plans:**

• Complete acoustic tank testing of compact, high power, broadband single crystal transducer for Next Generation Countermeasure.
• Integrate transducer into the Countermeasure.
• Continue in-water data collection to evaluate technologies for a 2 on 2 salvo engagement with test vehicles in open loop mode.
• Initiate in-water testing with of sonar channels for Anti-Torpedo Torpedo terminal homing in wake at shallow depth.

FY 2005 Plans:

• Finalize in-water demonstration and transition to AN/WSQ-11 of guidance and control for terminal homing of Anti-Torpedo Torpedo (ATT) for one on-one engagements in wake environments at shallow depths.
• Complete in-water data collection to evaluate technologies for a 4 on 4 salvo engagement with test vehicles in open loop mode.
• Demonstrate full-duplex transmit/receive capability for Next Generation Countermeasure (NGCM) with towed array fixture.

	FY 2003	FY 2004	FY 2005
Littoral Surface Craft – Experimental (LSC(X))	7,003	4,510	10,244

X-Craft is envisioned as an S&T platform designed for experimentation with lifting bodies, drag reduction and mission modularity. A high-speed, all-aluminum catamaran, it displaces 1400 tons at full load. Performance requirements are 50 knots at combat load (about 1200 tons), 40 knots in sea state 4, and a 4000 nautical miles range without replenishment. It will be capable of landing two helicopters up to the size of SH-60R, transporting and operating autonomous vehicles, and carrying several reconfigurable mission modules in standard Twenty-foot Equivalent Unit (TEU) boxes. The crew will be minimal and the vessel will be built to commercial American Bureau of Shipping (ABS) standards.

FY 2003 Accomplishments:

• Completed concept level design of LSC(X).
• Contracted for detail design and construction.
• Keel laid June 2003.

FY 2004 Plans:

- Complete detail design of the LSC(X) prototype craft.
- Continue design and development of lifting body and drag reduction systems.
- Continue development of technologies for small, fast craft in the 500-1000 ton range. These technologies enable a craft for missions such as littoral anti-submarine warfare (ASW) and mine countermeasures.

FY 2005 Plans:

- Complete construction of the LSC(X).
- Conduct hydrodynamic testing of the X-craft.
- Continue design and development of lifting body and drag reduction system.

C. OTHER PROGRAM FUNDING SUMMARY:

RELATED RDT&E:

NAVY RELATED RDT&E:
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0206313M (Marine Air Communications Systems)
PE 0601153N (Defense Research Sciences)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602235N (Common Picture Applied Research)
PE 0602271N (RF System Applied Research)
PE 0603235N (Common Picture Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603561N (Advanced Submarine System Development)
PE 0603563N (Ship Concept Advanced Design)
PE 0603564N (Ship Preliminary Design and Feasibility Studies)
PE 0604307N (Surface Combatant Combat System Engineering)
PE 0603609N (Conventional Munitions)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))

PE 0604518N (Combat Information Center Conversion)
PE 0604558N (New Design SSN)

NON NAVY RELATED RDT&E: Not Applicable.

D. ACQUISITION STRATEGY:
Not Applicable.

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

Exhibit R-2a

BA: 03 PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: Force Protection Advanced Technology

PROJECT NUMBER: R3049 PROJECT TITLE: Force Protection

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
R3049 Force Protection	3,972	5,102	8,606	3,104	3,534	3,606	3,683

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Includes funds to develop and demonstrate advanced technologies that support platform self-protection. The new capabilities include the areas of all-weather, day/night protection of naval platforms and forces against all weapon threats, counter-stealth and countermeasures. Demonstrated capabilities support the ability to prevent or control platform damage while preserving operational capability. Hull life assurance addresses: development of new structural system approaches for surface ships and submarines, management of weapons effects to control structural damage, and improvement of structural materials. Distributed intelligence for automated survivability addresses both the basic technology of automating damage control systems as well as distributed auxiliary control with self-healing capability.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Emerging Threats	3,972	5,102	8,606

This activity includes: Efforts in hull life assurance and distributed intelligence for automated survivability. Addresses the management of weapon effects to control structural damage and the improvement of structural materials. All efforts were previously funded in the Hull Mechanical and Electrical Activity of Project R2912.

FY 2003 Accomplishments:

- All passive protection efforts were suspended to pursue higher priority Fleet and Force Protection FNC areas. This includes:
  - Ship test planning for passive ship protection full-scale tests.
  - Passive ship protection system design.
  - Blast yield/propagation test for passive protection.
- Continued small-scale testing of high efficiency water-mist system for application to electronic spaces within advanced damage countermeasures program.

- Continued data collection and field test of optical sensor prototype for volume sensor.
- Initiated development of prototype optical sensor for volume sensing (fire & smoke detection) application. This effort was a small-scale test.

FY 2004 Plans:

- Complete small-scale tests of prototype optical sensor for volume sensing (fire and smoke detection).
- Complete small-scale testing of high efficiency water-mist system.
- Initiate testing of hybrid water-mist at an intermediate scale.
- Initiate development to increase the capability of previous volume sensor by extending capabilities to allow real-time response.
- Initiate collection of field data on real-time volume sensor.

FY 2005 Plans:

- Complete development of real-time volume sensor.
- Completed concept level design of LSC(X).
- Complete intermediate-scale testing of hybrid water-mist system.
- Continue data collection and field test of volume sensor.
- Initiate full-scale ship tests on ex-USS Shadwell to validate performance of the real-time volume sensor.
- Initiate full-scale ship trials of hybrid water-mist system on ex-USS Shadwell to validate performance.

C. OTHER PROGRAM FUNDING SUMMARY:
RELATED RDT&E:

PE 0601153N (Defense Research Sciences)
PE 0602123N (Force Protection Applied Research)
PE 0602235N (Common Picture Applied Research)
PE 0603235N (Common Picture Advanced Technology)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603561N (Advanced Submarine System Development)
PE 0603563N (Ship Concept Advanced Design)
PE 0603564N (Ship Preliminary Design and Feasibility Studies)
PE 0604558N (New Design SSN)
PE 0604561N (SSN-21 Developments)

NON NAVY RELATED RDT&E: Not Applicable.

D. ACQUISITION STRATEGY:
Not Applicable.

CONGRESSIONAL PLUS-UPS:

R2706	FY 2003	FY 2004
PROJECT M	2,024	4,945

FY03: Demonstrated derivatives of Project M active control technology for active degaussing (reduction of electromagnetic signatures) of naval motors and for mitigation of shock on small naval craft. FY04: Build Advanced Development Model (ADM) and conduct laboratory tests, as well as sea-trials on MKV boats. The final seat will also include Look Ahead Detection System (LADS).

R2711	FY 2003	FY 2004
SUPERCONDUCTING DC HOMOPOLAR MOTOR	2,666	5,537

FY03: Completed test stand motor testing and design of a 3.7 MW subscale motor. Completed a conceptual design of full scale main propulsion motor. Motor design addresses development of an advanced acyclic motor with superconducting windings. The design effort addresses the complete machine design, including issues such as high reaction forces resulting from high magnetic fields, mechanical and cooling issues. FY04: Plans are to complete construction, test the 3.7MW sub-scale motor, perform brush risk reduction, and preliminary design of full scale propulsion motor.

R2826	FY 2003	FY 2004
SHIP SERVICE FUEL CELL	2,857	0

Developed a dynamic simulation and validation capability for a diesel fuel cell. Developed a 625 kW molten carbonate fuel cell and reformer system for land based testing. Collected data to model the reliability and maintenance characteristics of such fuel cells. The system can be used as a training platform.

R2828	FY 2003	FY 2004
ADVANCED WATERJET-21 (AWJ-21)	0	1,978

Develop large scale demonstrator platform for signature, propulsion efficiency, and mechanical design interface evaluation.

R2831	FY 2003	FY 2004
HIGH TEMPERATURE SUPERCONDUCTING AC SYNCHRONOUS SHIP PROPULSION MOTOR & GENERATOR	4,763	5,933

FY03: Provided design tradeoffs and preliminary design for a 36.5MW HTS high power density propulsion motor. Tradeoff and preliminary design addresses all aspects of electromagnetic and mechanical design, including addressing the aspects of high field levels in superconducting windings and the influence of subsequent high forces on the mechanical design of the machine. Began construction of key prototype HTS propulsion motor and power electronic components. FY04: This effort will continue with final design of 36.5 MW propulsion motor and motor drive, long lead item procurement and the initiation of manufacture.

R9013	FY 2003	FY 2004
LITTORAL SUPPORT CRAFT-EXPERIMENTAL (LSC-X)	0	13,844

Continue the construction of the X-Craft. Expected to be delivered early in FY05, X-Craft will be built to evaluate the hydrodynamic performance, structural behavior, and propulsion system efficiency of high speed hull form technologies. The 79-meter all-aluminum craft will also be used to evaluate mission modularity through a large open mission bay and will eventually serve as a platform for testing lifting body and drag reduction technology.

R9014	FY 2003	FY 2004
PRECISION FABRICATION OF LARGE CURVED STEEL SHIP STRUCTURES	0	2,472

Development of curved plate technology in the construction of double hull vessels using steel and alloy metals with low magnetic, anti-corrosive properties. Demonstrating this application addresses welding technology for stainless steel that is different from conventional carbon steel approaches. The demonstration builds full-scale hull sections that may be used for air-blast and underwater explosion resistance testing.

R9015	FY 2003	FY 2004
DEPLOYABLE SMART LINK COMMUNICATIONS UPGRADE	1,429	0

The effort provided advanced technology application for a Smart Link System. The prototype communication system has demonstrated an order of magnitude improvement in bandwidth. Provided improved primary

communication capabilities during operational deployment.

R9017	FY 2003	FY 2004
WIRELESS SENSOR NETWORK	0	989

Develop wireless sensor technology for monitoring all shipboard systems and provide situational awareness.

R9019	FY 2003	FY 2004
WAVE POWER DEMONSTRATION PROJECT	1,905	3,362

FY03: (Previusly titled: Wave Powered Electric Power Generating System For Remote Naval Sites.) Provided advanced technology support for the development of a power generating system driven by ocean wave motion. Provided testing, extended the hydrodynamic modeling of a buoy system and validated those models. Addressed environmental issues, means to improve reliability and increase energy efficiency, and issues associated with operation of a multi-buoy system. FY04: The system will be installed and tested.

R9120	FY 2003	FY 2004
HIGH SPEED CARGO CRAFT	715	0

Designed, constructed and tested a small prototype High Speed Cargo Craft. The prototype craft demonstrated an advanced hull form incorporating a combination of catamaran and surface effect technologies with the goal of evaluating the craft’s suitability as a high-speed cargo craft.

R9138	FY 2003	FY 2004
CENTER FOR MARITIME SYSTEMS	1,335	0

Developed an integrated system of observing networks and forecasting models to provide real-time information on oceanographic and atmospheric conditions affecting Navy sensors and operations. Provided real time data/model uncertainty analysis and a display suitable for decision making. Provided high resolution surveillance of ship traffic oceanic and atmospheric conditions within a specified geographic region. Provided means of rapidly addressing security concerns at USN ship berths at any location in the world.

R9139	FY 2003	FY 2004
GRAPHITE FIBER SANDWICH COMPOSITES FOR ADVANCED WARSHIP DESIGN	952	0

Investigated the use of carbon sandwich materials for surface ship hull structure. Combined analytical and experimental investigations to address design, survivability and fatigue issues associated with the implementation of these materials for future Navy platforms.

R9140	FY 2003	FY 2004
HIGH PERFORMANCE LIGHTWEIGHT GENERATOR	3,334	3,560

FY03: (Previously titled: High Speed Permanent Magnet Generator.) Funds used to develop a high speed permanent magnet generator. Evaluate heat removal techniques with the preliminary design of the generator. Generator design issues were addressed to establish the best approach for the electromagnetic and mechanical design, including thermal design issues. Effort provided assessment of the machines potential efficiency and other performance characteristics. FY04: Funds will construct an approximately 3MW prototype machine.

R9141	FY 2003	FY 2004
MARINE DIRECT SHIP SERVICE FUEL CELL TECHNOLOGY VALIDATION TRAINER	1,141	0

Began development of a fuel cell training program for both fuel cell operators and engineers. Developed detail plan for test and evaluation on Molten Carbonate Fuel Cell Systems.

R9142	FY 2003	FY 2004
SMART MICROSENSOR ARRAYS FOR SHIPBOARD DAMAGE CONTROL	5,048	0

Developed a high temperature cermet (ceramic-metallic) prototype smart microsensor array system for Navy damage control applications. The chemical microsensor array system offered a small size, light weight, and low cost alternative to conventional sensors and the potential for fabrication of smart sensor arrays with on-chip logic integration. The arrays were networked using E-Smart (Environmental Systems Management, Analysis and Reporting network) system. Developed flexible readout circuitry using standard Si and then SOI microelectronics offering high operating temperature control and logic circuitry applicable to shipboard damage control environments.

R9143	FY 2003	FY 2004
SMART SENSOR WEB	1,004	0

Developed a network of smart, ground based sensors that operate in an urban environment. The sensors communicate via power lines or in a wireless mode in the absence of power lines. This technology is applicable to a variety of operational environments including chemical and biological warfare. It is also applicable to Military Operations Other Than War (MOOTW).

R9303	FY 2003	FY 2004
AGILE PORT AND HIGH SPEED SHIP TECHNOLOGY	0	4,945

Develop and demonstrate advanced maritime technologies with commercial and military applications. Includes scale model and full-scale demonstration of advanced hull forms, and supporting technologies in the areas of hydromechanics and lightweight structures.

R9304	FY 2003	FY 2004
AVIATION GROUND NAVIGATION SYSTEMS (AGNAS)	0	1,682

Effort will support Aviation Ground Navigation Systems (AGNAS).

R9305	FY 2003	FY 2004
COMPOSITE SPECIAL OPERATIONS CRAFT	0	989

Develop a replacement design for special operations craft that will incorporate composite hull construction technology and reduce slamming loads.

R9306	FY 2003	FY 2004
DOCKSHOCK	0	989

Develop and complete system design studies for an advanced ship/platform shock test technology utilizing DARPA developed electrochemical explosive devices.

R9307	FY 2003	FY 2004
E-2C INFRARED SEARCH AND TRACK (IRST) TECHNOLOGY EXPERIMENTATION	0	1,359

The program will demonstrate staring infrared (IR) sensors on the E-2C aircraft for detection and tracking of Theater Ballistic Missiles (TBMs), as well as for aircraft and anti-aircraft missiles.

R9308	FY 2003	FY 2004
GLOBAL PERSONAL LOCATOR BEACON (PLB)	0	1,730

Development of Global Personal Location Beacon (PLB) Smart Sensor Web. This effort will enhance the current Emergency Positions Indicating Radio Beacons (EPIRBs) international constellation of satellites to relay an alerting distress message to a regional rescue coordination center (RCC) with critical situational data such as the nature of the emergency, what type of rescue will be required, number of people in the party, location, condition of victims, and who should be alerted.

R9309	FY 2003	FY 2004
LARGE UNMANNED UNDERSEA VEHICLE (LUUV) TEST BED	0	1,187

Produce an integrated vehicle and guidance design for a Large Unmanned Undersea Vehicle (LUUV) Test Bed including the design of a water tunnel modification and test fixture for evaluating and validating distributed electrical propulsion concepts.

R9310	FY 2003	FY 2004
LASER WELDING AND CUTTING	0	3,461

Funding will be dedicated to testing and qualification of the fabricated shapes, automating the laser process controls, and automating material handling for transition to the carrier programs.

R9311	FY 2003	FY 2004
QUAD HULL SECURITY CAISSON TECHNICAL DEMONSTRATION	0	2,472

Construct and evaluate a quad hull security caisson constructed from segmented curved plates (a proprietary structural design and manufacturing technology). The technology may offer a robust and economical means of

protecting shore facilities and ships from sea based terrorist attack.

R9312	FY 2003	FY 2004
REMOTE CONTINUOUS ENERGETIC MATERIAL MANUFACTURING PYROTECHNIC IR DECOYS	0	1,187

Utilizing twin-screw extrusion technology, a remote-operation manufacturing capability could be installed at the Louisiana Army Ammunition Plant. In about one year, a production line could be operational with scale-up to full production capability within 2 years. This would provide a secure domestic source for infrared (IR) decoys, with benefits in term of safety, cost and environmental impact as well as capability for de-mining torches.

R9313	FY 2003	FY 2004
TECHNOLOGIES FOR FUTURE NAVAL CAPABILITIES (FNC)	0	1,088

Develop a test-bed model of an unmanned surface vehicle to be employed in the development of control and monitoring algorithm. Systems integrations will be performed to ensure the viability of the models, simulations and signal processing.

R9314	FY 2003	FY 2004
WIRELESS PROGRAMMABLE LOGIC CONTROLLERS	0	989

Effort supports Wireless Programmable Logic Controllers.

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

BA: 03 PROGRAM ELEMENT: 0603235N
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology

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
R2919 Communications Security	35,558	68,417	79,521	62,624	60,080	56,314	57,470
R9020 Vessel Tracking	0	4,351	0	0	0	0	0
R9145 Command Center Visualization	6,668	0	0	0	0	0	0
R9146 Improved Shipboard Combat Information Center	3,430	0	0	0	0	0	0
R9315 CONSOLIDATED UNDERSEA SITUATIONAL AWARENESS SYS (CUSAS)	0	3,955	0	0	0	0	0
R9316 SHIPBOARD AUTOMATED RECONSTRUCTION CAPABILITY (SHARC)	0	1,978	0	0	0	0	0
R9317 TECHNOLOGY INSERTION SUPPORT	0	989	0	0	0	0	0
Totals	45,656	79,690	79,521	62,624	60,080	56,314	57,470

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) addresses the advanced technology development, test and evaluation of a dynamic distributed common picture that will improve situational awareness across command echelons. The goal is to refine technologies that exploit information and networking technology to ensure mission success in an unpredictable warfighting environment. It creates network centric capability by demonstrating technologies that support seamless information services afloat and ashore; collaborative decision-making among geographically dispersed warfighters; a common, consistent view of the battlespace geared to user requirements; system interoperability with coalition forces; real-time information access with quality of service guarantees; and information assurance. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to decisive, precise, desired engagement outcomes. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower. The Common

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

BA: 03 PROGRAM ELEMENT: 0603235N
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology

Picture Program supports the Knowledge Superiority and Assurance (KSA), Missile Defense (MD), Littoral Anti-Submarine Warfare (ASW), and Fleet/Force Protection (FFP) Future Naval Capabilities (FNC). In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet, "Persistent Intelligence, Surveillance, and Reconnaissance," "Time Sensitive Strike," "Sea Based Information Operations," "Sea Strike" Ship-to-Objective Maneuver, and "Sea Shield" Theater Air and Missile Defense.

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	47,262	69,194	73,620
Cong. Rescissions/Adjustments/Undist Reductions	0	-904	0
Congressional Actions	0	11,400	0
Execution Adjustments	-1,337	0	0
Inflation Savings	0	0	-238
Rate Adjustments	0	0	6
SBIR Assessment	-269	0	0
Technical Adjustments	0	0	6,133
FY 2005 President's Budget Submission	45,656	79,690	79,521

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

BA: 03 PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: Common Picture Advanced Technology

PROJECT NUMBER: R2919 PROJECT TITLE: Communications Security

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
R2919 Communications Security	35,558	68,417	79,521	62,624	60,080	56,314	57,470

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses the advanced technology development, test and evaluation of a dynamic distributed common picture based on emergent technologies that will improve situational awareness across command echelons. The goal is to refine technologies that exploit information and networking technology to ensure mission success in an unpredictable warfighting environment. It creates network centric capability by demonstrating technologies that support seamless information services afloat and ashore; collaborative decision-making among geographically dispersed warfighters; a common, consistent view of the battlespace geared to user requirements; system interoperability with coalition forces; real-time information access with quality of service guarantees; and information assurance. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to decisive, precise, desired engagement outcomes. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower. The Common Picture Program supports the Knowledge Superiority and Assurance (KSA), Missile Defense (MD), Littoral Anti-Submarine Warfare (ASW), and Fleet/Force Protection (FFP) Future Naval Capabilities (FNC). In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet, "Persistent Intelligence, Surveillance, and Reconnaissance," "Time Sensitive Strike," "Sea Based Information Operations," "Sea Strike" Ship-to-Objective Maneuver, and "Sea Shield" Theater Air and Missile Defense.

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

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Knowledge Superiority and Assurance (KSA)	14,179	24,364	44,184

Knowledge Superiority and Assurance explores fundamental technologies that enhance the Navy's capability to exploit, manage and integrate complex, heterogeneous, multi-source information for the next generation common picture through 1) Common Consistent Knowledge; 2) Dynamically Managed, Interoperable, High-Capacity Connectivity; and 3) Time-Sensitive Decision Making. Common Consistent Knowledge addresses the needs of operating forces for common picture information in the planning, monitoring, and re-planning cycle of operational and tactical force employment. Dynamically Managed, Interoperable, High-Capacity Connectivity addresses wireless network technology critical to the performance and robustness of Naval communications by providing higher data rates, expanded coverage to disadvantaged platforms, and improved bandwidth management. Time-Sensitive Decision Making supports tactical operations where the timeliness and accuracy of decisions is crucial to the successful and efficient application of available forces.

FY 2003 Accomplishments:

- Conducted at sea demonstrations of the Integrated Decision Support System Product Suite (IDSSP).
- Continued demonstrations of the Multi-National Virtual Operation Network (MNVOC) between UK and US platforms.
- Continued refining and testing the Link 16 time-slot allocation protocol and the features of the Virtual Information Center Technologies for Open Source Requirements by improving the filters needed to retrieve diverse information.
- Continued development of a Joint Mission Planning System for Expeditionary Forces Surface Assault Planning.
- Continued demonstrations of distributed collaborative planning and execution tools to support the Commander In Chief Twenty-First Century Advanced Concept Technology Demons (CINC 21 ACTD).
- Initiated development of software and system certification of secure web servers to share tactical multiple media data products with coalition forces.

FY 2004 Plans:

- Continue at-sea demonstrations of Link 16 dynamic reconfiguration, the CINC 21 Advanced Concept Technology Demonstration (ACTD) and the Multi-National Virtual Operational Network.
- Develop large scale end-to-end demonstrations that integrate multiple technologies under development (e.g., IDSSP, MNVOC) to allow focus on increased speed and quality of command decisions through visualization, knowledge management, network monitoring, and collaboration tailored to command decision points; enabling dispersed decision-makers to synchronize operations and assess alternatives through groupware and collaborative work sessions; enabling integration and information sharing across commands through a web-based crisis management tool; and supporting faster than real-time course of action development with

simulations and models.
• Develop an extensible data management framework and tactical management system to support a wide range of joint mission application developers, permitting seamless and rapid integration of ISR data sources into a common picture.
• Demonstrate the capability to access, update and maintain the common operation picture (COP) through an integrated and interoperable set of software applications.
• Demonstrate the Battle Force Email High Frequency (HF) Local Area Network system, already deployed on 200 US ships and 100 allied ships, to carry Internet Protocol (IP) data over HF (and other Line of Site Systems) to complement satellite communications assets.

FY 2005 Plans:

• Demonstrate command decision-making, dynamically managed connectivity (e.g., Link 16 and other initiatives), and collaborative planning (CINC 21 ACTD), as well as replanning and rehearsals of operational and tactical forces.
• Continue to conduct large scale integrated end-to-end demonstrations of initiatives focusing on course of action analysis.
• Demonstrate the capability to manage complex, heterogeneous information through advanced information search, retrieval and management techniques and user-tailorable situation-at-a-glance visualization technology to enable cross-force and cross-echelon situational awareness.
• Integrate software and conduct a Joint Limited Technology Experiment to demonstrate Joint Real Time Coordinated Engagement (JRCE) in the Global Information Grid (GIG) environment, enabling coordination and application of strike assets in real time.
• Continue to demonstrate dynamic bandwidth management for legacy communications systems to support battleforce networking.
• Expand the development of satellite communications phased arrays so surface platforms can connect to multiple communications platforms simultaneously, supporting frequency diversity and allowing submarines to participate in Network Centric Warfare.
• Develop an Integrated Autonomous Network Management (IANM) prototype system to support assessment and optimization of network performance in real time.
• Develop software tools, procedures and protocols that enable the analysis, validation and verification of information so that adversaries cannot corrupt software, data and information on Naval networks.

	FY 2003	FY 2004	FY 2005
USCG Vessel Tracking	0	9,523	10,670

Details are of a higher classification.

	FY 2003	FY 2004	FY 2005
Multi-Source Integration (MSI) and Combat Identification (CID)	3,150	4,567	9,125

This activity describes S&T projects of the Missile Defense Future Naval Capability (FNC) program: Multi-Source Integration (MSI), Advanced Sensor Netting Technology (ASNT), and Composite Combat Identification (CCID).

FY 2003 Accomplishments:

• Transitioned initial MSI capability (funded in this PE in FY 2002) to the E-2C acquisition program in December 2002. This will enable satellite communications (SATCOM) delivered intelligence data to appear on the E-2C tactical display.
• Continued demonstration of Composite Combat Identification (CCID) algorithms to correlate and fuse Cooperative Engagement Capability (CEC) data with intelligence, surveillance and reconnaissance (ISR) data processed aboard EP-3E aircraft and Ship Signal Exploitation Equipment (SSEE)-equipped surface ships. Also continued CCID project development of common ID reasoning algorithm for the naval open architecture combat system.

FY 2004 Plans:

• Resume demonstration of advanced MSI algorithms begun in FY2003 in PE 0602235N to integrate radio frequency (RF) sensors, Identification Friend or Foe (IFF) data, Cooperative Engagement Capability (CEC), Joint Tactical Information Distribution System (JTIDS), and correlate SATCOM data to the integrated track file in the E-2C mission computer.
• Continue demonstration and testing of algorithms for an advanced sensor netting technology (ASNT) project begun in FY 2002 in PE 0602235N for integration of electronic warfare support (ES) data into CEC.
• Complete demonstration of CCID algorithms for use in reconnaissance aircraft. Continue development of similar algorithms for shipboard SSEE and a common identification (ID) reasoning capability for the naval open architecture combat system.

FY 2005 Plans:

• Continue operational demonstration and testing of MSI algorithms for the E-2C aircraft using data sets portraying increasingly complex scenarios and sensor/source mixes. Also ensure MSI will meet requirements and standards for the naval open architecture combat system.
• Continue operational demonstration and testing of Advanced Sensor Networking Technology (ASNT) algorithms for the CEC program. Tests will include passing of ID attributes with air tracks and measuring impact on CEC bandwidth and timing. Also ensure ASNT meets the requirements for CEC Block II.
• Continue development of and demonstrate the Composite Combat Identification (CCID) common reasoning algorithm in an open architecture environment in preparation for subsystem integration, operational experimentation, and transition to the naval open architecture combat system. Also continue development and initiate demonstrations of CCID algorithms for the SSEE in land-based facilities.

	FY 2003	FY 2004	FY 2005
Platform Protection/Electronic Warfare Systems	3,650	8,293	7,544

This activity supports the Fleet/Force Protection (FFP) Future Naval Capability (FNC). Currently, small surface, ground-based and airborne platforms have little-to-no Situational Awareness (SA) capability, which jeopardizes their battlefield effectiveness and combat survivability. This activity develops the Electronic Warfare Integrated System for Small Platforms (EWISSP), a compact small platform electronic warfare capability providing radio frequency (RF), electro-optic (EO) and infrared (IR) sensors for platforms such as smaller ships, expeditionary fighting vehicles (EFV), and surveillance aircraft. This activity integrates successful proof-of-concept hardware and software developed under PE 0602235N into systems suitable for capability demonstration under Naval environments and tactical conditions. The SA system, a subset of EWISSP, addresses several small surface platform self-protection system integration requirements and employs monolithic micro/integrated circuit (MMIC) devices and a new antenna to form a compact, low volume/lightweight system that provides accurate hemispheric direction finding and self-protection.

FY 2003 Accomplishments:

• Concluded EWISSP Phase I and began Phase II acceptance testing of the Shipboard Laser Acquisition System (SBLAS).
• Conducted 90 degree system testing.
• Fabricated and integrated component modules.
• Delivered the Laser Warning receiver (LWR) to Naval Research Labatory (NRL) for mating to an optimized analog filter.

- Assembled the first Bi-Stem unit to demonstrate structural rigidity and payload capacity.
- Conducted optical injection tests to measure laser power transfer efficiency into the Bi-Stem's fiber optic line.

FY 2004 Plans:

Continue EWISSP Phase II. Some specific plans include:
- Demonstrate the application of advanced technology to increase the survivability of the Marine Expeditionary Fighting Vehicle (EFV).
- Development of the SA and Electronic Attack (EA) subsystems that operate in the Millimeter Wave (MMW), RF, EO, and IR regions will begin with subsystem initial assembly and integration.
- Testing of a prototype flexible mast for MMW and EO sensors will be performed in parallel with compatibility testing with existing and/or planned basic physical and electrical designs and features of host platforms.
- Integration of the EWISSP with the EFV will continue and involve a significant effort due to limited space and power available in the EFV as well as severe restrictions on modifications to the vehicle's exterior configuration.

FY 2005 Plans:

Complete development and demonstrations of EWISSP Phase II. Some specific plans include:
- Phase II will continue with the assembly and integration of SA and EA subsystems. Focus will be on hardware and software integration at the subsystem level.
- Incremental testing of subsystems will be conducted as they are assembled to ensure technical performance requirements are being met.
- As part of the transition effort, configuration management of the design will be implemented to track development and integration progress and identify technology insertion points.

	FY 2003	FY 2004	FY 2005
Global Positioning System (GPS) & Navigation Technology	5,000	5,000	5,000

This activity enhances GPS anti-jam (AJ) capabilities and develops other technologies to provide alternative navigation methods. In the GPS AJ area, Space-Time Adaptive Processing (STAP) is being pursued to remove the operational risks associated with enemy jamming of GPS functions. Also, the next generation GPS receiver will be programmed with M-code; therefore, both the next generation M-code and the existing C/Y-codes must be used at the same time frame. Office of Naval Research (ONR) initiated a transitional receiver which will

accommodate both the C/Y- and M-codes. The alternative navigation methods investigated include GPS receivers with a tightly coupled Inertial Navigation System (INS); organic Link-16 relative navigation; gravity gradiometer development, used in a terrain-following concept; and an electro-optic accelerometer developed as an improved element in INS. This activity also develops the atomic clock for inclusion in Naval Systems. The atomic clock efforts include small, low-cost Rubidium (Rb), Coherent Population Trapping (CPT) atomic clock development. These areas will provide alternatives to GPS navigation and alternatives to the availability of precision, GPS-provided, time transfer.

FY 2003 Accomplishments:

- Initiated Scalable Multi-Element STAP; adaptive array will suppress jamming signals in the receiver.
- Developed Atom Interferometer Gravity Gradiometer that reduced size of the optical and electronic control units.
- Examined modifications to Link-16 that could provide the spatial and temporal precision needed when GPS is denied.
- Initiated the Differential GPS Navigation with Link-16 (DGPS) effort to increase positional accuracy and data reliability.
- Initiated fabrication of a 10 cubic centimeter Rb CPT Atomic Clock to improve time transfer in military platforms.

FY 2004 Plans:

- Develop a 7-element STAP dual polarization receiver antenna.
- Develop a Field Programmable Gate Array (FPGA) GPS software receiver which can adapt to “near-far” reception in real time operation to take advantage of pseudolites.
- Concentrate on GPS requirements when both M- and C/Y-codes need to be hosted in a single receiver with a minimum disruption for Navy users, i.e., Application Specific Integrated Circuit (ASIC) design continuation.
- Initiate a new gravity gradiometer effort to use the principle of the vibrating beam accelerometer.
- Adapt Electro-optic Accelerometer effort into a practical Inertial Measurement Unit for embedded inertial measurement in hybrid GPS.
- Implement Link-16 Relative Navigation with corrections to latencies in precision time transfer.
- Demonstrate accuracy of the DGPS effort at a test range.

FY 2005 Plans:

- Continue NRL's Vibrating Beam Accelerometer (VBA) gravity gradiometer.
- Apply Electro-optic Accelerometer effort to several DOD miniature electro-mechanical system (MEMS) Inertial Measurement Unit (IMU) efforts.
- Demonstrate Differential GPS Navigation with Link-16 in a test bed capable of hosting an integrated Navigation System and Time Refinement System.
- Test Scalable Multi-Element STAP-based Adaptive Array with dual polarization.
- Demonstrate Raytheon's Integrated GPS/INS with improved anti-jam margin for tracking GPS signals in strong interference environments.
- Simulate GPS M- and C/Y-code input to refine specifications for multi-code ASIC development.
- Combine optical and electronic subsystems of the ultra-miniature Rb CPT clock. Complete clock.

	FY 2003	FY 2004	FY 2005
Information Security Research	1,998	1,998	1,998

The goal of this activity is to protect the Navy and Joint information infrastructure from hostile exploitation and attack. This requires situational awareness of network assets and operations. This activity focuses, in part, on integrating successful proof of concept research prototypes developed under PE 0602235N. The goal is to develop tools, techniques and methodologies in order to: improve network resistance to denial of service attacks; improve indications and warnings of suspect activities; conduct traffic analysis; monitor and assess network status and health; identify new capabilities to analyze and network vulnerabilities and attacks; measure the effectiveness of Information Assurance (IA) protective measures; and improve the quality and level of certification of IA software.

FY 2003 Accomplishments:

- Developed and validated secure group network protocols for peer-to-peer trusted hosts, as well as developing tools and methodologies to formally prove assurance properties and to enable data analysis from passive monitoring of intrusive network behaviors.
- Continued examination of the tools, techniques, and methodologies that will ensure network survivability.
- Continued the development of the Naval Research Lab (NRL) Network Pump, to support transferring data securely from a lower to a higher level of classification, and to enable built-in self-test and to be field-upgradeable.

FY 2004 Plans:

• Continue to develop and validate secure group network protocols within a small enclave, as well as develop the tools and methodologies to formally prove and verify scaleable assurance properties and to enable correlated analysis from passive monitoring of intrusive network behaviors in near real-time.
• Continue to examine the tools, techniques, and methodologies that will ensure secure network survivability and resistance to denial of service attacks.
• Continue development of the NRL Network Pump, including development of methodologies to securely transfer data from a higher to lower level of classification, including stronger connection authentication and secure administration capabilities.

FY 2005 Plans:

• Continue to develop and validate scaleable secure group network protocols for trusted coalition partners along with the tools and methodologies to prove and certify assurance properties about information sharing and to enable correlated statistical analysis of pro-active monitoring of intrusive network behaviors in near real-time.
• Continue to examine the tools, techniques, and methodologies that will ensure secure network survivability, security, and resistance to denial of service attacks while deterring traffic analysis.
• Complete development, demonstration, and common criteria evaluation of the NRL Network Pump for its ability to transfer data securely from high to lower levels of classification across dissimilar networks while providing strong authentication and secure administration capabilities.

	FY 2003	FY 2004	FY 2005
Marine Mammals	1,055	1,000	1,000

This initiative provides data and technology for making informed decisions regarding the interaction of Naval activities with protected marine life and habitats to enable platform operation and force projection, and maximize use of Navy training ranges within environmental constraints. Ensure Navy compliance with national environmental laws, Executive Order 12114, and SECNAVINST 5090.1.b while still maintaining full operational and training exercise capabilities.

FY 2003 Accomplishments:

• Integrated passive acoustic marine mammal monitoring (M3R) detection technology with existing Navy assets and initiated operator training at the Atlantic Undersea Test and Evaluation Center (AUTEC).
• Synthesized an acoustic safety criteria model based on existing temporary threshold shift (TTS) data to predict impact of Navy sound sources on marine mammals.

FY 2004 Plans:

• Integrate M3R tracking technology with existing range assets and complete operator training at AUTEC while continuing data collection and analysis to calibrate passive technology with visual surveys. Assess M3R capabilities for the Navy range wide tactical theater training assessment planning (TAP) with N45. Collect TTS data to determine time/energy trade-off and recovery rates for long duration sound exposures and multiple pings typical of Navy operations and training.

FY 2005 Plans:

• Develop and test M3R classification software for identification of marine mammal species and populations. Complete demonstration of M3R at AUTEC and begin installations at other Navy ranges.
• Establish an Acoustic Safety Criteria Model for multiple sonar pings based on TTS data for recovery rates and long duration sound exposures.

	FY 2003	FY 2004	FY 2005
Integrated Anti-Submarine Warfare (IASW)	1,890	0	0

Integrated Anti-Submarine Warfare (IASW) supporting the Littoral Anti-Submarine Warfare (LASW) Future Naval Capability (FNC). Develop a common Anti-Submarine Warfare (ASW) tactical and environmental picture to improve detecting, tracking, and classifying subsurface platforms while reducing false alarms and increasing the timeliness of inputs to the common undersea picture. Technologies include cross platform data fusion; common sensor performance predictions across platforms; capturing sensor performance uncertainty; command and control and tactical level data fusion; decision aids and displays for Anti Submarine Warfare (ASW). These technologies provide input to the common tactical and environmental ASW picture, significantly enhancing ASW effectiveness. Achieving transformation to network-centric capabilities in the ASW environment has proven difficult because of restricted connectivity to submarine platforms and bottom-deployed systems. Advances in data fusion, decision aids, and display technologies are needed to fully achieve network-centric ASW.

FY 2003 Accomplishments:

• Delivered inter- and intra-platform engines for fusion of Distant Thunder data.

FY 2004 Plans:

Not applicable.

FY 2005 Plans:

Not applicable.

	FY 2003	FY 2004	FY 2005
Extending the Littoral Battlespace/JTF Warnet	1,000	0	0

Extending the Littoral Battlespace (ELB) Advanced Concept Technology Demonstration (ACTD) transition phase was re-focused and re-named Joint Task Force Wide Area Relay Network (JTF WARNET). It is designed to bring tactical level network connectivity and data interoperability of a Joint Task Force across all services. This activity demonstrates enhanced integrated command, control/fires, and targeting capability in support of dispersed units, thus enabling common situational awareness, enhanced access to joint fires and facilitating dynamic maneuver while reducing fratricides.

FY 2003 Accomplishments:

• Completed end-to-end field demonstration of JTF WARNET components with a pre-deployment exercise to prepare for FY 2004 operational deployment, and implemented transition agreements to acquisition programs of record.

FY 2004 Plans:

Not applicable.

FY 2005 Plans:

Not applicable.

	FY 2003	FY 2004	FY 2005
Joint Program Office Special Technology Countermeasures	3,636	13,672	0

Details are of a higher classification.

C. OTHER PROGRAM FUNDING SUMMARY:
RELATED RDT&E:

PE 0601153N (Defense Research Sciences)
PE 0602114N (Power Projection Applied Research)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602235N (Common Picture Applied Research)
PE 0602271N (RF Systems Applied Research)
PE 0603123N (Force Protection Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603609N (Conventional Munitions)
PE 0603640M (Marine Corps Advanced Technology Demonstrations)
PE 0603658N (Cooperative Engagement)
PE 0604307N (Surface Combatant Combat System Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0206313M (Marine Corps Communications Systems)
PE 0303140N (Information Systems Security Program)
PE 0308610N (Modeling and Simulation and Support)

NON-NAVY RELATED RDT&E:

PE 0603750D8Z (Advanced Concept Technology Demonstrations)

D. ACQUISITION STRATEGY:
Not applicable

BA: 03 PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: Common Picture Advanced Technology
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R9020	FY 2003	FY 2004
VESSEL TRACKING	0	4,351

This effort will determine and develop the optimum technology mix for identification, surveillance, and tracking of maritime vessels. The effort will develop high resolution radar techniques from multiple aspects to verify and validate automated information system data fields. This effort will emphasize small craft tracking and automatic target recognition -- key surface Navy needs for operations in the littorals and harbor areas.

R9145	FY 2003	FY 2004
COMMAND CENTER VISUALIZATION	6,668	0

This effort integrated and explored various automated information gathering, integration, and visualization techniques for integrating and presenting large amounts of multi media time sensitive information to the operator standing watch in operational command centers. This prototype command center visualization system demonstrated the capability of emerging technologies to further automate and improve the warfighting operations of a command center resulting in improved speed of command and improve operational effectiveness with reduced manpower levels.

R9146	FY 2003	FY 2004
IMPROVED SHIPBOARD COMBAT INFORMATION CENTER (CIC)	3,430	0

This effort integrated and explored various decision-making and display technologies for improving the CIC. This prototype system demonstrated the capability of emerging technologies to further automate and improve the warfighting operations of surface ship combatants. The system has technologies that were re-configured depending on mission and tasking requirements and allowed CIC watchstanders to better receive, comprehend and respond to incoming data during combat operations. An improved shipboard CIC system streamlined and integrated information workflow, yielding improved speed of decision-making and improved operational effectiveness in combat situations.

R9315	FY 2003	FY 2004
CONSOLIDATED UNDERSEA SITUATIONAL AWARENESS SYSTEM (CUSAS)	0	3,955

This effort is a decision-support system that provides knowledge superiority to undersea warfare forces through the use of advanced, interactive software. Developed initially as a DARPA-sponsored effort, CUSAS offers enormous transformational advantages to fleet operators as it helps to remove the fog of war with a high fidelity 2D and 3D presentation augmented with real-time tactical intelligent agent-based recommendations in a user-friendly format. The use of intelligent software agents is a major, new enabler that provides timely, effective and efficient decision support under conditions of overwhelming and uncertain data. It offers fleet operators a significant opportunity to address one of their most vexing requirements – the need for a consistent, accurate and timely situational understanding of the battlespace by a submerged submarine. In addition, CUSAS is designed to assist operators with recommended actions in response to complex tactical developments that involve significant uncertainty.

R9316	FY 2003	FY 2004
SHIPBOARD AUTOMATED RECONSTRUCTION CAPABILITY (SHARC)	0	1,978

This system will assist submarine operators to plan, execute and evaluate highly complex tactical and covert submarine missions. SHARC is designed to capture and dynamically present all relevant operational data such as ship’s logs (deck, quartermaster’s, sonar, communications, and engineering), casualty and intelligence reports, environmental summary with fire control solutions, ship’s track history indicating heading, speed, depth, as well as the Commanding Officer’s narrative. This automatic data capture and visual replay will allow a submarine’s commander and crew to accurately reconstruct high interest events experienced during the mission. This capability will permit the ship to conduct post-analysis of encounters in near real-time and to provide the intelligence community with pre-processed data that will enable more rapid and accurate analysis of interactions of operational value. Currently, this task is done manually, using a process that is inefficient and susceptible to errors and omissions. Additionally, SHARC will greatly enhance one of the most fundamental and necessary ship functions – continuous operational improvement through reviewing and critiquing previous missions.

R9317	FY 2003	FY 2004
TECHNOLOGY INSERTION SUPPORT	0	989

This effort will investigate new information technologies which will require testing and evaluation of

applications throughout the Joint services.

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

BA: 03 PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology

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
R2915 WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	54,866	52,531	61,103	62,693	65,333	66,690	68,117
R3008 HIGH SPEED SEALIFT VESSEL	20,400	0	0	0	0	0	0
R9021 LOW VOLUME PRODUCTION PROGRAM	2,826	0	0	0	0	0	0
R9023 COTS CARBON FIBER QUALIFICATION PROGRAM	1,433	1,978	0	0	0	0	0
R9147 DEFENSE SYSTEMS MODERNIZATION AND READINESS INITIATIVE	3,812	1,978	0	0	0	0	0
R9148 ELECTRONIC INTERCONNECTION RESEARCH AND DEVELOPMENT PROGRAM	952	3,461	0	0	0	0	0
R9149 ENERGY AND ENVIRONMENTAL TECHNOLOGY	3,255	4,203	0	0	0	0	0
R9150 INTEGRATED AIRCRAFT HEALTH / ON-LINE ELECTRO-HYDRODYNAMIC FILTER	1,625	7,132	0	0	0	0	0
R9151 WIRE CHAFFING DETECTION TECHNOLOGY	1,332	0	0	0	0	0	0
R9318 AUTOGEN	0	2,967	0	0	0	0	0
R9319 AUTOMATED CONTAINER AND CARGO HANDLING SYSTEM	0	1,978	0	0	0	0	0
R9320 EXPEDITIONARY LOGISTICS SOFTWARE DEVELOPMENT	0	989	0	0	0	0	0
R9321 EXTREME ENVIRONMENT URBAN WARFARE RESEARCH/FLIGHT HANGER DECK CLEANER IMPROVEMENTS	0	3,511	0	0	0	0	0

BA: 03 PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
R9323 IMPRINT	0	989	0	0	0	0	0
R9324 NAVAL MAINTENANCE MANAGEMENT	0	989	0	0	0	0	0
R9326 PHOTONIC MACHINING APPLICATIONS	0	989	0	0	0	0	0
R9327 REDUCTION OF CATAPULT POST-RETRACTION EXHAUST DISCHARGE	0	989	0	0	0	0	0
R9328 TITANIUM MATRIX COMPOSITES PROGRAM	0	1,780	0	0	0	0	0
Totals	90,501	86,464	61,103	62,693	65,333	66,690	68,117

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Warfighter Sustainment Advanced Technology supports: a) Manpower and Personnel, Training, and Readiness; b) the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff; and c) the Future Naval Capabilities (FNC) for Total Ownership Cost, and Littoral Combat/Power Projection. It develops technologies that enable the Navy to recruit, select, classify, assign and manage its people; to train effectively and affordably in classroom settings, in simulated and actual environments and while deployed; and to effect human systems integration into weapon systems. Other technologies developed in this PE enable reduced operating costs through life-extension of legacy systems, increased efficiency of future propulsion systems and improved diagnostic tools. The Expeditionary Logistics investment addresses transformational Naval surface distribution/replenishment techniques, and improves the situational awareness of readiness and operating logistics status.

Within the Naval Transformation Roadmap, this investment supports the achievement of all the transformational capabilities of Sea Warrior and the transformational capabilities of: Ship to Objective Maneuver and Time Sensitive Strike required by Sea Strike; Littoral Sea Control and Anti-Sub Warfare required by Sea Shield; Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing; and Battlespace Integration required by FORCEnet.

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	96,320	54,794	56,053
Cong. Rescissions/Adjustments/Undist.Reductions	0	-971	0
Congressional Actions	0	32,650	0
Execution Adjustments	-3,954	0	0
Inflation Savings	0	0	-181
Rate Adjustments	0	-9	111
SBIR Assessment	-1,865	0	0
Technical Adjustments	0	0	5,120
FY 2005 President's Budget Submission	90,501	86,464	61,103

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Budget change FY 2003 to FY 2004 due to completion of High Speed Sealift Vessel project. Change from FY 2004 to FY2005 due to increased core effort in Total Ownership Costs, Expeditionary Logistics, Capable Manpower, and Littoral Combat/Power Projection.

Schedule: Not applicable.

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

BA: 03 PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology
PROJECT NUMBER: R2915 PROJECT TITLE: Warfighter Sustainment Advanced Technology

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
R2915 Warfighter Sustainment Advanced Technology	54,866	52,531	61,103	62,693	65,333	66,690	68,117

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Warfighter Sustainment Advanced Technology supports: a) Manpower and Personnel, Training, and Readiness; b) the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff; and c) the Future Naval Capabilities (FNC) Total Ownership Cost, and Littoral Combat/Power Projection. It develops technologies that enable the Navy to recruit, select, classify, assign and manage its people; to train effectively and affordably in classroom settings, in simulated and actual environments and while deployed; and to effect human systems integration into weapon systems. Other technologies developed in this project enable reduced operating costs through life-extension of legacy systems, increased efficiency of future propulsion systems and improved diagnostic tools. The Expeditionary Logistics investment addresses transformational Naval surface distribution/replenishment techniques, and improves the situational awareness of readiness and operating logistics status.

Within the Naval Transformation Roadmap, this investment supports the achievement of all the transformational capabilities of Sea Warrior and the transformational capabilities of: Ship to Objective Maneuver and Time Sensitive Strike required by Sea Strike; Littoral Sea Control and Anti-Sub Warfare required by Sea Shield; Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing; and Battlespace Integration required by FORCEnet.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Manpower and Personnel Development	4,091	4,569	3,233

This activity provides Navy personnel system managers with the ability to attract and retain the right people and to place them in jobs that best use their skills, training, and experience. Application of modeling and simulation, mathematical optimization, advanced testing, statistical forecasting, information visualization, data warehousing, data cleansing, web-based knowledge management, and human performance measurement

technologies enhances Fleet readiness and reduces personnel costs.

FY 2003 Accomplishments:

• Completed Rating Identification Engine (RIDE) algorithms for matching applicant skills to jobs and Jobs and Occupational Interest in the Navy (JOIN) interest profiles which measure interests in various jobs.
• Continued Attrition Reduction Technologies, which demonstrate the use of attrition, cultural, and organizational measures between applicants/Sailors and the Navy that can be mitigated.
• Continued Distribution Incentive System, which incorporates the economic methods, business rules, and incentive structures to incentivize traditionally difficult-to-fill assignments or locations.
• Continued the Enlisted Manpower and Personnel Integrated Planning System (EMPIPS), an integration of compensation models into a decision support system and database for enlisted manpower and personnel planning.
• Initiated Non-Cognitive Measures of Personality and Social Competency related to teamwork, Navy adaptability, leadership, and job performance to be applied in personnel selection and classification.
• Initiated Career Case Manager Technologies, which integrates intelligent agents, simulation models, and statistical methods to support Sailors/Marines' career planning and decision making.
• Initiated Web Based Marketplace for Sailors and Jobs, the computational operating environment in which the command, broker, and Sailor cognitive agents will interface to distribute and assign military personnel.
• Initiated Enterprise Management System that provides near-term decision support for personnel policy and resource allocation and long-range personnel enterprise strategic planning "executive simulation."

FY 2004 Plans:

• Complete Enlisted Manpower & Personnel Integrated Planning system (EMPIPS).
• Continue focus on manpower selection and classification, career management, and personnel planning programs.

FY 2005 Plans:

• Complete Attrition Reduction Technologies metrics for screening applications at high risk of attrition.
• Complete Enterprise Management System decision tool and strategic planning "executive simulator."
• Continue focus on manpower selection and classification, career management, and personnel planning programs.

	FY 2003	FY 2004	FY 2005
Training Systems	18,547	10,778	14,397

This activity improves mission effectiveness and safety by applying both simulation and instructional technology to the design of affordable education and training methods and systems. Improved training efficiency and cost-effectiveness is achieved by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the logistics, development, delivery, evaluation, and execution of training.

FY 2003 Accomplishments:

- Completed development of intelligent agents for real-time distributed exercise scenario modification.
- Completed Virtual Technology and Environments (VIRTE) demonstration I, Combat Vehicles and Craft for Expeditionary Warfare.
- Completed development of Deployable Sonar Operations Training (DSOT) and developed PC-IMAT.
- Completed the development of the Synthetic Cognition for Operational Team Training (SCOTT).
- Continued distributed learning guidelines and simulation-based exercise debriefing technologies.
- Continued development of collaborative network-centric visualization systems for sensor operations and training for operators and for Officers/Tacticians.
- Continued integrating existing technologies to produce advanced surface fire support training prototype.
- Began development of human performance assessment tools in support of Navy-wide distributed learning.
- Initiated Virtual Technologies and Environments (VIRTE) Demo II, Close Quarters Battle (CQB) for Military Operations in Urban Terrain (MOUT).
- Initiated development of Battle Group Level Advanced Under Sea Warfare (USW) Visualization systems.
- Initiated task to design, test and demonstrate an expendable, buoy-based acoustic scoring system and real-time transmission of scenario-based data for Virtual At-Sea Training (VAST) between platforms.

FY 2004 Plans:

- Complete distributed learning guidelines for development of Navy courseware.
- Complete integration of existing technologies to produce an advanced fire support prototype for VAST.
- Continue focus on VIRTE Demonstration II, Battle Group Level Advanced Under Sea Warfare (USW) visualization systems, VAST, collaborative network-centric visualization systems, performance assessment tools and debriefing technologies.
- Initiate advanced technologies for Interactive Electronic Technical Manuals.
- Initiate Virtual Technologies and Environments (VIRTE) Demo III, which provides integrated virtual training

across the Full Spectrum of Combat.
• Initiate task to evaluate alternative ways to display information in the cockpit to support Naval air combat training in airborne platforms, exploiting the training capabilities offered by Virtual At Sea Training (VAST).

FY 2005 Plans:

• Complete development of human performance assessment tools for Navy-wide distributed learning.
• Continue focus on VIRTE Demonstration II and III, Battle Group Level Advanced Under Sea Warfare (USW) visualization systems, VAST, collaborative network-centric visualization systems, performance assessment tools, debriefing technologies and alternate cockpit information display evaluations.
• Initiate architecture design for integrating Naval Surface Fire Support and AirVAST into a joint operations constellation that includes cross-echelon and multi-platform training.

	FY 2003	FY 2004	FY 2005
Human Systems Integration	1,073	1,316	1,293

This effort supports the warfighter by designing affordable user-centered systems that are easy to use and train. Focus is on the application of a reusable user-centered design process to design a user interface to support user tasks, extract software requirements, and develop software design models.

FY 2003 Accomplishments:

• Completed development of a transition plan to include the products of this effort into future versions of Tactical Tomahawk Weapons Control Systems (TTWCS).
• Continued integrating Land Attack and Human-Computer Interaction (HCI) designs into a rapid prototype.
• Continued software architecture design to accommodate task-based user interface for Land Attack systems.

FY 2004 Plans:

• Continue focus on integration of Land Attack and Human-Computer Interaction (HCI) designs, and software architecture designs for Land Attack systems.

FY 2005 Plans:

• Complete integration of Land Attack task and HCI designs into the rapid prototype.

• Complete software architecture design to accommodate task-based user interface for Land Attack systems.

	FY 2003	FY 2004	FY 2005
Turbine Engine Technology - Integrated High Performance Turbine Engine Technology (IHPTET)/ Versatile Affordable Advanced Turbine Engines (VAATE)	8,670	9,024	11,113

This activity provides integration and experimental engine testing of new gas turbine engine technologies to demonstrate readiness and reduce technical risk for entering engineering development. IHPTET is a Tri-Service program in which each Service contributes established shares of Advanced Technology funding and laboratory resources to meet specified goals. This activity covers the Navy's share. The objective of VAATE, which begins in FY04, is to develop and demonstrate versatile, durable, "intelligent" engine technologies for the spectrum of legacy, pipe line, and new military aircraft, rotorcraft, missiles, and unmanned air vehicles (UAVs). The VAATE goal is 10X improvement in turbine engine affordability (capability/cost) by 2017, with an interim goal of 6X by 2010.

FY 2003 Accomplishments:

• Completed Phase II Joint Turbine Advanced Gas Generator (JTAGG) component optimization and third build of Honeywell Engine and Systems (HES) demonstrator.
• Continued the Phase II Joint Technology Demonstrator Engine (JTDE) General Electric (GE)/Allison Advanced Development Company (AADC) demonstrator engine.
• Continued the Phase III JTDE (GE/AADC and Pratt & Whitney (P&W) demonstrator engines) and demonstration of P&W and GE/AADC progress toward Phase III goals.
• Continued the Phase III (JTAGG) development and initial core test of HES demonstrator.

FY 2004 Plans:

• Continue focus on the Phase II & III JTDE (GE/AADC and P&W) demonstrator engines, Phase III JTAGG development, and core test HES demonstrator.
• Initiate VAATE Phase I: Component design and technology development to meet the VAATE Phase I goals.

FY 2005 Plans:

• Complete the Phase II JTDE (GE/AADC) demonstrator engine.
• Complete the Phase III JTDE (GE/AADC and P&W) demonstrator engines.

- Complete the Phase III JTAGG development and initial core test of HES demonstrator.
- Continue VAATE Phase I: Component design and technology development to meet VAATE Phase I goals.
- Initiate VAATE Phase I: Design, component development, integration and fabrication of Phase I demonstrator engines.

	FY 2003	FY 2004	FY 2005
Airframe/Ship Corrosion	3,776	4,808	4,918

This activity includes an integrated approach for the control of the effects of external and internal corrosion in Naval weapon systems. The work develops advanced, cost effective prevention and lifecycle management technologies. This is particularly significant to life extension for the aging fleet.

FY 2003 Accomplishments:

- Completed initial demos with ship tank coatings that exhibited promising coating properties (2 Ballast tanks of USS Whidbey Island, 1 Ballast tank of USS WASP and 1 DC Void of CVN George Washington).
- Completed a test bed design for Modular Hybrid Pier (MHP) and modules and large panel tests.
- Completed a 1st generation laboratory prototype Nondestructive Inspection (NDI) system that integrates thermography and spectral imaging into one system.
- Continued Airframe Corrosion efforts and development of coating database for USMC vehicles, advanced coatings and inhibitor applied washdown system for USMC vehicles, and aircraft Corrosion and Corrosivity Monitoring System (C2MS).
- Initiated development of single coat system for ship tanks, USMC vehicle road test methodology, and modular hybrid pier.

FY 2004 Plans:

- Complete the development of single coat systems for ship tanks (ballast tank) and C2MS for aircraft.
- Continue Airframe Corrosion efforts and development of modular hybrid piers, advanced coatings and washdown system, single coat system for ship tanks, road test methodology, and coating database.
- Initiate the development of Nondestructive Inspection (NDI) Technology for aircraft structures.

FY 2005 Plans:

- Complete development of a modular hybrid pier, single coat system for ship tanks (potable water tank), Corrosion Preventive Compounds (CPCs), and NDI technology for corrosion detection for aircraft structures.

- Continue Airframe Corrosion efforts, single coat systems for ship tanks, and road test methodology.
- Initiate the development of single coat systems for Collection-Holding-Transfer (CHT) ship tanks.
- Initiate NDI technology for heat damage detection on composite materials.

	FY 2003	FY 2004	FY 2005
Smart Wiring	2,061	526	0

Smart Wiring is a subset of the Total Ownership Cost (TOC) Future Naval Capability (FNC). Smart Wiring develops flight-qualified smart aircraft wiring system hardware and performs required flight demonstrations. Smart wiring reduces wiring maintenance man-hours, reduces wiring induced mission aborts and non-mission capable hours, and reduces in-flight electrical fires and subsequent loss of aircraft.

FY 2003 Accomplishments:

- Completed transition of Total Oil Monitoring System (TOMS) Oil Condition Monitor to Tech Solution prototype for Portable Fluid Analyzer and smart wires aircraft suitability/requirements analysis.
- Continued smart wiring hardware and software development, lab/bench test analysis, and flight test planning/hardware assessment.

FY 2004 Plans:

- Complete Smart wires flight development/test/certification. Program completes in FY04.

	FY 2003	FY 2004	FY 2005
Littoral Combat	2,997	3,564	4,901

The goal of Littoral Combat is the application of technologies to enhance the ability of the Navy/Marine Corps team to execute the naval portion of a joint campaign in the littorals. This activity considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR), fires, maneuver, sustainment, force protection, and training.

FY 2003 Accomplishments:

- Completed four axis stabilization algorithms enabling EX-45 Stable Gun Mount for smaller USMC craft.
- Continued development and integration of the Position Location Information (PLI) and range instrumentation

system to include After Action Review (AAR) capability.

FY 2004 Plans:

• Continue PLI update, including capability to collect azimuth.
• Initiate development of innovative relays in the areas of wideband communications between command posts and narrowband communications between maneuver elements and their headquarters.

FY 2005 Plans:

• Finalize the PLI system and demonstrate in a scheduled training exercise. Transition to acquisition.
• Complete development of innovative relays in the areas of wideband communications.
• Complete testing of the advanced weapon materials technology efforts on the Expeditionary Fires Support System (EFSS) and the light weight 155mm artillery system.
• Initiate development of a capability to rapidly generate a terrain database for use in simulations for evaluation of maneuver plans.
• Initiate testing of the advanced weapon materials technology efforts on the Expeditionary Fires Support System (EFSS) and the light weight 155mm artillery system.

	FY 2003	FY 2004	FY 2005
Strike Up/Strike Down Selective Offload Systems	3,278	7,047	5,017

This activity produces new techniques and systems to automate transfer of cargo from shipboard unload point to stowage spaces (strike down), and from stowage to offload point for ship-to-ship or shore transit (strike up) during high sea states. New technologies include linear electric drive induction motors, high-strength composites, ship-motion compensation for force control-based systems, intelligent systems, and robotics.

FY 2003 Accomplishments:

• Continued down-selection of promising technologies for carrier/logistics shipboard strike up/strike down.
• Continued mature technology transition plan with Program Executive Office (PEO) Carriers and National Defense Sealift Fund.

FY 2004 Plans:

• Continue focus on maturing technology for automated storage and retrieval for linear electric drive and

maturation of blast mitigation packaging.
• Initiate technology demonstration and testing, linked with Seapower 21 seabasing demonstrations and CVN21 aircraft carrier, for first group of matured capabilities.

FY 2005 Plans:

• Complete technology demo and testing, possibly linked with Seapower 21 seabasing demos.
• Continue technology maturation in linear electric drive with scaled demo in a lab environment.
• Begin 1/4 scale shipboard automated storage and retrieval demo in simulated relevant environment.

	FY 2003	FY 2004	FY 2005
Seabase to Shore Surface Craft	1,873	2,155	3,355

This activity improves the capability for transfer of personnel and cargo between sea base/logistics vessels and unimproved beaches during high sea states. Capabilities being developed include propulsion technologies, cargo stabilization technologies, advanced hull form technologies and fabrication of lightweight robust structures needed for sustained operations at high speed in a moderate seaway.

FY 2003 Accomplishments:

• Completed air flow studies and computational fluid dynamic studies.
• Initiated program; provided hydrodynamic modeling of a new propulsion system for the Heavy Landing Craft Air Cushioned (LCAC), addressing a 50% propulsion plant power increase in the same space.

FY 2004 Plans:

• Continue heavy lift surface transport development and the study of beachable heavy lift surface transport.

FY 2005 Plans:

• Complete design studies and conduct limited prototyping and model basin testing.
• Continue design space trade studies of speed, range, payload, beaching, and at-sea interfaces.
• Initiate technology exploration in hydrodynamic impacts and design space trade studies.

	FY 2003	FY 2004	FY 2005
Underway Replenishment/Material Transfer	937	0	0

These activities were targeted to improve current Underway Replenishment capability for the transfer of cargo between sea base/logistics vessels during high sea states, while increasing ship separation for safety. This is a key capability for indefinite sustainment of the seabase, and interoperability of the Naval task force.

FY 2003 Accomplishments:

• Completed the development of a 12K underway connected replenishment capability with focused investment in algorithm development (mathematical modeling), and responsive controls for heavy loads. Program completed in FY03.

	FY 2003	FY 2004	FY 2005
High Speed Vessel Experiments	281	0	0

This effort is for short term participation in the Joint experimentation with the High Speed Vessel. Seakeeping and Structural data were collected and analyzed.

FY 2003 Accomplishments:

• Completed data collection and analysis. Program completed in FY03.

	FY 2003	FY 2004	FY 2005
At Sea Arrival And Assembly	1,873	4,988	6,676

This effort supports the seabasing mission of marrying troops to equipment, and providing support to seaborne forces via surface distribution interfaces.

FY 2003 Accomplishments:

• Continued modeling and conducted wargame on transition process of new concept into seabasing construction.
• Initiated technology studies through hydrodynamic modeling and seaway motion analysis.

FY 2004 Plans:

• Continue investment and technology development in ship to ship securing systems and seaway cargo handling technologies.
• Initiate work in station keeping for two platforms at sea.

FY 2005 Plans:

• Complete work in station keeping and scale demonstrations in a relevant environment.
• Continue development in ship to ship securing systems and seaway cargo handling technologies.

	FY 2003	FY 2004	FY 2005
Consumption Reduction	0	1,204	4,000

This effort will provide technologies and processes for managing shipboard logistics across the spectrum of the seabased forces, to Navy and Marine Corps logistics needs. Energy production and storage, and advanced materials will form the technology foundation. Intermediate support base activities for rapid runway repair, rapid pier upgrades, and expeditionary gap crossing will be reviewed for technology enhancement opportunities.

FY 2004 Plans:

• Initiate and complete blast mitigation packaging modeling, development, testing, and evaluation.

FY 2005 Plans:

• Initiate technology exploration in advanced basing with reduced lift and manpower demands.

	FY 2003	FY 2004	FY 2005
Logistics Command and Control (C2)	4,712	2,552	2,200

Seabasing will require more robust afloat command and control for sustainment activities. Logistics must integrate with the joint task force common operating picture, and provide awareness of mission supportability and readiness at an operational and tactical level.

FY 2003 Accomplishments:

• Completed Version 2.0 of a beta software system capable of providing ashore based sustainment situational awareness, and project the status onto the legacy common operating picture.
• Continued development of Combat Service Support Tool Kit modules for Logistics Commander ashore.

FY 2004 Plans:

• Complete Combat Service Support Tool Kit software modules for the Logistics Commander ashore.
• Continue planning for software development (FY05) of the afloat component of Naval Sustainment Command and Control.

FY 2005 Plans:

• Complete Version 1.0 of a software product and conduct Beta Testing.
• Continue afloat command and control software for the joint task force command sustainment component.
• Initiate effort to address seaborne asset visibility, lift scheduling, and sustainment component.

	FY 2003	FY 2004	FY 2005
Advanced Shipboard Crane Motion System ATD	697	0	0

The Advanced Shipboard Crane Motion Control System Advanced Technology Demonstration demonstrates a crane control system that combines recent advances in nonlinear control system technologies with existing strategic Auxiliary Crane Ship electro-hydraulic cranes. This technology extends the capability for ship to lighterage transfer of expeditionary warfare logistics to at least 300 containers per day in sea state three.

FY 2003 Accomplishments:

• Completed effort and conducted at sea demonstration, during military exercises, funded by NAVSEA. Program completed in FY03.

C. OTHER PROGRAM FUNDING SUMMARY:
RDT&E:

NAVY RELATED RDT&E:
- PE 0206624M - Marine Corps Combat Services Support
- PE 0601103N - University Research Initiatives
- PE 0601152N - In-House Laboratory Independent Research
- PE 0601153N - Defense Research Sciences
- PE 0602123N - Force Protection Applied Research
- PE 0602236N - Warfighter Sustainment Applied Research
- PE 0603512N - Carrier System Development
- PE 0604703N - Manpower, Personnel, Training, Simulation, and Human Factors
- PE 0605013M – Marine Corps Information Technology Development/MOD
- PE 0605152N - Studies and Analysis Support – Navy

NON NAVY RELATED RDT&E:
- PE 0601102A - Defense Research Sciences
- PE 0602211A - Aviation Technology
- PE 0603003A - Aviation Advanced Technology
- PE 0603007A - Manpower, Personnel and Training Advanced Technology
- PE 0601102F - Defense Research Sciences
- PE 0602203F - Aerospace Propulsion
- PE 0603216F - Aerospace Propulsion and Power Technology

D. ACQUISITION STRATEGY: Not applicable.

FY 2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2004
Exhibit R-2a
BA: 03 PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology
PROJECT NUMBER: R3008 PROJECT TITLE: High Speed Sealift Vessel

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
R3008 High Speed Sealift Vessel	20,400	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFCATION:
The High Speed Vessel project develops technology to enable a future generation of fast ships for rapid movement of military payloads from Continental United States (CONUS) to theater as well as within theater. Speeds of up to 70 knots will be considered in the design. Increased payload fraction and reduced friction drag are key technical objectives. Technologies to be demonstrated include advanced hull forms, drag reduction, power dense propulsion, and high strength-to-weight ratio structural materials.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
High Speed Vessel	20,400	0	0

Within the Naval Transformation Roadmap, this investment will support the achievement of Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing.

FY 2003 Accomplishments:

• Completed hydrodynamic testing system for high speed vessels which can conduct hydrodynamic drag and lift testing at appropriate fluid velocities and evaluate potential drag reduction approaches. Program completed in FY03.

C. OTHER PROGRAM FUNDING SUMMARY:
RDT&E:

NAVY RELATED RDT&E:
PE 0601153N - Defense Research Sciences
PE 0602123N - Force Protection Applied Research
PE 0603123N - Force Protection Advanced Technology

PE 0603758N - Navy Warfighting Experiments and Demonstrations

D. ACQUISITION STRATEGY: Not applicable.

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

Exhibit R-2a

BA: 03 PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology

PROJECT NUMBER: R9150 PROJECT TITLE:Integrated Aircraft Health/On-Line Electro-Hydrodynamic Filter

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
R9150 Integrated Aircraft Health / On-Line Electro-Hydrodynamic Filter	1,625	7,132	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFCATION:

The Interactive Multisensor Analysis Training (IMAT) project is aimed at improving the preparation of operational users of undersea-warfare sensor systems. IMAT provides exploratory environments in which operators and tacticians examine the effects of change in any of the variables involved in the end-to-end sequence of emission, transmission, reflection, and detection. Sensor settings, environmental conditions and target characteristics can all be modified through a "what-if" simulation approach. The effort focuses on training technology at the battlegroup, fleet and theater level.

Note: Integrated Aircraft Health (FY 2003 $1,625, FY 2004 $2,521) and On-line Electro-Hydrodynamic Filter (FY 2004 $2,967) are discussed in the Congressional Plus-Up section.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Interactive Multisensor Analysis Training (IMAT)	0	1,644	0

Interactive Multisensor Analysis Training (IMAT) project will develop improved training technologies for anti-submarine warfare (ASW) in support of Sea-Warrior, Sea-Shield, and Pacific Fleet requirements.

FY 2004 Plans:

• Initiate and complete the development and application of IMAT techniques for visualization-based training (VISTRA).

C. OTHER PROGRAM FUNDING SUMMARY:
RDT&E:

NAVY RELATED RDT&E:
PE 0206624M - Marine Corps Combat Services Support
PE 0601103N - University Research Initiatives
PE 0601152N - In-House Laboratory Independent Research
PE 0601153N - Defense Research Sciences
PE 0602236N - Warfighter Sustainment Applied Research
PE 0604703N - Manpower, Personnel, Training, Simulation, and Human Factors
PE 0605152N - Studies and Analysis Support – Navy

NON NAVY RELATED RDT&E:
PE 0601102A - Defense Research Sciences
PE 0603007A - Manpower, Personnel and Training Advanced Technology
PE 0601102F - Defense Research Sciences

D. ACQUISITION STRATEGY: Not applicable.

CONGRESSIONAL PLUS-UPS:

R9021	FY 2003	FY 2004
LOW VOLUME PRODUCTION PROGRAM	2,826	0

Developed the capability to repair massive defective parts (possibly no longer manufactured or available as spares) without the need for expensive and time-consuming reverse engineering. This could increase the life cycle and performance of expensive new parts via protective claddings using laser weld technology.

R9023	FY 2003	FY 2004
COMMERCIAL OFF THE SHELF (COTS) CARBON FIBER QUALIFICATION PROGRAM	1,433	1,978

This effort is developing a high volume manufacturing technique for production of intermediate modulus (IM) carbon fibers that will be incorporated into strong lightweight polymer composites. This material will enable the development of advanced, lightweight, long-range Navy aircraft such as the Joint Strike Fighter.

R9147	FY 2003	FY 2004
DEFENSE SYSTEMS MODERNIZATION AND READINESS INITIATIVE	3,812	1,978

Conduct systems modernization, readiness assessment and tracking in four specific focus areas Material Aging; Life Cycle Engineering & Economic Decision System; Asset Health Management; and Reliability, Availability & Maintainability Initiative. The efforts will improve the longevity of the Navy's EA6B and F14 programs, as well as the Marine Corps Light Armored Vehicle (LAV). Additionally, ONR will leverage this work as part of an ongoing conversion of an advanced seaborne craft and the forthcoming design of a fast catamaran.

R9148	FY 2003	FY 2004
FOR EMERGING/CRITICAL INTERCONNECTION TECHNOLOGIES PROGRAM (E/CIT)	952	3,461

The E/CIT serves as a focus for DoD to work with the U.S. electronic interconnection industry. The E/CIT facilitates solutions to current military problem areas as well as evaluating new leading edge design and manufacturing technologies for both future military and commercial requirements prior to adoption by printed circuit board manufacturers.

R9149	FY 2003	FY 2004
ENERGY AND ENVIRONMENTAL TECHNOLOGY	3,255	4,203

This effort conducts research into fuel cell technologies and methane hydrates. The research is conducted in partnership with the Hawaii Energy and Environmental Technology Initiative (HNEI). The design, development and application of fuel cell systems and the exploration of sea-floor mehane hydrate resources will benefit Navy specific transportation needs such as undersea sensors and remotely operated vehicle power requirements.

R9150	FY 2003	FY 2004
INTEGRATED AIRCRAFT HEALTH	1,625	2,521

This add develops data interoperability software tools, diagnostic algorithms, and processes to ensure improved affordability and safety through the application of Integrated Aircraft Health Management (IAHM) practices, applicable to both manned and unmanned aircraft.

R9150	FY 2003	FY 2004
ON-LINE ELECTRO-HYDRODYNAMIC FILTER	0	2,967

This add supports the On-line Electro-hydrodynamic filter.

R9151	FY 2003	FY 2004
WIRE CHAFFING DETECTION TECHNOLOGY	1,332	0

Decaying, aged wiring is an insidious and usually unseen problem to aircraft maintainers and operators. With most aircraft wiring hidden from view, an enabling technology to detect wiring faults prior to electrical malfunction is urgently needed. Wiring defects are most often initially manifested by chaffing, followed by cumbersome, costly and time consuming repair. To counter this reality, this program investigated, developed, demonstrated and transitioned technology to detect the onset of wire chaffing in aircraft wiring and wiring harnesses.

R9318	FY 2003	FY 2004
AUTOGEN	0	2,967

This add is to support the commercialization phase to parallelize multi-processor driven applications for next generation shipbuilding.

R9319	FY 2003	FY 2004
AUTOMATIC CONTAINER AND CARGO HANDLING SYSTEM	0	1,978

This add is to produce a scaled demonstration of a multi-point control system and mast system for cargo transfer of containers at sea, in up to sea state 5.

R9320	FY 2003	FY 2004
EXPEDITIONARY LOGISTICS SOFTWARE DEVELOPMENT	0	989

This add is to produce a working prototype of a software prognostic vehicle health monitoring system, focused on the engine and drive train, and accurately forecast readiness posture.

R9321	FY 2003	FY 2004
EXTREME ENVIRONMENT URBAN WARFARE RESEARCH	0	989

This add is to support Extreme Environment Urban Warfare Research.

R9321	FY 2003	FY 2004
FLIGHT/HANGER DECK CLEANER IMPROVEMENTS	0	2,522

This add is to develop a full scale prototype of a deck scrubber for Naval platform flight decks, suited for removing oils and exhaust without damage to the non-skid deck plate and with low environmental disposal impact.

R9323	FY 2003	FY 2004
IMPRINT	0	989

This add continues work to enhance an Army-developed IMPRINT system to support human factors engineering in large-scale Navy platforms and applications. Navy-unique stressors such as ship motion and sea sickness will be added and case studies undertaken to address application of the Navy's Systems Engineering, Acquisition and Personnel Integration (SEAPRINT) in an ongoing acquisition program.

R9324	FY 2003	FY 2004
NAVAL MAINTENANCE MANAGEMENT	0	989

The focus of this add is to streamline required maintenance and predict failures so prevention maintenance can be performed.

R9326	FY 2003	FY 2004
PHOTONIC MACHINING APPLICATIONS	0	989

This add supports Photonic Machining Applications.

R9327	FY 2003	FY 2004
REDUCTION OF CATAPULT POST-RETRACTION EXHAUST DISCHARGE	0	989

This add supports the development of a dry lubricant for aircraft carrier catapult hardware and combines this technology with the capability to wirelessly monitor the health of the components lubricated.

R9328	FY 2003	FY 2004
TITANIUM MATRIX COMPOSITES PROGRAM	0	1,780

This add is to develop a lightweight produceable composite metal for key components of the joint strike fighter, to include possible candidates of the engine and hook components.

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

BA: 03 PROGRAM ELEMENT: 0603271N
PROGRAM ELEMENT TITLE: RF Systems Advanced Technology

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
R2913 RF Systems Advanced Technology	60,430	44,933	44,046	53,105	53,226	54,323	55,459
R9152 Common Affordable Radar Processor	4,060	5,933	0	0	0	0	0
R9153 E-2C Technical Upgrade for Optimized Radar	6,483	0	0	0	0	0	0
R9329 APY-6 REAL TIME PRECISION TARGETING RADAR	0	4,945	0	0	0	0	0
R9330 HIGHLY MOBILE TACTICAL COMMUNICATIONS	0	1,682	0	0	0	0	0
R9331 REMOTE OCEAN SURVEILLANCE SYSTEM (ROSS)	0	2,076	0	0	0	0	0
R9332 SCOUT (LPI) SURVEILLANCE RADAR DEMONSTRATION	0	2,472	0	0	0	0	0
Totals	70,973	62,041	44,046	53,105	53,226	54,323	55,459

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Work in this Program Element (PE) addresses technologies critical to enabling the transformation to network centric warfare which utilizes multiple, simultaneous and continuous communications/data links between platforms while simultaneously performing the functions of Electronic Warfare (EW) and radar surveillance. The Radio Frequency (RF) Systems Advanced Technology Program addresses RF technology for Surface and Aerospace Surveillance sensors and systems, Electronic Warfare sensors and systems, RF Communication Systems, and Multi-Function sensor systems. The program emphasizes near to mid-term transition opportunities by developing and demonstrating technologies which enable options for Time Critical Strike, Missile Defense, Fleet Force Protection, and Knowledge Superiority and Assurance Future Naval Capabilities (FNC). Within the Naval Transformational Roadmap, this investment will achieve transformational capabilities required by: “Sea Shield” Theater Air and Missile Defense; as well as technically enable “Sea Strike” Persistent Intelligence, Surveillance, and Reconnaissance

(ISR).

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	74,433	45,475	36,571
Cong. Rescissions/Adjustments/Undist Reductions	0	-734	0
Congressional Actions	0	17,300	0
Execution Adjustments	-368	0	0
Inflation Savings	0	0	-118
Manpower Adjustments	0	0	-56
Rate Adjustments	0	0	-58
SBIR Assessment	-3,092	0	0
Technical Adjustments	0	0	7,707
FY 2005 President's Budget Submission	70,973	62,041	44,046

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

BA: 03 PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF Systems Advanced Technology
PROJECT NUMBER: R2913 PROJECT TITLE: RF Systems Advanced Technology

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
R2913 RF Systems Advanced Technology	60,430	44,933	44,046	53,105	53,226	54,323	55,459

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Radio Frequency (RF) Systems Advanced Technology project addresses technologies critical to enabling the transformation to network centric warfare which utilizes multiple, simultaneous and continuous communications/data links between platforms while simultaneously performing the functions of Electronic Warfare (EW) and radar surveillance. Work in this project addresses RF technology for Surface and Aerospace Surveillance sensors and systems, Electronic Warfare sensors and systems, RF Communication Systems, and Multi-Function sensor systems. The project emphasizes near to mid-term transition opportunities by developing and demonstrating technologies which enable options for Time Critical Strike, Missile Defense, Fleet Force Protection, and Knowledge Superiority and Assurance Future Naval Capabilities (FNC). Within the Naval Transformational Roadmap, this investment will achieve transformational capabilities required by: "Sea Shield" Theater Air and Missile Defense; as well as technically enable "Sea Strike" Persistent Intelligence, Surveillance, and Reconnaissance (ISR).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Advanced Multi-Function RF Technology	24,264	18,310	22,588

Advanced Multi-function Radio Frequency (AMRF) Technology emphasizes development, demonstration and transition of wideband, high performance multifunction radio frequency (RF) apertures capable of transmitting and receiving multiple, simultaneous, independent RF beams while providing reduced signature and numbers of apertures. AMRF Systems Technology developments directly support the Department of Defense Joint Warfighter Science and Technology Plan and the Defense Technology Area Plans. Efforts within this activity have attributes that focus on enhancing the affordability of warfighting systems.

FY 2003 Accomplishments:

- The Advanced Multi-function Radio Frequency Concept (AMRF-C) effort completed integration and testing of a wideband multi-function Communication and Electronic Warfare (EW) testbed.
- The AMRF-C effort demonstrated multiple simultaneous communication links with simultaneous EW receive and transmit functions which evaluated testbed functionality and quantified an initial set of performance metrics and characteristics.
- The AMRF-C effort, within the testbed, evaluated and documented multifunction system efficiencies while executing simultaneous transmit/receive functions. Evaluated functions included system resource management with system scheduling, conflict resolution, and adaptive response to changing operations and environments. Effort also evaluated isolation characteristics and interference issues that occur when conducting simultaneous functions using shared/common system elements. These metrics are now available to serve as design guidelines for Multi-function RF system architectures.

FY 2004 Plans:

- The AMRF-C effort will initiate development of a multi-function system capable of demonstrating integrated communications and EW.
- The AMRF-C effort will include initial designs for wideband transmitter technology with power and linearity sufficient to support communications, EW and limited radar functions.
- The AMRF-C effort will continue operation of the wideband multi-function Communications and EW testbed in support of multi-function system development and multi-function technology insertion and demonstration.

FY 2005 Plans:

- The AMRF-C effort will complete demonstrations of the communications and electronic warfare testbed.
- Initiate integration of sub-array and subsystem components to demonstrate a scaled multi-function RF system capable of meeting the RF requirements for Communications and EW functions.
- Initiate prototype efforts for DD-X Electronic Warfare implementation.

	FY 2003	FY 2004	FY 2005
Radio Communications RF Advanced Technology	21,459	17,439	13,586

Radio Communications Radio Frequency (RF) Technology addresses critical naval communications technology deficiencies and needs that are not addressed by the commercial technology sector. The activity’s goal is enabling network-centric operations by addressing high-bandwidth, reliable interoperable communications at all

levels of command and technology to enable rapid and reliable utilization of government and commercial telecommunication assets worldwide.

FY 2003 Accomplishments:

- Continued at sea testing and evaluation of an S-Band receive phased array.
- Continued development of prototype demonstration hardware for a dual frequency, electronically steered X/Ku-Band RF Communications phased array to provide tactical data link connectivity to theater assets and initiated sub system integration.
- Continued the development of a K/Ka/Q-Band phased array electronically steered aperture.
- Continued the development of the Naval Battleforce Network (NBN), and integrated: the airborne communications with multi-beam, multi-frequency antenna package; littoral mobile wireless networking, and composite routing technologies into the NBN.
- Continued development and initiated fabrication of an Integrated Very High Frequency (VHF)/Ultra High Frequency (UHF)/L-Band (IVUL)aperture.

FY 2004 Plans:

- Complete integration and performance evaluation of the S-Band receive phased array and transition into the Naval Fires Network.
- Continue prototype hardware development and demonstration for a dual frequency, electronically steered X/Ku-Band RF Communications aperture to provide tactical data link connectivity to theater assets and transition to the NAVSEA Command.
- Continue fabrication and assembly of a K/KA/Q-Band phased array aperture, and begin initial test and evaluation to verify performance and operating characteristics.
- Continue development and integration of the NBN.
- Continue development, demonstration and performance characterization of the integrated IVUL prototype antenna.
- Initiate development of Next Generation Buoyant Cable Antenna (NGBCA) advanced development unit for submarine applications.

FY 2005 Plans:

- Complete demonstration of dual frequency, electronically steered X/Ku-Band RF communications aperture and transition to the Naval Sea Systems Command (NAVSEA).
- Complete fabrication and assembly of a K/KA/Q-Band phased array aperture, conduct demonstrations to

characterize performance and operational utility and develop transition plans.
- Continue integration and begin initial testing and evaluation of the fully integrated NBN.
- Continue demonstration and performance optimization of the integrated IVUL prototype antenna.
- Continue development of NGBCA advanced development demonstration unit.

	FY 2003	FY 2004	FY 2005
Surface and Aerospace Surveillance Advanced RF Systems	14,707	9,184	7,872

Surface and Aerospace Surveillance Advanced RF Systems address development of sensor technologies and systems for transition into new and existing naval platforms. The technology activity focuses on providing the Navy with high performance affordable surveillance systems that are responsive to identified naval needs for real time situational awareness, long range target detection, discrimination, identification, tracking and targeting of air and surface threats in all operating conditions.

FY 2003 Accomplishments:

- Completed the Advanced Signal Processing (ASP) effort resulting in hardware for the Radar Modernization Program (RMP) demonstration and evaluation.
- Within the Missile Defense (MD) FNC, Affordable Ground Based Radar (AGBR) effort, began fabrication of an advanced development model (ADM) radar for demonstration prior to the USMC Multi-Role Radar System (MRRS) Milestone B decision in FY 2005 timeframe.
- Under the Time Critical Strike (TCS) FNC, due to a change in program requirements, re-configured the design of the Precision Surveillance and Targeting (PS&T) radar from the previous pod-mounted configuration for F/A-18 carriage to an internal carriage configuration for time critical targeting demonstrations on board the Navy’s Global Hawk Broad Area Maritime Surveillance (BAMS) Unmanned Airborne Vehicle (UAV). The PS&T radar system is based on previously developed AN/APY-6 technology.

FY 2004 Plans:

- Within the MD FNC AGBR effort, complete fabrication and begin testing of an ADM radar for insertion into the USMC MRRS development program.
- Within the TCS FNC, continue development of a flyable PS&T radar system for integration and time critical targeting demonstrations aboard the Navy’s Global Hawk BAMS UAV.

FY 2005 Plans:

- Within the MD FNC AGBR effort, complete testing of an ADM radar for the USMC Multi-Role Radar System development program in anticipation of a Milestone B decision in FY 2005.
- Within the TCS FNC, continue development of a flyable PS&T radar system for integration and time critical targeting demonstrations aboard the Navy's Global Hawk BAMS UAV.
- Conduct system architecture and design studies for an advanced development model S-Band Digital Array Radar (DAR) for the next generation "CG" surface combatant.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0204152N (E-2 Squadrons)
PE 0601153N (Defense Research Sciences)
PE 0602271N (RF Systems Applied Research)
PE 0602123N (Force Protection Applied Research)
PE 0603123N (Force Protection Advanced Technology)
PE 0602235N (Common Picture Applied Research)
PE 0603235N (Common Picture Advanced Technology)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0603640M (Marine Corps Advanced Technology Demonstration)

NON-NAVY RELATED RDT&E: Not applicable

D. ACQUISITION STRATEGY: Not applicable

CONGRESSIONAL PLUS-UPS:

R9152	FY 2003	FY 2004
COMMON AFFORDABLE RADAR PROCESSOR (CARP)	4,060	5,933

FY 03 funds focused on the development of advanced processor technology to enable Navy radar system contact and track information to be converted to digital formats at the output of the radar array for subsequent routing and distribution to operator displays and combat systems using commercial information protocol interfaces, data transfer standards and processes. FY04 funds will be used to make a form fit phase III data distribution module and conduct demonstration.

R9153	FY 2003	FY 2004
E-2C TECHNICAL UPGRADE FOR OPTIMIZED RADAR	6,483	0

Funds developed a state of technology radar system/technology testbed concept which supports development and maturation of advanced technology enablers for the next generation E-2C Airborne Early Warning Radar system.

R9329	FY 2003	FY 2004
APY-6 REAL-TIME PRECISION TARGETING RADAR	0	4,945

The program will update the current AN/APY-6 with a wideband surface mode, increase the number of test flight hours and add additional software for surface target identification.

R9330	FY 2003	FY 2004
HIGHLY MOBILE TACTICAL COMMUNICATIONS	0	1,682

The program will integrate Iridium satellite communications with current Expeditionary Maneuvering Warfare (EMW) Line-of-sight terrestrial tactical communication systems, and provide a demonstration of this Iridium tactical communication overlay technology.

R9331	FY 2003	FY 2004
REMOTE OCEAN SURVEILLANCE SYSTEMS (ROSS)	0	2,076

The program will develop electro-optic technology for wide area surveillance in maritime environments.

R9332	FY 2003	FY 2004
SCOUT (LPI) SURVEILLANCE RADAR DEMONSTRATION	0	2,472

The program will initiate modifications to the timing and waveform subsystem for high resolution modes for the Scout radar system.

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

BA: 03 PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: USMC Advanced Technology Demonstration (ATD)

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
C2297 CMC Warfighting Lab-Core	43,493	41,345	36,431	37,492	35,594	36,727	37,503
C9154 MC Anti-Terrorist/Force Protection (AT/FP) ATDs	4,206	15,023	0	0	0	0	0
R2223 Marine Corps ATD	16,144	18,475	21,791	23,014	23,799	24,537	25,043
R2362 Extended Littoral Battlespace	856	0	0	0	0	0	0
R2995 California Central Coast Research Partnership (C3RP)	2,931	3,857	0	0	0	0	0
R9167 Man-Portable Quadrople Resonance Landmine Detection	0	3,500	0	0	0	0	0
R9290 Expeditionary Water Purification Technology	5,977	5,537	0	0	0	0	0
R9333 CENTER OF EXCELLENCE FOR ROBOTICS, ADV TECH DEMO	0	1,384	0	0	0	0	0
R9334 RAPID REPAIR, PORTABLE PRODUCTION (R2P2)	0	989	0	0	0	0	0
Totals	73,607	90,110	58,222	60,506	59,393	61,264	62,546

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: As the land warfare component of Naval Expeditionary Forces, the Marine Corps has unique and technologically stressing requirements resulting from its amphibious mission, Marine Air-Ground Task Force (MAGTF) organizational structure, reliance on maneuver, logistic sustainability, and intensive tempo of operations in diverse environments. Critical Marine Corps requirements addressed in this program element (PE) are Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), Maneuver, Logistics, Human Performance, Training and Education, Firepower, and Mine Countermeasures (MCM). These are ongoing efforts to develop and demonstrate advanced

technologies and system concepts in an operational environment. Multiple transitions into the Sub-system/Component Advanced Development phase are planned, as well as fieldable prototyping to reduce risk in System Concept Development and Demonstration. Joint service efforts are in line with Defense Technology Objectives (DTOs) and Joint Warfighting Objectives (JWOs). In addition, Marine Corps operational experimentation, warfighting concept experimentation, and conceptual operational assessment of emerging technologies are funded. This PE also provides Extended the Littoral Battlespace efforts in the area of command, control, communications, computers, and intelligence (C4I), and fires and targeting. Efforts focus on connectivity between MAGTF and Fleet organizations and naval sea-based fire support. Specifically, this PE supports the following capabilities: promptly engaging regional forces in decisive combat on a global basis; responding to all other contingencies and missions in the full spectrum of combat operations (high, mid, and low intensity), in Military Operations in Urban Terrain (MOUT), in Operations Other than War (OOTW), and warfighting experimentation. This PE supports all of the Marine Corps mission areas. Within the Naval Transformation Roadmap, this investment will achieve one of three key transformational capabilities required by Sea Shield as well as technically enable the Ship to Objective Maneuver (STOM) and Persistent ISR key transformational capabilities within Sea Strike and the enhanced Sea-borne Positioning of Joint Assets within Sea Basing.

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	74,970	56,404	58,446
Cong. Rescissions/Adjustments/Undist.Reductions	0	-757	0
Congressional Actions	0	34,474	0
Execution Adjustments	28	0	0
Inflation Savings	0	0	-188
Rate Adjustments	0	-11	-36
SBIR Assessment	-1,391	0	0
FY 2005 President's Budget Submission	73,607	90,110	58,222

PROGRAM CHANGE SUMMARY EXPLANATION:

Technical: C2297, Marine Corps Warfighting Laboratory (MCWL): FY 2003 controls contain an increase of $1.799M for the Spike program, a very small, low cost, man-packable, fire and forget guided missile and launcher system. Funding was used to prepare hardware/software for programmed missile test firings.

Also, since the FY 2004/2005 President's Budget submission, MCWL has reorganized reporting categories to better group/display like efforts and become more in line with the overarching Experimental Campaign Plan (ECP). In addition, experimentation goals for the Sea Viking 2004 (SV04) Advanced Warfighting Experiment (AWE) have been revised, as explained in the two following paragraphs.

MCWL's Sea Viking campaign is designed to transform the 1997 Ship to Objective Maneuver (STOM) concept into an operational reality. The first phase of this campaign, SV04, was initially focused at the Marine Expeditionary Unit (MEU) level. In May 2003 the Commandant of the Marine Corps refocused SV04 to a Marine Expeditionary Brigade (MEB) conducting Operational Maneuver from the Sea (OMFTS). Then late in 2003, the First Marine Expeditionary Force (I MEF) was assigned the mission of returning to Iraq as part of Operation Iraqi Freedom II (OIF II). The scope of I MEF's deployment precludes West Coast experimentation in 2004. However, MCWL's development of experimental technologies that enable today's commander to develop future operating concepts led to an intersection of current requirements and future capabilities. As a result, SV04 experimentation will now occur in theater with deployed I MEF forces. Experimentation will focus on tactical-level "on the move/over the horizon" (OTM/OTH) communications with the embedded position location indication (PLI) required to build a common tactical picture. These are key capabilities required to execute seabased OMFTS and STOM operations and the lessons learned will support follow-on experimentation in SV06.

Schedule: C2297, Marine Corps Warfighting Laboratory (MCWL): Due to OIF campaigns, I MEF elements anticipated experimentation availability for SV04 has become tenuous. Efforts are underway to reschedule and adjust events leading up to SV04 AWE to accommodate troop availability.

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

BA: 03 PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: USMC Advanced Technology Demonstration (ATD)
PROJECT NUMBER: C2297 PROJECT TITLE: CMC Warfighting Lab-Core

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
C2297 CMC Warfighting Lab-Core	43,493	41,345	36,431	37,492	35,594	36,727	37,503

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Marine Corps Warfighting Laboratory (MCWL) is the centerpiece experimental test bed for the operational enhancements of the Marine Corps. Using the Special Purpose Marine Air-Ground Task Force (Experimental) (SPMAGTF(X)), augmented by other Marine units, as its "test bed" organization, MCWL demonstrates the usefulness and necessity of integrating advanced concepts and new technological developments into the Operational Forces of the Marine Corps. Performing in the joint, as well as Marine Corps service arena, MCWL focuses on developing, assessing, and field evaluation of future operational and technological concepts and serves as the focal point for the enhancement/refinement of future warfighting capabilities.

Real-time exercises held in existing environments being used to simulate campaign theater (wartime) experiences "live experimentation" permits exploration of prototype and surrogate technologies in order to better refine equipment requirements and to identify Doctrine, Organization, Training, Material, Leadership, Personnel, and Facilities (DOTMLPF) initiatives needed to produce future capabilities. The use of modeling and simulation (M&S), both conducted within service wargaming and virtual experiment venues (conducted in partnership with the Navy and Joint Forces Command (JFCOM)) will provide both a necessary joint context for the Marine Corps Expeditionary Force Development System process as well as the opportunity to explore the implications of proposed future programs on seabased power projection capabilities. MCWL experimentation encompasses inquiries into multiple warfighting areas, including: Command, Control, Communications, and Computers (C4); Intelligence, Surveillance, and Reconnaissance (ISR); Fires, Targeting, and Maneuver; Seabasing, Logistics, Combat Service Support (CSS), and Combat in Cities; and Warfighting Excellence.

Using operational forces, MCWL conducts Advanced Warfighting Experiments (AWEs) supported by Limited Objective Experiments (LOEs), Limited Technology Assessments (LTAs), Wargames, and Studies. AWEs, LOEs, and LTAs examine discrete variables in as much isolation as can be achieved. Technologies assessed in LTAs are incorporated in LOEs while LOEs are building blocks from which resulting AWEs are constructed. Detailed descriptions are provided below:

- An AWE is defined as a larger scale operational experiment where advanced warfighting capabilities and enabling technologies are evaluated to determine the military utility, operational effectiveness and operational suitability in as realistic an environment as possible (e.g. Sea Viking 2004 (SV04)).
- LOEs are smaller in scope than AWEs and focus on a discrete set of closely related experiment objectives. LOEs are designed to answer questions that, if left unanswered, would have a significant adverse impact on the successful execution of experimental operations in the related AWE.
- LTAs are oriented on the performance characteristics of specific tactics, techniques, technologies, and procedures (TTTPs) to assess their usefulness by means of analysis or experimentation. MCWL conducts LTAs in cases where the performance characteristics of developing TTTPs are insufficiently documented to conduct operational planning necessary for experimentation.
- A Wargame is a broad discipline manifested in a range of activities from a few individuals conducting Action-Reaction-Counteraction drills to a significant commitment from Operating Forces, Headquarters, Marine Corps (HQMC), and Marine Corps Combat Development Command (MCCDC) Staffs, JFCOM, and other services to execute a Command Post Exercise (CPX) that may also be supported by M&S. A Wargame is integral to MCWL's experimental process and ideally precedes the execution of LOEs and the AWE in order to refine the Experimentation Plan.
- A Study is a low-cost (relative to operational experimentation) technique designed to result in broader or deeper research into an experimental issue. MCWL undertakes a study when a literature search reveals that existing studies are inadequate to support experiment objectives and synthesis is required and is focused on one or a few closely related experiment issues.

Under the guidance of the Experimental Campaign Plan (ECP) (formerly known as the Five Year Experimentation Plan (FYEP)), MCWL's prior accomplishments and current plans include AWE "build-up" phases culminating in actual AWE execution:

- Millennium Challenge 2002 (MC02): (FY 2001 through FY 2002) Congressionally mandated, Secretary of Defense directed, United States JFCOM sponsored joint field experiment. (MCWL participation referred to as "Millennium Dragon"). MC02 was a large-scale, live, virtual, and constructive joint field experiment and demonstration, incorporating elements of all the Services and Special Operations Command (SOCOM) critical future warfighting capabilities and forces at the operational level of war.
- Sea Viking 2004 (SV04)(formerly known as Olympic Dragon): (FY 2002 through calendar year (CY) 2004) SV04 is a series of related events that constitute the overall Marine Corps Service Experimentation campaign through 2004. Its goals and objectives are based on the Commandant of the Marine Corps' guidance. While the Commanding General of the MCWL will exercise overall control over the experiment, its initial phases (experiment definition) will rely heavily on "external" support and input (HQMC, Operating Forces, Expeditionary Force Development Center (EFDC), Navy). The experiment will focus on the seabased Marine Expeditionary Brigade (MEB), emphasizing execution of the Operational Maneuver From the Sea (OMFTS) and Ship

to Objective Maneuver (STOM) concepts, in a Joint context. SV04 has been designated as a Naval Sea Trial event and will be conducted in a joint context.
- Sea Viking 2006 (SV06): (FY 2005 through FY 2006) Because SV04 was refocused to conduct experimentation as part of a real world deployment, SV06 will build on the results, findings, and events of SV04, but will be the first opportunity to examine a true seabased capability within the context of emerging Joint concepts. SV06 will use an integrated "campaign" approach, be a key component of the Navy's Sea Trial process, and fully support the Naval Transformation Roadmap. SV06 constitutes the principal exploratory effort into development of the future capabilities required for realization of the Naval Operational and Enhanced Network Seabasing concepts. It will also explore emerging seabased Command and Control (C2) capabilities involving distributed, collaborative planning, and execution. In addition to continuing to examine fires and maneuver C2, SV06 will also focus on logistic C2, involving a combination of amphibious and future maritime prepositioning ships, while also exploring the utility of the Joint High Speed Vessel (JSHV). In exploring the seabase, such issues as: seabased fires -- as an integral part of joint fires; at sea arrival and assembly; strike-up/strike-down techniques; and various applications of "sense and respond" portal technologies -- for adaptive logistics capitalizing on autonomic logistics features – will be addressed in support of the operating forces conducting operational maneuver from the seabase.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Command, Control, Communications, Computers (C4)	9,541	8,965	8,463

This section encompasses all Marine Corps Warfighting Laboratory (MCWL) C4 related experimentation efforts.

FY 2003 Accomplishments:

- Initiated experimental planning and C4 development to support the Sea Viking 2004 (SV04) Advanced Warfighting Experiment (AWE).
- Continued to develop information processing and further integration of capabilities into the Command and Control Integration (CCI) (formerly known as Integrated Marine Multi-Agent Command and Control System (IMMACCS)) and the C4 Lab facility.
- Continued to develop enhanced capability for Shared Net and Graphical User Interface (GUI) communications/situational awareness technologies.
- Conducted experiments and evaluated the performance of advanced command and control (C2) investigations and experiments for sea based C2.
- Continued to evaluate the effectiveness of commercially available (off-the-shelf) technology for providing

wireless connectivity to the tactical level.
- Continued/expanded alternative Over The Horizon (OTH) communications technology investigations.
- Initiated efforts to constitute an On The Move (OTM)/Digital Combat Operations Center (DCOC) capability.
- Expanded experimentation and integration of the intra-squad radio systems.

FY 2004 Plans:

- Provide C4 support for the SV04 AWE.
- Continue to develop information processing and further integration of capabilities into the C4 Lab facility.
- Conclude CCI integration and experimentation, to include Shared Net and GUI efforts.
- Continue to conduct experiments and evaluate the performance of advanced C2 investigations and experiments for sea based C2.
- Continue to evaluate the effectiveness of commercially available (off-the-shelf) technology for providing wireless connectivity to the tactical level.
- Continue OTH communications investigations in support of First Marine Expeditionary Force (I MEF) Operation Iraqi Freedom (OIF) II deployment.
- Continue efforts to constitute an OTM/DCOC capability.
- Investigate collaborative planning capabilities. Investigate tactics, techniques, technologies, and procedures (TTTPs) of a Navy/Marine seabased Combat Operational Center (COC).
- Conclude experimentation and development of intra-squad radio systems.

FY 2005 Plans:

- Conclude C4 support for the SV04 AWE and initiate C4 support for the SV06 AWE.
- Continue to develop information processing and to further integrate capabilities into the C4 Lab facility.
- Continue to conduct experiments and evaluate the performance of advanced C2 capabilities to support sea based C2 interoperability.
- Continue to evaluate the effectiveness of commercially available (off-the-shelf) technology for providing wireless connectivity to the tactical level.
- Continue OTH communications investigations.
- Continue to investigate collaborative planning capabilities.
- Continue to investigate TTTPs of a Navy/Marine seabased COC.
- Continue development and experimentation of OTM/DCOC capability.
- Initiate investigation of TTTPs to achieve common tactical picture (CTP) for Marine Expeditionary Brigade (MEB) conducting OMFTS.
- Initiate investigation of TTTPs for fires C2 in order to simplify operations/training and enhance

interoperability of Joint, Navy, and Marine Corps systems.

	FY 2003	FY 2004	FY 2005
Marine Corps Warfighting Laboratory (MCWL)Operations (Support)	8,378	8,057	8,294

MCWL Operations (Support) efforts include overall MCWL experimentation doctrine, planning, analysis, data collection, as well as transition efforts.

FY 2003 Accomplishments:

- Continued Sea Viking 2004 (SV04) planning focused on enhancing the capabilities of a deploying Expeditionary Strike Group (ESG)/Marine Expeditionary Brigade (MEB).
- Examined programs of record (POR) and experimental technologies developed with an eye toward achieving a significantly more capable force in support of Operational Maneuver from the Sea (OMFTS).
- Continued Strategic Planning through the location, development, and evaluation of advanced warfighting operational and organizational concepts and related enabling technologies.
- Continued providing technical, strategic, and managerial support to the Marine Corps.
- Continued development and integration of Marine Corps Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) recommendations. Synthesized results and lessons learned into proposed tactics, techniques, and procedures (TTPs) for the Marine Corps and expanded investigations into transition avenues for maturing tactics, techniques, technologies, and procedures (TTTPs).
- Continued Science and Technology Operations Information Center (STOIC) development, an Information Management Database System used to support MCWL.
- Continued to provide overall analysis and reporting of experimentation efforts.
- Continued to support tactical instrumentation capability that provides battlespace instrumentation for experimentation. Continued effort to improve upon the automated data collection system. Initiated Integrated Global Positioning System (GPS) Radio System (IGRS) II data collection efforts.

FY 2004 Plans:

- Conclude SV04 and initiate Sea Viking 2006 (SV06) Advanced Warfighting Experiment (AWE) planning and technology investigations.
- Maintain Strategic Planning efforts.
- Continue to synthesize results and lessons learned into proposed DOTMLPF recommendations for the Marine Corps. Continue pursuing transition avenues for maturing TTTPs.

- Continue to provide technical, strategic, and managerial support to Marine Corps Experimentation.
- Complete Science and Technology (S&T) Common Operational Picture (COP) (formerly known as STOIC) development, focusing on linking S&T communities.
- Maintain overall analysis and reporting of experimentation efforts, analytical experimental design support, and a capability to provide ad-hoc analysis support as required. Continue tactical instrumentation and IGRS II data collection/reconstruction efforts.
- Initiate development of an experimental effort that allows IGRS II to become an On The Move (OTM), beyond line of sight (Over The Horizon (OTH)) blue force tracking capability; serving both tactical position location information (PLI) system and administrative ground truth functions.

FY 2005 Plans:

- Continue SV06 AWE planning and technology investigations.
- Continue Strategic Planning efforts.
- Continue to synthesize results and lessons learned into proposed DOTMLPF recommendations for the Marine Corps. Continue pursuing transition avenues for maturing TTTPs.
- Provide technical, strategic, and managerial support to Marine Corps Experimentation.
- Provide overall analysis and reporting of experimentation efforts, provide analytical assistance during experiment design, and maintain an ad-hoc analysis capability.
- Complete tactical instrumentation and continue IGRS II data collection/reconstruction efforts.
- Continue IGRS II OTM/OTH blue (friendly) force tracking efforts.

	FY 2003	FY 2004	FY 2005
Intelligence, Surveillance, and Reconnaissance (ISR)	4,560	3,856	5,704

This section includes Marine Corps Warfighting Laboratory (MCWL) ISR related experimentation efforts involving enhanced reconnaissance; sensors; and unmanned ground and aerial vehicles.

FY 2003 Accomplishments:

Initiated ISR support for the Sea Viking 2004 (SV04) Advanced Warfighting Experiments (AWE).
- Continued Dragon Eye Unmanned Aerial Vehicle (UAV) payload development, integration, and experimentation. Dragon Eye is a back-packable system with modular payloads, designed to provide the small unit leader with an "over-the-hill" reconnaissance and surveillance capability.
- Transitioned Dragon Eye UAV to Marine Corps Systems Command’s (MCSC’s) program of record (POR).
- Expanded/refined Dragon Runner Mobile Ground Sensor (MGS) efforts. Dragon Runner is a ground mobile sensor

that will be used by marine infantry battalions.
- Continued Unmanned Ground Vehicle (UGV) payload and micro UAV/UGV payload development efforts.
- Initiated Visual Intelligence, Surveillance, Tactical Alert System (VISTAS) (formerly known as Local Area Sensor System (LASS)) efforts. VISTAS is an unattended ground sensor system.

FY 2004 Plans:

- Continue ISR support for the SV04 AWE.
- Continue Dragon Eye UAV payload development, integration, experimentation, and refinement of tactics, techniques and procedures (TTPs).
- Initiate investigation of refocused Tier II UAV capabilities. The purpose of the Tier II UAV program is to test a fully autonomous, small UAV system for Marine Corps reconnaissance, surveillance, target acquisition (RSTA) and communication relay missions.
- Continue Dragon Runner MGS efforts.
- Continue UGV payload and micro UAV/UGV payload development efforts.
- Continue VISTAS development efforts.

FY 2005 Plans:

- Conclude ISR support for SV04 and initiate ISR support for the Sea Viking 2006 (SV06) AWE.
- Complete Dragon Eye UAV payload development, integration, experimentation, and refinement of TTPs.
- Continue investigation of refocused Tier II UAV capabilities; initializing focusing on a complete shipboard compatibility that requires minimal maintenance and time to train.
- Continue Dragon Runner MGS efforts.
- Continue UGV payload and micro UAV/UGV payload development efforts.
- Continue VISTAS development efforts.
- Initiate investigation of ISR/RSTA capabilities needed to support a Marine Expeditionary Battalion (MEB) conducting Operational Maneuver From The Sea (OMFTS).

	FY 2003	FY 2004	FY 2005
Seabasing, Logistics, Combat Service Support (CSS), and Combat in the Cities	3,391	7,839	5,039

This section includes Marine Corps Warfighting Laboratory (MCWL) experimentation efforts involving seabasing, logistics, CSS, urban combat, medical, as well as training and education.

FY 2003 Accomplishments:

- Continued to develop and integrate the CSS tools/systems/equipment that will support the "Marine of 2020."
- Continued to search for, evaluate, and assess potential solutions to enhance seabased sustainment capabilities. This effort explores the use of Command and Control (C2), fires, maneuver, and sustainment required of a Marine Combat Service Support Detachment (MCSSD) in support of a Marine Air-Ground Task Force (MAGTF) Operational Maneuver From The Sea (OMFTS) operation.
- Initiated effort with experimental vehicles to enable mobility of forces executing OMFTS sustainment operations.
- Established the MAGTF Utility Tractor Tactical (MUTT) initiative to assess the military utility of small, utility tractors in support of airfield and rapid runway repair and rapidly constructed field fortifications and revetments. The MUTT initiative was performed in concert with the establishment of Joint Expeditionary Field Fortification (JEFF) program efforts, augmented by the Rapid Deployment Fortification Wall (RDFW) Congressional enhancement (Project C9154).
- Established a Mine Counter Measures (MCM) initiative to develop and assess the tactics, techniques, technologies, and procedures (TTTPs) surrounding a Marine Expeditionary Unit (MEU) MCM Capability Set.
- Continued Military Operations in Urban Terrain (MOUT) experimentation efforts to include Project Metropolis and Project Rifleman. Project Metropolis is the definitive multi-year experiment designated to create realistic warfighting allowing Marines to shoot, move, and communicate as they accomplish missions during MOUT. Project Rifleman, a subset of Project Metropolis, is a project conducting experimentation with the tactics and techniques (TTPs) of the individual Marine to better enable him/her to fight and survive in the expeditionary combat environments.
- Continued investigating/integrating clothing and equipment that will enhance Marines' survivability.
- Continued aviation experimentation in the urban environment and aviation based simulation/instrumentation efforts.
- Investigated Marine Corps and Special Operations Command (SOCOM) TTTPs collaboration.
- Assisted the Joint Operations Center with Joint High Speed Vessel (JHSV) program efforts to explore the concepts and capabilities with commercially available advanced hull and propulsion technology.
- Completed Night Integrated Training Environment (NITE) Lab support efforts.
- Completed experimentation efforts with zinc-air batteries.
- Continued bio-science (medical) efforts to include en route care, mission package prototypes for Health Service Support (HSS) for long distance raids and homeostatic dressings for field user evaluation.
- Transitioned SEAWAY efforts (formerly referred to as SEAWAY-LOGGY) to Marine Corps Systems Command (MCSC) program of record (POR) (i.e., the logistics decision support module). As a decision support tool, it provides logistical data used to validate the supportability of courses of actions developed in wargames.

FY 2004 Plans:

- Continue to develop and integrate the CSS tools/systems/equipment that will support the "Marine of 2020."
- Continue to search for, evaluate, and assess potential solutions to enhance seabased sustainment capabilities.
- Complete effort with experimental vehicles to enable sustainment of forces in an OMFTS environment.
- Continue development of the MUTT initiative. Conduct assessment and documentation of JEFF military utility in conjunction with MUTT. JEFF efforts are augmented by the RDFW Congressional enhancement.
- Continue development of MCM initiative.
- Continue MOUT experimentation efforts.
- Continue to investigate individual equipment to enhance Marines' survivability and combat effectiveness.
- Initiate an assessment to determine the utility of Land Warrior technologies for Marine Corps application. Land Warrior is an integrated computer/weapon system worn by the individual Marine.
- Continue aviation experimentation in the urban environment and aviation based simulation/instrumentation efforts.
- Maintain Marine Corps and SOCOM TTTPs collaboration.
- Expand JHSV development, integration, and experimentation.
- Continue bio-science initiatives.
- Initiate SEAWAY effort to enable intra-hull assessment capability.
- Initiate TTTPs to facilitate sustaining a seabased Marine Expeditionary Battalion (MEB) conducting OMFTS/Ship to Objective Maneuver (STOM).

FY 2005 Plans:

- Continue to develop and integrate the CSS tools/systems/equipment that will support the "Marine of 2020."
- Continue to search for, evaluate, and assess potential solutions to enhance seabased sustainment capabilities.
- Complete MUTT and JEFF initiatives.
- Complete MCM development/experimentation efforts.
- Continue MOUT experimentation efforts.
- Continue to investigate individual equipment to enhance Marines' survivability and combat effectiveness.
- Continue utility assessment of Land Warrior technologies for Marine Corps application.
- Continue aviation experimentation in the urban environment and aviation based simulation/instrumentation efforts.
- Maintain Marine Corps and SOCOM TTTPs collaboration.
- Continue JHSV efforts.

- Continue bio-science (medical) initiatives.
- Continue SEAWAY initiative.
- Continue TTTPs to facilitate sustaining a seabased MEB conducting OMFTS/STOM.

	FY 2003	FY 2004	FY 2005
Warfighting Excellence	1,993	3,915	4,125

This section includes Marine Corps Warfighting Laboratory (MCWL) experimentation efforts in the areas of wargaming, the Center for Emerging Threats and Opportunities (CETO), and Project Albert.

FY 2003 Accomplishments:

- Continued research; planning; modeling and simulation (M&S), concept, and wargame development; preparation; execution; and analysis and assessment to extend exploration of critical components.
- Continued focus on advancing policy, concept and operational exploration at several levels to include Title X wargaming, joint and external gaming efforts, Joint Forces Command (JFCOM) Joint Concept Development and Experimentation (JCDE) programs, and a broad and diverse array of service programs. Title X wargames generally address future capabilities in the context of core Title X readiness responsibilities and include participation in other service Title X wargames, as well as, planning and executing the Marine Corps Title X Expeditionary Warrior program. JCDE efforts include the co-sponsored Marine Corps/JFCOM Joint Urban Warrior (JUW) program designed to support JFCOM Joint Urban Operations (JUO) efforts. External events include the Office of the Secretary of Defense's (OSD's) Net Assessment wargames. Marine Corps wargaming programs also include such efforts as Revolution in Military Affairs (RMA)/Project Ellis and Fast Train programs. RMA and Fast Train programs provide an exploratory venue to address critical conceptual, organizational, and technical issues essential to success on the 21st century battlefield. Moreover, these programs contribute significantly toward the assessment of the impact of changes in the strategic landscape on concepts, organization, and technology.
- Completed experimentation efforts and transitioned the Combat Decision Range to Marine Corps Systems Command (MCSC).
- Investigated Intelligence, Surveillance and Reconnaissance/Reconnaissance, Surveillance, and Target Acquisition (ISR/RSTA) capabilities needed to support a Marine Expeditionary Battalion (MEB) conducting Operational Maneuver From The Sea (OMFTS) via Wargaming and M&S.
- Provided CETO support for asymmetric warfare studies/investigations, as augmentation to the CETO Congressional enhancement (Project C9154).

FY 2004 Plans:

- Continue research; planning; M&S, concept, and wargame development; preparation; execution; and analysis and assessment to extend exploration of critical components.
- Continue to refine and extend established wargaming programs (Title X, JUO, RMA/Project Ellis, and Fast Train), and explore and develop innovative research and gaming methods and techniques to include "next generation" M&S capabilities.
- Continue to provide CETO support. (Note: Although administratively attached to MCWL, CETO will now be operationally controlled by the Marine Corps Combat Development Command (MCCDC)).

FY 2005 Plans:

- Continue research; planning; M&S, concept, and wargame development; preparation; execution; and analysis and assessment to extend exploration of critical components.
- Continue to refine and extend established wargaming programs (Title X, JUO, RMA/Project Ellis, and Fast Train), and explore and develop innovative research and gaming methods and techniques to include "next generation" M&S capabilities.
- Continue to provide CETO support.
- Project Albert provides design and development of new tools to capture emergent behavior in synthetic environments that, over time, will lead to more effective warfighters. The project's vision includes strong interdisciplinary collaborative teams to address previously unanswered questions relevant to success in warfare. Provide one man-year of program support as augmentation to the FY 2004 Project Albert Congressional Enhancement.

	FY 2003	FY 2004	FY 2005
Fires, Targeting, and Maneuver	4,818	5,052	3,726

This section includes Marine Corps Warfighting Laboratory (MCWL) experimentation efforts in the areas of fires, targeting, and maneuver.

FY 2003 Accomplishments:

- Prepared Spike hardware/software for programmed missile test firings to verify airframe performance matches measured wind tunnel test program data and the flight characteristics of the missile inertial measurement system. Spike is a very small, low cost, man-packable, fire and forget guided missile and launcher system.
- Continued breach loading capability redesign and fabrication efforts of the fully functional Dragon Fire I

concept demonstrator. Dragon Fire is a modular 120-millimeter Light Armored Vehicle (LAV) concept demonstrator mortar system.
- Continued Level I design of the Dragon Fire II including carriage design, fire control design, firing systems design and the integration of all of the systems to achieve the weight objective of 3,000 pounds and full compatibility with internal transport in the MV-22 Osprey (medium lift, vertical takeoff and landing (VTOL) tilt-rotor aircraft).
- Conducted Limited Technology Assessments (LTAs) firing the Dragon Fire I from the modular LAV testbed.
- Continued support for the development of the Target Handoff System experimental THS(X). The THS(X) program investigates and conducts experiments in aviation and fire support technologies that could lead to increased accuracy and effectiveness of close air and fire support missions while also reducing the possibility of fratricide. Also continued complementary laser rangefinder investigations/experimentation.
- Provided nominal engineering support for continued investigations and evaluations of the Remote Precision Gun (Telepresent Rapid Aiming Platform (TRAP)).
- Provided for continued Mobile Counter Fire System (MCFS) system development, as augmentation to the MCFS Congressional enhancement. MCFS is a sniper detection/force protection system.
- Continue exploration of precision targeting technologies and systems.
- Continued M3M machine gun mounted on helicopter platforms experimentation.
- Continued M3M mounted on vehicle platforms experimentation.

FY 2004 Plans:

- Complete first Dragon Fire II concept demonstrator and conduct proof firings, instrumented firings, and ballistic kernel verification/modification. This effort is an augmentation to the Mobile Fire Support System (MFSS) Congressional enhancement (Project C9154).
- Complete THS(X) development and transition to the Marine Corps Systems Command (MCSC).
- Continue engineering support as well as upgrade and assess current TRAP systems design. This effort is an augmentation to the TRAP Congressional enhancement (Project C9154).
- Continue laser rangefinder investigations/experimentation (i.e. in concert with THS(X), TRAP, and other MCWL program efforts).
- Initiate Digital Fires Coordination Device (DFCD) development, by providing concept demonstrator design and version I system delivery to participate in Sea Viking 2004 (SV04) Advanced Warfighting Experiment (AWE). The DFCD program will design a concept demonstrator of an advanced fire support coordination software system hosted in a ruggedized computer (handheld or laptop) to give the forward elements of a Ship to Objective Maneuver (STOM) force the ability to control and deconflict fires. The system will be based on the THS(X) software and will be designed to give the advance force commander a simplified and compact system to develop and transmit coordinating measures, target lists, fire plans, fire missions, and warnings.

- Continue exploration of precision targeting technologies and systems.
- Complete M3M mounted on helicopter platforms experimentation.
- Initiate investigations into highly mobile, internally transportable counter-fire radar to support a vertical maneuver element.
- Complete M3M mounted on vehicle platforms experimentation.

FY 2005 Plans:

- Continue development of modular design for fire support systems using the Dragon Fire/LAV test-bed.
- Initiate development of the "Fire on the Move" technology.
- Continue laser rangefinder investigations/experimentation.
- Continue DFCD efforts.
- Continue investigations into highly mobile, internally transportable counter-fire radar to support a vertical maneuver element.
- Investigate capabilities to enhance tactical mobility of a vertical maneuver element.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E: The Navy's 6.1 program contributes indirectly to this effort. PE 0602131M Marine Corps Landing Force Technology
NON-NAVY RELATED RDT&E: Not applicable

D. ACQUISITION STRATEGY:
Not applicable

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

Exhibit R-2a

BA: 03 PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: USMC Advanced Technology Demonstration (ATD)

PROJECT NUMBER: R2223 PROJECT TITLE: Marine Corps ATD

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
R2223 Marine Corps ATD	16,144	18,475	21,791	23,014	23,799	24,537	25,043

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Critical Marine Corps requirements/imperatives addressed in this Project are: Maneuver; Firepower; Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR); Logistics; Human Performance, Training and Education; and Mine Counter Measures (MCM). These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment. Multiple transitions into the Sub-system/Component Advanced Development Phase are planned, as well as fieldable prototyping to reduce risk in System Concept Development and Demonstration. A tactically effective MCM capability is necessary if MCM is to become a functional component of Naval Expeditionary Maneuver Warfare (EMW). MCM provides synchronization and speed of detection, breaching, clearance, proofing, and marking operations. This project supports: 1) engaging regional forces in decisive combat on a global basis; 2) responding to all other contingencies and missions in the full spectrum of combat operations (high, middle, and low intensity), in Military Operations in Urban Terrain (MOUT), and in operations other than war (OOTW); 3) and warfighting experimentation. By providing the technologies to enable these capabilities, this project supports the goals and objectives of the Strike, Littoral Warfare and Surveillance Joint Mission Areas. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment.

In addition, this project supports the goals and objectives of the Littoral Combat Future Naval Capabilities (FNC) process.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Littoral Combat/Power Projection (LC/PP)	6,035	7,366	5,379

The goal of the LC/PP Future Naval Capabilities (FNC) is to support the development of Naval Expeditionary Maneuver Warfare via the application of technologies which enhance the ability of the Navy-Marine Corps team to achieve assured access and sustained operations in the littorals as the naval portion of a joint campaign. By being assigned Science and Technology (S&T) responsibility for littoral combat, the LC/PP FNC has been

given an expansive warfighting problem set. The littoral region is where the future fight will take place and requires a broad naval perspective in identifying and solving capability gaps. In identifying capability gaps, the LC/PP FNC considers all the critical warfighting functions: Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), fires, maneuver, sustainment, and force protection.

FY 2003 Accomplishments:

- Demonstrated secure wireless network capabilities in various environments to characterize performance.
- Expeditionary Fires Technology Program developed a prototype system with self-contained survey, networked, real-time geospatial fire control, communications and automatic aiming subsystems.
- Developed and flight tested tactical unmanned vertical take-off and landing platform technologies for United States Marine Corps (USMC) Tier II Unmanned Air Vehicle demonstrator.
- Tested beta version of software to aid in Marine Expeditionary Unit (MEU) planning and execution of Ship to Objective Maneuver (STOM) to include assault craft moving map displays.

FY 2004 Plans:

- Demonstrate prototype expeditionary fires system with stabilization technologies, advanced pointing and aiming system, and advanced ballistic prediction capability.
- Develop, integrate and test additional functionality for STOM planning software. Install with deploying MEUs for evaluation and feedback.
- Initiate development of a remote sensor fusion capability to enable correlation, cross-cueing, and triggering of imagery with other remote sensor data for eventual transition to the Tactical Remote Sensor System (TRSS).
- Initiate development of algorithms for identifying battlespace targets by Radio Frequency (RF), magnetic, acoustic, or other emissions signature.
- Initiate design and development of lightweight materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Develop requirements for a Marine Corps Senior Intelligence System that enables advanced data parsing, fusion and discrimination.
- Initiate development of a system that provides for emitter tracking in high multi-path urban environment.
- Initiate development of tools that help operators initially understand a new radio frequency environment and assist in the generation of collection plans.

FY 2005 Plans:

- Continue development and improvements to the remote sensor fusion capability for the TRSS.
- Continue algorithm development and testing for RF emitter identification and geo-location.
- Continue refinements to expeditionary fires technologies for inclusion in Expeditionary Fires Support System (EFSS) and Lt Wt 155 Howitzer acquisition programs.
- Initiate integration and testing of Collision Avoidance System on the Expeditionary Fighting Vehicle (EFV) and transition.
- Transition a system that provides for emitter tracking in high multi-path urban environment to acquisitions.
- Transition tools that help operators initially understand a new radio frequency environment and assist in the generation of collection plans.

	FY 2003	FY 2004	FY 2005
Mine Countermeasures (MCM)	1,000	3,730	4,000

This activity focuses on advanced development and demonstration of mine countermeasures (MCM) technologies enabling MCM capabilities in synchronization and speed of mine detection, organic neutralization, assault breaching, tactical clearance, proofing, marking, and Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4I) operations.

This activity includes efforts for the Advanced Mine Detector (AMD). AMD will combine multiple sensing technologies to detect explosives in antipersonnel and antitank mines, a key capability due to the worldwide proliferation of low and non-metallic mines. Initial operational capability is scheduled for FY 2008 and full operational capability for FY 2009.

AMD will apply nuclear quadrupole resonance (NQR) science to confirm the presence of explosives. NQR science detects the electromagnetic signal emitted by relaxation of nitrogen atom nuclei in explosives, after tipping caused by a near-resonant frequency pulse. NQR science also detects metal objects and voids by sensing discontinuities in the dielectric properties of the medium, after application of an alternating current pulse. Specialized NQR science applications enable discrimination of buried, multi-compound explosives from clutter such as metal fragments, rocks, and voids.

FY 2003 Accomplishments:

-Continued refinement of NQR sensor design, achieving improvement in signal-to-noise ratio (SNR), reduced acoustic ringing effects, improved power management, and lighter system weight.

-Performed independent empirical analytical modeling of NQR sensor integrated with a specific ground penetrating radar (GPR) and electromagnetic induction (EMI) system.

FY 2004 Plans:

-Initiate NQR technology integration efforts with a GPR and EMI system.
-Develop very low power stochastic NQR pulse sequencing techniques for detection of multiple lines of Trinitrotoluene (TNT).
-Explore methods to compensate for the inhomogeneous radio-frequency (RF) field of surface coils, for optimizing SNR for varying inspection depths.
-Continue to improve Radio Frequency Interference (RFI) mitigation techniques and hardware, by considering coil designs, alternate RFI reference antenna designs, correlation between channels, and mitigation algorithms.
-Develop advanced NQR techniques for improved TNT detection, to include pulse sequences that are less sensitive to temperature variations, and examine the possibility of increasing TNT SNR by hybrid NQR/Nuclear Magnetic Resonance techniques.
-Reduce acoustic ringing by developing coils with a reduced electric field and composite RF pulses.
-Complete TNT characterization by determining whether observed differences in TNT formulations represent mixtures of pure orthorhombic and monoclinic crystalline forms, or twinning effects of the monoclinic phase.
-Extend characterization to a broader range of TNT sources, and to tetryl.

FY 2005 Plans:

-Continue refinement of RFI mitigation, SNR enhancement, and acoustic ringing techniques.
-Continue NQR technology integration efforts with a GPR and EMI system.
-Transition the AMD effort to the Littoral Combat Future Naval Capability (LC FNC).

	FY 2003	FY 2004	FY 2005
Human Performance, Training & Education	1,950	2,500	3,000

This activity develops and demonstrates advanced training technology and technologies that enhance neural and cognitive aspects of human performance including tactical decision-making, modeling, simulation, range instrumentation, synthetic environment generation and training effectiveness evaluation.

FY 2003 Accomplishments:

- Integrated Advanced Close Combat Marines Ground Combat Element (GCE) Tactical Decision-making Simulation (TDS) for use in the Staff Sergeant's Course at the Marine Corps Institute (MCI).
- Integrated the Close Combat Marines GCE TDS for use in Infantry Platoon Sergeant's Course at the School of Infantry (SOI) East. Completed Training Effectiveness Evaluation (TEE).
- Integrated the Marine Air/Ground Task Force – XXI (MAGTF-XXI) GCE TDS for use in Captain's Course at the Expeditionary Warfare School (EWS). Preliminary TEE was completed.
- Integrated the MAGTF-XXI GCE TDS for use in Operations Chief Course at the SOI East.
- Performed technology search and experimentation in the areas of combating terrorism, support for the 4th Marine Expeditionary Battalion (MEB) Anti Terrorism (AT), and thermobaric weapons.
- Demonstrated prototype of Video Flashlights capability for enhanced situational awareness in a Military Operations in Urban Terrain (MOUT) training environment for the Special Reaction Team (SRT) at Marine Corps Base (MCB) Quantico.

FY 2004 Plans:

- Demonstrate and evaluate technologies available for prototype of Logistics Combat Services Support Element (CSSE) TDS for use in the Logistics Officer's Course at the Logistics School.
- Perform TEE for MAGTF-XXI GCE TDS in use for the Captain's Course at the EWS.
- Demonstrate and evaluate technologies available for prototype of an Anti-Terrorism Force Protection (ATFP) TDS for use by the 4th MEB Marine Security Force.
- Demonstrate and evaluate technologies available for prototype of a Combat Engineers TDS for use in the Engineer Officer's Course.
- Demonstrate and evaluate prototype of Video Flashlights capability for enhanced situational awareness in a Military Operations in Urban Terrain (MOUT) training environment for the Marine Security Forces. This will include a TEE.
- Demonstrate and evaluate technologies available for prototype of Radio Frequency (RF) tracking and video tracking fusion capability for enhanced situational awareness in a MOUT training environment.
- Demonstrate and evaluate technologies available for prototype of a Rapid Portable Synthetic Environment Generation capability.

FY 2005 Plans:

- Integrate Logistics CSSE TDS for use in the Logistics Officer's Course at the Logistics School at Camp Johnson. This will include a TEE.

- Integrate Combat Engineer's TDS for use in the Engineer Officer's Course at the Engineers School.
- Integrate the ATFP TDS for use in the Supervisor's Course by the 4th MEB Marine Security Force.
- Demonstrate and evaluate technologies available for prototype of an Aviation Combat Element (ACE) TDS.
- Demonstrate and evaluate technologies available for prototype of a common three-dimensional database format and tool kit capability for rapid synthetic environment generation and tactical decision-making simulations.
- Demonstrate and evaluate technologies available for prototype of RF tracking and video tracking fusion capability for enhanced situational awareness in a MOUT training environment.
- Demonstrate and evaluate technologies available for prototype of a Rapid Portable Synthetic Environment Generation capability.

	FY 2003	FY 2004	FY 2005
Logistics	2,000	1,500	2,875

This activity supports Expeditionary Maneuver Warfare capabilities assessing technologies for power, as well as technologies that enhance logistics flow (focusing on sensors and autonomic logistics).

FY 2003 Accomplishments:

- Investigated the feasibility of the hybridization of Zinc Air battery and Ultra Capacitor technologies as an alternative to BA5590 Lithium batteries with a goal of 30% weight savings and 50% power increase.
- Initiated the development of Micro-Channel Methanol Fuel Cells as a battery recharger for secondary batteries such as the BA2590 lithium rechargeable battery. Goal is to have a technology readiness level 5 brass board system.
- Developed a lightweight (3kw) power generator (mini-brayton cycle) with micro turbine technologies.
- Leveraged DARPA's Palm Power effort to evaluate direct methanol fuel cells for application in field battery charging stations.

FY 2004 Plans:

- Continue development of alternative power initiatives (Hybrid Zinc Air batteries).
- Continue Expeditionary Energy effort by down selecting the most promising lightweight power generation technologies to demonstrate the feasibility of performance improvement.

FY 2005 Plans:

- Continue development of alternative power initiatives to demonstrate performance improvement.

- Continue Expeditionary Energy effort development of lightweight power generation and alternative power technologies to demonstrate the feasibility of performance improvement.
- Explore efforts in support of Sea Based Logistics and Expeditionary Maneuver Warfare by assessing concepts that permit precision delivery of logistics assets while also reducing the logistics footprint ashore.

	FY 2003	FY 2004	FY 2005
Command, Control, Communications, Computers, and Intelligence, Surveillance and Reconnaissance (C4ISR)	2,200	1,650	2,760

This activity integrates and demonstrates enhanced communications and situational awareness in warfighting environments and communication and situational awareness technologies for near term U S Marine Corps (USMC) operations.

FY 2003 Accomplishments:

- Initiated demonstration of Low-Probability of Intercept/Low-Probability of Detection (LPI/LPD) ultra-wide band radios for reconnaissance and urban communications.
- Initiated & completed development of a Marine-portable, deployable, Tactical Jammer (transferred to Littoral Combat FNC).
- Continued Command and Control Technology testbed culminating in the migration of functionality in the systems integration environment for user prototyping, and requirements generation on prospective commercial and developmental software products.

FY 2004 Plans:

- Initiate and complete ground weapons locating radar study to determine the feasibility of modifying advanced ground-based radar functionality through software changes.
- Initiate development of blue-force tracking information management and data interoperability capabilities.
- Complete demonstration of Low-Probability of Intercept/Low-Probability of Detection (LPI/LPD) ultra-wide band radios for reconnaissance and urban communications.
- Continue Command and Control Technology testbed culminating in the migration of functionality in the systems integration environment for user prototyping, and requirements generation on prospective commercial and developmental software products.

FY 2005 Plans:

- Initiate development of measurement and signature intelligence data management and integration capability.
- Continued Command and Control Technology testbed culminating in the migration of functionality in the systems integration environment for user prototyping, and requirements generation on prospective commercial and developmental software products transitions to 6.4.

	FY 2003	FY 2004	FY 2005
Maneuver	1,840	1,187	2,375

This activity demonstrates technologies to enhance battlespace mobility and survivability through analysis and development of demonstration hardware.

FY 2003 Accomplishments:

- Analyzed and tested several individual structural armor materials and countermeasure technologies in support of Marine Corps Air Ground Task Force (MAGTF) Marine Expeditionary Family of Fighting Vehicles (MEFFV) to determine effect on maneuver and survivability.

FY 2004 Plans:

- Develop detailed designs and build technology demonstrators of Tactical Unmanned Ground Vehicles (TUGV) to demonstrate advanced unmanned capabilities in the areas of mobility, survivability, Command and Control (C2), ISR (intelligence, surveillance, and reconnaissance), lethality (lethal and non-lethal systems), and mine countermeasures.

FY 2005 Plans:

- Analyze maneuver and survivability technologies for demonstration on a technology demonstrator testbed.
- Demonstrate key maneuver components, subsystem, and system breadboards to support initial MEFFV system design studies and trade-offs.
- Develop and evaluate MEFFV platform design concepts and mission variants.

	FY 2003	FY 2004	FY 2005
Firepower	750	0	2,482

This activity demonstrates enhanced lethality through technological improvements in fuzes and targeting.

FY 2003 Accomplishments:

- Completed Objective Crew Served Weapon air bursting munitions and weapon reliability testing support in conjunction with Joint Service Small Arms Project.

FY 2004 Plans:

- No Firepower Advanced Research projects available to transition to this funding line in this year.

FY 2005 Plans:

- Conduct Firepower effects enhancement “technology push” efforts.
- Support development of enhanced submunition fuse safety and reliability technologies for submunitions based on results of the FY04 6.2 fuse technology assessment.
- Support development of future mortar systems.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0602131M (Marine Corps Landing Force Technology)
PE 0603612M (Marine Corps Mine/Countermeasures Systems)
PE 0603635M Marine Corps Ground Combat/Supporting Arms Systems
PE 0206313M (Marine Corps Communications Systems)
PE 0206623M (Marine Corps Ground Combat/Supporting Arms Systems)
PE 0601152N (In-House Laboratory Independent Research)
PE 0601153N (Defense Research Sciences)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0603236N (Warfighter Sustainment Advanced Technology)
PE 0204163N (Fleet Communications - (Tactical))

PE 0305204N (Tactical Unmanned Air Vehicles)

NON-NAVY RELATED RDT&E:
PE 0603004A (Weapons and Munitions Advanced Technology)
PE 0603005A (Combat Vehicle and Automotive Advanced Technology)
PE 0603606A (Landmine Warfare and Barrier Advanced Technology)
PE 0603607A (Joint Service Small Arms Program)
PE 0603619A (Landmine Warfare and Barrier Advanced Development)
PE 0603772A (Advanced Tactical Computer Science and Sensor Technology)
PE 0604710A (Night Vision Systems - Engineering Development)
PE 0604808A (Landmine Warfare and Barrier Engineering Development)
PE 0602301E (Computing Systems and Communications Technology)
PE 0602702E (Tactical Technology)

D. ACQUISITION STRATEGY:
Not Applicable

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

Exhibit R-2a

BA: 03 PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: USMC Advanced Technology Demonstration (ATD)

PROJECT NUMBER: R2362 PROJECT TITLE: Extended Littoral Battlespace

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
R2362 Extended Littoral Battlespace	856	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION:

The Extending the Littoral Battlespace (ELB) Advanced Concept Technology Demonstration (ACTD) project responds to the top level military need to rapidly deploy a Naval Expeditionary Task Force with an embarked Marine Air Ground Task Force (MAGTF) as part of a larger Joint Task Force to any region of the world's littorals and conduct military operations from a sea base across the spectrum of conflict to implement national military strategy. Forces employed ashore will be light, agile, distributed, and desegregated and capable of optimizing remote fires, to effectively deter aggression, halt attacks and secure critical areas as a precursor to a much larger force. Forces will be empowered by unprecedented situational awareness via a robust information infrastructure that is fully coupled to a decision/planning/execution system on a shared battlespace network (sea/land). The objective of the ACTD is to demonstrate an enhanced integrated command and control/fires and targeting capability to enable rapid employment, maneuver, and fires to support joint dispersed unit operations in an extended littoral battlespace. A Major Systems Demonstration (MSDI) was completed FY 1999 and a second one (MSDII) was completed in FY 2001. The ELB ACTD was approved by Deputy Under Secretary of Defense (Acquisition and Technology) (DUSD (AT)) on 16 January 1997.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Extended the Littoral Battlespace (ELB)	906	0	0

The demonstration phase of this effort will continue as Joint Task Force (JTF) Warrior Network (Warnet) beginning in FY04. United States Marine Corps (USMC) transition initiatives are part of the Littoral Combat/Power Projection Future Naval Capability (LC/PP FNC).

FY 2003 Accomplishments:

- Completed the transition of demonstrated technologies, hardware, software, and processes to Marine Corps acquisition and JTF WarNet.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0206313M Marine Corps Communications System

D. ACQUISITION STRATEGY:
Not Applicable

CONGRESSIONAL PLUS-UPS:

C2297	FY 2003	FY 2004
ADVANCED LIGHT STRIKE VEHICLE (ALSV)	3,015	3,482

This synergistic effort capitalized upon lessons learned from the Internally Transportable Vehicle (ITV) and the Reconnaissance Surveillance Targeting Acquisition - Vehicle (RSTA-V) teaming Marine Corps, Navy, and industry subject matter experts (SMEs) to investigate promising technologies leading to an effective, combat suitable, ALSV. This effort began with a "clean sheet of paper" harnessing promising technologies in an effort to balance and mitigate competing performance requirements against vehicle characteristics such as speed, weight, and size. Through the use of computer-aided design and key technologies such as advanced suspension, hybrid electric drives, and composites, the goal is to produce a working prototype ultimately leading to an objective prototype.

C2297	FY 2003	FY 2004
MOBILE COUNTER-FIRE SYSTEM (MCFS)	2,392	0

The Marine Corps Warfighting Laboratory (MCWL) provided for improvements to the MCFS in the areas of correcting previously identified problems, repackaging Fire Control and Sniper Detection systems, increasing areas of vehicle protection, increasing accuracy of vehicle location coordinates, incorporating a laser range finder, adding calibration circuits, and conducting system experimentation. Began investigations into using infra-red sensors, in addition to acoustic, to pinpoint incoming enemy fires.

C2297	FY 2003	FY 2004
PROJECT ALBERT	5,758	4,203

FY 03 efforts: Models and developing data farming techniques were used in two distinct ways to allow decision-makers to deal with asymmetric threats and the uncertainty inherent in conflicts in today's world. The first was to understand the large landscape of possibilities in our changing world environment and the second was to discover outliers that, while individually improbable, collectively must be considered when building a robust force capable of protecting the interests of our country. Specific areas of application include surf zone/beach obstacle reduction and mine counter measures, human decision-making, command and control, and defense against enhanced blast weapons. Other areas of potential application included ship-to-objective maneuver, urban operations, homeland defense, force protection, and uninhabited vehicles.

FY 04 efforts: Continue modeling and developing data farming techniques to allow decision-makers to deal with asymmetric threats and the uncertainty inherent in conflicts in today's world.

C9154	FY 2003	FY 2004
CENTER FOR EMERGING THREATS AND OPPORTUNITIES (CETO)	974	0

This effort continued developing approaches to identify emerging threats, explore concepts, and determine capabilities and policies for addressing the asymmetric operational challenges emerging in the 21st century. These efforts result in the development, understanding, refinement, and application of operational and technical solutions to increasingly complex conflicts, many of which resist conventional application of military force. To meet future challenges in coordination with the Operating forces, CETO efforts included recommending emerging capabilities that are candidates for transition to the Expeditionary Force Development System.

C9154	FY 2003	FY 2004
MOBILE FIRE SUPPORT SYSTEM (MFSS) 120MM MORTAR PROGRAM	0	2,787

This effort formerly known as Dragon Fire and now referred to as Dragon Fire II, is a modular 120-millimeter Light Armored Vehicle (LAV) concept demonstrator mortar system. The FY 2004 Plans are to proceed with efforts to complete design and fabrication. These include: second gun assembly, safety release testing/documentation, and firing tests.

C9154	FY 2003	FY 2004
RAPID DEPLOYMENT FORTIFICATION WALL LIVE FIRE TESTING	1,021	995

Investigated and experimented with new tactics, techniques, and procedures (TTPs) to improve deployable fortification wall design and construction. This Joint Expeditionary Field Fortification (JEFF) program was established in concert with the establishment of the Marine Corps Warfighting Lab (MCWL)-core Marine Air-Ground Task Force (MAGTF) Utility Tractor Tactical (MUTT) initiative to assess the military utility of small, utility tractors in support of airfield and rapid runway repair and rapidly constructed field fortifications and revetments.

Established the MAGTF Utility Tractor Tactical (MUTT) initiative to assess the military utility of small,

utility tractors in support of airfield and rapid runway repair and rapidly constructed field fortifications and revetments. The MUTT initiative was performed in concert with the establishment of JEFF program efforts, augmented by the Rapid Deployment Fortification Wall (RDFW) Congressional plus-up (Project C9154).

C9154	FY 2003	FY 2004
TELEPRESENT RAPID AIMING PLATFORM (TRAP) ADVANCEMENT PROGRAM	0	1,741

This effort will focus on multi-spectral sensor suites and wireless command and control (C2) systems integration. Begin design overhaul of current system human interface. Begin upgrade of weapon integration, magazine, and batteries.

C9154	FY 2003	FY 2004
TRANSPORTABLE TRANSPONDER LANDING SYSTEM (TTLS)	2,177	3,481

The Marine Corps Warfighting Laboratory (MCWL) investigated technology developments in support of TTLS concept demonstration. Efforts included:
System Specification Documentation
Final System Demonstration Plan
Demonstration of tracking aircraft in 360 degree service volume and providing guidance to reciprocal ends of a main runway.
Final Project Reporting, to include executive summary, program accomplishments, and appendix listing of applicable program documentation.

C9154	FY 2003	FY 2004
USMC UAV/UGV WEARABLE COMPUTER PROJECT	0	2,537

Effort will provide for prototype development, software development, testing, and purchase of limited numbers of prototype MOWC computers. The Marine Corps Warfighting Laboratory (MCWL) will then experiment and assess the prototype MOWCs to determine the efficacy of such a computer system at the Marine small unit level.

R2995	FY 2003	FY 2004
CALIFORNIA CENTRAL COAST RESEARCH PARTNERSHIP (C3RP) INITIATIVE	2,931	3,857

Defined an area of core excellence and established an Interdisciplinary Center of Excellence in research relevant to national security and the Marine Corps on the Central Coast of California by bringing together the University, government agencies and units (both federal and state), and the private sector, which can evolve into an exceptional national resource. Efforts continue to explore this potential and to identify and support relevant research and expertise.

R9167	FY 2003	FY 2004
MAN-PORTABLE QUADRUPOLE RESONANCE	0	3,500

This effort will focus on advanced development and demonstration of landmine countermeasures technologies; specifically, a landmine detection system on quadrupole resonance technology, engineered into a man-portable configuration. ($2,445 was appropriated in FY 2003 PE 0603792N).

R9290	FY 2003	FY 2004
EXPEDITIONARY WATER PURIFICATION TECHNOLOGY	5,977	5,537

FY 03 - Efforts addressed large capacity water production capabilities in the 100K-500K gallons per day range. These efforts focused on developing new technologies that reduced the logistics footprint making these large scale systems much more expeditionary and C130 transportable. This effort culminated with the development of a proof of concept system.

FY 04 - Efforts will continue modeling and developing data farming techniques to allow decision-makers to deal with asymmetric threats and the uncertainty inherent in conflicts in today's world. Specific areas of application include surf zone/beach obstacle reduction and mine counter measures, human decision-making and command and control, and defense against enhanced blast weapons. Other areas of potential application include ship-to-objective maneuver, urban operations, homeland defense, force protection, and uninhabited vehicles.

R9333	FY 2003	FY 2004
CENTER FOR EXCELLENCE FOR ROBOTICS, ADVANCED TECHNOLOGY DEMO	0	1,384

This effort is related to development and deployment of robotic systems, to include the use of autonomous and semi-autonomous vehicles in military and civil application domains.

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

Exhibit R-2a

BA: 03 PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: USMC Advanced Technology Demonstration (ATD)

PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9334	FY 2003	FY 2004
RAPID REPAIR, PORTABLE PRODUCTION (R2P2)	0	989

This effort will provide new capabilities in basic infrastructure technologies such as construction materials. New lighter materials that are thermally resistant, bio-resistant, and more rapidly deployable are mission critical to Expeditionary Forces.

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

BA: 03 PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION

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
R2497 Joint Experimentation	101,816	137,315	167,626	173,292	171,693	161,539	161,451
Totals	101,816	137,315	167,626	173,292	171,693	161,539	161,451

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Combatant Commander, U.S. Joint Forces Command (C/C USJFCOM) was chartered "as the Executive Agent for conducting joint warfighting concept development and experimentation within the Department of Defense." The Secretary of Defense signed the U.S. Joint Forces Command's Joint Warfighting Experimentation Charter on 15 May 1998. H8150, 22 September 1998, Sec 922, directed the establishment of Joint Warfighting Experimentation.

Each Combatant Commander (C/C) has input to the priorities for experimentation through the U.S. Joint Forces Command Combatant Commander Engagement program. The future of joint warfighting is the U.S. Joint Forces Command's area of responsibility. Joint Experimentation's purpose is to lay the foundation for national security transformation. Development of a coherent joint force starts with aggressive concept development and robust joint experimentation. U.S. Joint Forces Command establishes a common joint context for the Department of Defense, which has already proven to be a powerful tool that fosters coherence, improved stewardship and early interoperability materiel solutions "born joint." Concept development, both Joint and Service, happens through intellectual exploration, focus, and partnerships.

DoD priorities supported by Joint Experimentation: a) Successfully pursue the Global War on Terrorism; b) Strengthen joint warfighting capabilities; c) New concepts of global engagement; d) Transform the joint force; e) Homeland Security; f) Optimize intelligence capabilities; and g) Improve Department of Defense Processes. We ensure this transformation by exploring, testing, and then establishing new combinations of concepts, capabilities, people, and organizations. Through the process of discovering new capabilities, we can exploit our nation's strengths and advantages while protecting ourselves from asymmetric forces that threaten our strategic superiority. Joint Experimentation implements this transformation mission through a process of discovery, innovation, concept development, and experimentation to provide for optimal joint future force capability.

BA: 03 PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION

The Joint Experimentation campaign focuses on developing two distinct products as the result of a two-path strategy on which we base our approach to innovation. The first path is called the Joint Prototype Pathway. This conceptual/prototypical system or doctrine evolves from concept experimentation in concert with our partners. These systems are inserted into real world situations (e.g., U.S. Forces Korea) so that we can expand the experimental ground and refine the concept/prototype at the user level to ensure the solutions work as envisioned. This path is designed to help the Department improve near-term warfighting capabilities now by taking new ideas or concepts that originate on the joint concept development pathway and converting them into physical form, as developmental prototypes. From there, these prototypes are put into the hands of joint warfighters as quickly as possible to validate the capability at the user level. While commanders feel that a number of new concepts offer greater promise than current capabilities, they use them with the understanding that they are part of the continuing refinement process. Some aspects of these concepts were utilized in Operation Enduring Freedom and Operation Iraqi Freedom.

The second path is called the Joint Concept Development Pathway. This path and its products consist of actionable recommendations that result from collaborative experimentation with new concepts and capabilities that focus on the next decade. Based on how these concepts perform at the user level, we make recommendations to senior leaders that help them decide how to invest military resources in the next decade. Work performed on the joint concept development path is dedicated to making long-term improvements to military capability, focusing on making next decade improvements to joint warfighting. Part of the campaign strategy is continuous experimentation using Combatant Commanders' exercises and operations (engagement and combat) across a Distributed Continuous Experimentation Environment. U.S. Joint Forces Command designed the Distributed Continuous Experimentation Environment to be a world-class resource designed to support continuous experimentation—a sophisticated network of high-tech model and simulations with a global reach, both virtual and physical. This laboratory is capable of conducting various experiments, either locally or globally and, because of this, our partners, the Services, Combatant Commanders, allied nations, or various agencies, may participate in experiments at levels specific to their needs and interests.

For joint concept experimentation to be effective, we use four common scenarios that reflect current and future threats based on the geopolitical and military realities we see emerging between now and 2015: 1) Major Combat operations against an inaccessible adversary who presents a global weapon of mass destruction threat; 2) Joint operations in urban environments; 3) Operations against a non-state actor with significant regional combat capability, weapons of mass effect, and ties to global terrorist operations; and 4) Operations against a faltering or failing state that has regional weapons of mass destruction of mass effect capability. These scenarios are the basis for evaluating the major military challenges that were derived from strategic guidance and input from the Services and combatant commands.

BA: 03 PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION

USJFCOM's efforts over the next several years will focus in particular on the following concepts: Achieving decision superiority: shared-situation understanding so that we can make decisions and take action faster than any adversary; Creating coherent effects: Harmonizing military, interagency, and multinational activities at the strategic, operational, and tactical levels against any type of adversary; Conducting and supporting distributed operations: Planning, preparing, and executing simultaneously in multiple theaters and widely distributed points of action within each theater while denying sanctuaries and protecting ourselves from homeland to point of action.

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	95,512	151,058	162,105
Cong. Rescissions/Adjustments/Undist.Reductions	0	-1,741	0
Congressional Actions	0	-12,000	0
JNTC Operations	8,800	0	0
Inflation Savings	0	0	-544
JFCOM PE Realignment	0	0	766
Rate Adjustments	0	-2	-1
SBIR Assessment	-2,496	0	0
Training Transformation	0	0	5,300
FY 2005 President's Budget Submission	101,816	137,315	167,626

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

BA: 03 PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION

PROJECT NUMBER: R2497 PROJECT TITLE: Joint Experimentation

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
R2497 Joint Experimentation	101,816	137,315	167,626	173,292	171,693	161,539	161,451

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Joint Experimentation Campaign Plan focuses on high priority tasks assigned to U.S. Joint Forces Command (USJFCOM) through the Defense Planning Guidance (DPG) and the Chairman of the Joint Chiefs of Staff (CJCS) Instructions on Joint Concept Development and Experimentation which direct USJFCOM to continue development and refinement of, and experimentation with, Rapid Decisive Operations (RDO) as an integrating concept supported by eight functional concepts that provide critical capabilities for Rapid Decisive Operations. These functional concepts are: Knowledge Centric Command and Control (K/C2) comprised of: Common Relevant Operational Picture (CROP), Adaptive Joint Command and Control (AJC2), and Joint Interactive Planning (JIP); Focused Logistics (FL); Information Operations (IO); Assured Access (AA); Strategic Deployment (SD); Operational Net Assessment (ONA); Joint Intelligence, Surveillance and Reconnaissance (JISR); and Effects-Based Operations (EBO).

In FY 2003, USJFCOM moved to a continuous experimentation environment. USJFCOM accelerated the Impact/Vision Experiments as a continuous experimentation pathway in addition to the Joint Prototype Pathway for Standing Joint Force Headquarters (SJFHQ) enabling concepts. A series of experiments addressed the challenges of Rapid Decisive Operations -- Next Decade, Joint Operations Concept (JOpsC), and subordinate Joint Operating Concepts (JOC) to integrate concepts in FY 2015 and beyond. The Impact/Vision experiments provide the joint context for exploring how well these future concepts work together to transform joint military capabilities at the operational level of war. In the Campaign Plan 2003, the Combatant Commander of USJFCOM directed that concepts relating to Joint Command and Control meet the Chairman’s goal of having a Standing Joint Force Headquarters capability for the Combatant Commanders by 2005. USJFCOM synchronized Joint and Service efforts in a “battle rhythm” that balances concept development with experimentation and smaller events that are more agile and adaptable. USJFCOM continues to strengthen these tools for conducting joint concept development and experimentation, including scalable parallel processing for modeling and simulation, providing highly capable and thinking adversaries through more effective red teaming initiatives, and building stronger links with other U.S. agencies and potential coalition partners.

USJFCOM efforts over the next several years will focus in particular on two paths: the Joint Prototype Pathway, which is aimed at improving warfighting capabilities now, maturing capabilities through developmental prototyping activities by putting concepts at the user level for refinement efforts; and the Joint Concept Development Pathway, which is aimed at developing future warfighting capabilities. Developing the enabling concepts for Standing Joint Force Headquarters (SJFHQ) on the Joint Prototype Pathway addresses the first two of four transformation pillars identified in the Quadrennial Defense Review, and meets specific guidance from the Secretary of Defense and the Chairman Joint Chiefs of Staff.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Joint Concept Development Pathway	54,606	47,775	51,191

This includes Joint Capstone Concept (JCC), Impact and Vision Experiment Series, Knowledge Centric Command & Control (K/C2), Limited Objective Experiments (LOE), Concept Development, and Multi-national and Coalition Concept Development previously in the FY 2004 President's Budget.

FY 2003 Accomplishments:

During FY 2003 USJFCOM initiated work on future concepts in the FY 2015 timeframe and out. Efforts for the year included Pinnacle Impact 2003, which focused on addressing the 18 issues identified by Regional Combatant Commanders.

Achieving Decision Superiority	**Creating Coherent Effects**	**Conducting & Supporting Distributed Operations**
1. Achieving info superiority (anticipatory understanding)	1. Info operations and info assurance	1. Force projection: Deployment, Employment and Sustainability
2. Decision making in a Collaborative Information Environment	2. Joint maneuver and strike: a. Global b. Operational c. Tactical	2. Force protection and base protection
3. Coalition and interagency info sharing	3. Interagency operations	3. Counter anti-access and area-denial (includes Forcible Entry Ops)
4. Global integration	4. Multinational operations	4. Low density high demand assets

5. JISR	5. Precise effects	5. Proper decentralization
	6. Urban operations	
	7. Deny sanctuary	
	8. Transition operations	

FY 2004 Plans:

- Joint Operations Concepts (JOpsC): Describes how the Joint Force intends to operate within the next 15 to 20 years. We link strategic guidance with the conceptual framework to guide future joint operations and joint, Service, combatant command and combat support defense agency concept development and experimentation, and the foundation for the development and acquisition of new capabilities.
- Major Combat Operations (MCO): Communicates a more specific vision of how a Joint Force Commander will integrate multiple functional concepts within a coherent warfighting strategy that addresses conflicts ranging between nuclear war and peacekeeping.
- Stability Operations: Addresses activities that precede and follow conflict. This concept will directly affect future doctrine development, the aforementioned functional concepts, and support the further development of recommendations.
- Joint Urban Operations (JUO): Developing operational capabilities for warfighting in urban terrain impacting maneuver, engagement and force protection.
- Strategic Deterrence (SD): Strategy that addresses activities designed to deter aggression or coercion, including counter-proliferation efforts, defense against weapons of mass destruction, overseas presence, peacetime military engagement, and both nuclear and non-nuclear strikes.
- Joint Concept Development: Strengthens joint warfighting capabilities and transforms the joint force and wins the global war on terrorism with JOpsC and subordinate Joint Operating Concepts (JOC), development and implementation of the CJCS directed Standing Joint Force Headquarters (SJFHQ) and its enabling concepts, and development and implementation of the DPG 04-09 directed Joint National Training Capability (JNTC). Development of the JOpsC and subordinate JOCs are critical to transformation of the Department. The TPG states the transformation of how we fight "hinges on the development of future joint warfighting concepts" and the ongoing reform in the acquisition process will allocate resources based on these joint operating concepts.

FY 2005 Plans:

USJFCOM Joint Concept Development Pathway continues to refine future concepts in the 2015 timeframe and out.

	FY 2003	FY 2004	FY 2005
JNTC Advanced Training Technologies (ATT)	8,800	27,100	46,747

FY 2003 Accomplishments:

The Joint National Training Capability began RDT&E efforts in FY 03 to move towards the goal of an Initial Operating Capability by October 04 as is articulated in DPG 04 and the DEPSECDEF approved Training Transformation Plan. Three major focus areas were undertaken, Modeling and Simulation Improvements, Range Integration, and Development of Virtual Capabilities for future use in the Joint National Training Capability. The development of a "Federated Object Model" enables future joint training that can join the current service specific models for their warfare areas. Range integration allows the fusion of live, virtual and constructive (LVC) capabilities to increase the complexity of joint training problems to emulate real world capabilities. Finally significant investments were made with each of the Services to enable various platform virtual simulators to be used in joint training exercises. These successful activities are a precursor to expanding joint training to the tactical level and enabling JFCOM to train like it fights as was directed by the SECDEF.

FY 2004 Plans:

- Establish an architecturally based systems engineering process to systematically progress from requirements analysis, through architecture development, system design, capability development and integration, testing, certification and deployment. This function includes the definition of required standards and interfaces for operation of JNTC infrastructure/capabilities and the implementation of a Collaborative Information Environment.
- Define, develop and model the JNTC Operational, System and Technical Architectures for a distributed training capability designed to execute Joint Tactical Task-based joint training events. The architecture development will form the technical framework from which JNTC infrastructure and its interfacing systems will be designed/integrated. The Operational Architecture will organize and model system requirements. The System Architecture will translate Logical Nodes and packages of requirements to JNTC Physical Nodes and system Configuration Items (CIs) (i.e. sites, products and applications). The Technical Architecture will furnish the standards and technical interfaces for integration of JNTC systems.
- Establish a prototype Collaborative Information Environment (CIE) designed to support; 1) an Operational Collaborative Environment in which USJFCOM, Combatant Commands, Services, and Components can participate in the development of coordinated training plans, event planning and cooperative execution of the Joint Event Life Cycle; 2) a Technical Collaborative Environment for the concurrent development of JNTC software and

hardware; and 3) an Event Execution Collaborative Environment for the conduct of distributed joint training events.
- Develop an operational information management/knowledge management plan that serves the needs of JNTC.

FY 2005 Plans:

- Perform experimental testing with a LVC distributed testbed to support the conduct of distributed training events in the context of the joint integrated battlespace. The testbed will operate as a Continuous Training Environment and provide the foundation to a deployable Mission Rehearsal System. The LVC testbed will support joint training events, Research and Development (R&D) test events and interoperability certification assessments. The testbed will enable new training CONOPS to drive efficiency into the planning and conduct of complex joint training events. It will also provide capability to identify, evaluate and solve training system shortfalls.
- Prototype a knowledge management framework that provides access to digital libraries and distributed learning centers in the centers of excellence to support Standing Joint Force Headquarters training and mission rehearsal.
- Develop a real world database for geography and forces to facilitate mission rehearsal capability.
- Develop OPFOR Threat systems to include Service instrumentation, interoperability standards, weapons models and simulated terrain, and virtual training capabilities.

	FY 2003	FY 2004	FY 2005
Standing Joint Force Headquarters Enabling Concepts	28,810	31,288	33,524

FY 2003 Accomplishments:

Prototype concepts were inserted into Regional Combatant Commands (RCCs) to refine the concepts at the user level in real world environments. These enabling concepts are as follows:
- Collaborative Information Environment (CIE): Facilitates information and knowledge exchange among members of the joint force and its supporting organizations, thereby providing warfighters with the ability to share information and ideas, to reduce planning times and to enhance operational effectiveness. CIE permits joint force commanders and their staffs to plan interactively in an information-rich, shared environment, enabling them to collaborate with supporting organizations wherever they are located. Decision-makers and planners will overcome geographic separation to access relevant information sources and decision support systems.
- Operational Net Assessment (ONA): A continuous, dynamic, system of systems analysis of the enemy’s total war-making capability providing the joint force a comprehensive analysis of the extended battlespace. Conducted through reach-back to a national network of centers of excellence giving the combatant commander

access to the full capabilities of US interagency community, non-governmental and possibly, to allied and coalition partners. It identifies those capabilities, assets, connections, loyalties, networks, and other assets (both physical and non-physical) that are important and most valuable to the adversary and ONA. The ONA capabilities are available to the entire national force, including all of the elements of national power that can be leveraged. The ONA provides the commander with a set of effects-based courses of action from which to choose for implementation.
– Effects-Based Operations (EBO): Views the adversary and battlespace "holistically" as an integrated "system-of-systems." It leverages networked knowledge and understanding of the adversary and battlespace environment to translate policy into actions to create a desired end state, and seeks to match, coordinate, and synchronize the best combination of military actions to support the interagency actions required to generate the effects necessary to achieve our national aims.
- Joint Interagency Coordination Group (JIACG): A multi-functional advisory element on the Combatant Commander's staff that facilitates information sharing across the interagency community through habitual collaboration to integrate campaign-planning efforts between the strategic and operational levels across all U.S. government agencies.
- Joint Fires Initiative (JFI): Encompasses products that describe a jointly integrated/interoperable fires and fire support prosecution capability. JFI coordinates the efforts of various DoD fires and fire support efforts towards a single jointly interoperable set of functionalities and processes from operational to tactical levels with a common set of automated functionalities and processes.
- Joint Intelligence, Surveillance, and Reconnaissance (JISR): A network-centric approach that transforms inter-agency, all source intelligence, surveillance, and reconnaissance to support the knowledge demands emerging from joint, component, service, and multinational needs.

FY 2004 Plans:

USJFCOM Joint Prototype Path continues to refine the enabling concepts to support the Chairman Joint Chief of Staff's (CJCS) direction to establish an operable Standing Joint Force Headquarters (SJFHQ) by 2005 for each of our Combatant Commanders and to develop next decade warfighting capabilities.

FY 2005 Plans:

USJFCOM Joint Prototype Path continues to refine forthcoming enabling concepts from the Joint Concept Development Pathway in order to ensure U.S. military superiority into the 21st century.

	FY 2003	FY 2004	FY 2005
Standing Joint Force Headquarters (SJFHQ) Interoperability Technology Demonstration Center (ITDC)	0	10,000	13,500

FY 2003 Accomplishments:

Not applicable.

FY 2004 Plans:

Interoperability Technology Demonstration Center (ITDC) will demonstrate the five categories of operational, system of systems, technical, software, and procedural interoperability of selected new programs or systems prior to further progress within the acquisition system. ITDC is an initiative supporting USJFCOM's responsibilities for Joint Command & Control (JC2) capabilities. ITDC will execute interoperability demonstrations for selected new programs or systems. The purpose of demonstrations is to ensure interoperability within the Joint Command and Control environment (JC2E). The added advantage of demonstrations is the provision of high quality cost and schedule estimates of low cost support options for a program office. For example, the ITDC, in conjunction with the Deployable Joint Command and Control (DJC2) program office, could demonstrate interoperability of prototype capabilities, in support of Standing Joint Force Headquarters (SJFHQ), at lesser cost than contract supported prototype. The ITDC will provide interoperability demonstrations leveraging vehicles such as the Joint National Training Capability.

The successful fielding of interoperable JC2 systems is equally dependent on the ITDC as well as the successful completion of the operational assessment process. Both processes support the acquisition process, as it should be implemented in support of SJFHQ standup and other DOD transformation programs. The operational assessment process supports the assessment of operational prototypes in operational environments. These operational prototypes are developed as enablers to approved needs created out of concept experiments and lead to identification for fielding interim capabilities. The ITDC provides interoperability demonstrations of selected (configuration controlled) pilot capability implementations in coordination with a joint program office, such as DJC2. Successful performance of a candidate capability to be fielded in an interoperability demonstration will support the need for capabilities to be "born joint."

FY 2005 Plans:

ITDC will continue demonstrating the five categories of operational, system of systems, technical, software, and procedural interoperability of selected new programs or systems prior to further progress within the acquisition system. ITDC will continue to provide interoperability demonstrations of selected (configuration controlled) pilot capability implementations in coordination with a joint program office. Demonstrations of pilot implementations will lead to early identification of interoperability issues and allow for earlier fielding of interoperable joint capabilities.

	FY 2003	FY 2004	FY 2005
Joint Deployment, Employment and Sustainment (JDES)	1,000	7,475	8,009

FY 2003 Accomplishments:

- Logistics Quick Wins: Identified and instituted doctrinal and training changes for existing logistic systems to streamline deployments. Changes were worked with TRANSCOM and Services.
– Logistics Common Relevant Operational Picture (Log CROP): A tool used to manage volumes of logistical information and to develop a shared understanding of the battlespace among commands. This virtual warehouse is integrated, customizable, and tailored to be relevant to the user and assists all echelons to achieve situational logistical awareness. It includes: top to bottom information access, decision support tools used to transform information knowledge, and situational awareness in a shared environment.
- Joint Deployment Process Owner (JDPO): Transformed deployment, employment, and sustainment of the joint force into a simple seamless, knowledge-based joint deployment process supported by distributed, concurrent, collaborative planning processes and tools, using real-time, accurate and reliable information, enabling supported and supporting commanders to execute effective and efficient joint deployment operations. It addresses the continuum of deployment, employment, and sustainment for a coherently joint and multinational force that is capabilities based, fully networked and knowledge centric.

FY 2004 Plans:

Joint Deployment, Employment, and Sustainment (JDES) is focused on near term improvement and next decade capabilities in DES (Logistics and Transportation), to support or solve issues related to Force projection; how we deploy, employ, and sustain the force. JDES directs the development of a collaborative information environment that facilitates the fusion of logistics information and visibility that enhances a Combatant Commander’s ability to deploy and sustain forces.

FY 2005 Plans:

JDES will continue to be focused on near term improvement and next decade capabilities in DES (Logistics and Transportation) by identifying joint concepts and capabilities that support or solve issues related to Force projection; how do we deploy forces; employ forces in the combat areas such as multi-service force packages (e.g., special forces, seals) in hostile zones; and sustain the forces.

	FY 2003	FY 2004	FY 2005
Integration with Other Regional Combatant Commanders, Military Services and Agencies	4,570	6,927	7,422

FY 2003 Accomplishments:

Continued communication efforts to fully coordinate planned concept development and experimentation with Combatant Commanders and the Services. Adequately captured and assessed current joint warfighting needs and directions for experimentation. This is done through a continued leveraging of Service and Title X wargames such as Pinnacle Impat 2003, Navy Global, Air Force Global Engagement, Army Transformation Wargame, SPACECOM Schriever, SOCOM Vision Series, and USMC Expeditionary Warrior.

FY 2004 Plans:

Continuing communication efforts to fully coordinate planned concept development with our partners. This is done through a continued leveraging of Service and Title X wargames. The key activities will be PACOM Cobra Gold, EUCOM Agile Response, SOUTHCOM Blue Advance, Army Unified Quest, Navy Unified Course, and Terminal Fury.

FY 2005 Plans:

Continuing communication efforts to fully coordinate planned concept development and experimentation with our partners. Adequately capture and assess current joint warfighting needs and directions for experimentation. This is done through a continued leveraging of Service and Title X wargames. The key activities will be Internal Look, Navy Unified Course, OSD Transformation Wargame, USMC Expeditionary Warrior, SPACECOM Schriever, Army Unified Quest, Air Force Global Engagement VII, DARPA Technology Wargames, and other future wargames not yet identified.

	FY 2003	FY 2004	FY 2005
Innovation and Exploration/Project Alpha	4,030	6,750	7,233

FY 2003 Accomplishments:

USJFCOM initiated a quick turn around, analytical modeling capability to rapidly assess new ideas without investing large amounts of resources until viability is proven. Initiatives include Swarming Unmanned Aerial Vehicles concept using robotic entities—centrally commanded, but autonomously controlled—dispersed in swarms to assist the future Joint Force against an adversary. With the assistance of Defense Advanced Research Project Agency (DARPA), experiments are on-going to determine how the Swarming Unmanned Aerial Vehicles (UAVs) mitigate the risks of Surface to Air Missiles (SAMs) defending enemy Transporter Erector Launchers (TELs) in a Joint Area of Responsibility (JOAR).

FY 2004 Plans:

USJFCOM continues using the analytical model to rapidly assess new ideas. Innovation and exploration efforts continue for impacting 2025-2040 timeframe. Investigation continues in areas of Hard-to-Get Signals, sensor development, complexity, crisis and instability forecasting, and others.

FY 2005 Plans:

As in 2004, USJFCOM continues using the analytical model to rapidly assess new ideas. Innovation and exploration efforts continue for impacting 2025-2040 timeframe. Investigation continues in areas of application of nano-biotechnology, knowledge workers, unmanned effects, multinational information sharing, among others.

C. OTHER PROGRAM FUNDING SUMMARY:

RELATED RDT&E:

PE 0601152N In-house Laboratory Independent Research
PE 0601153N Defense Research Sciences
PE 0602114N Power Projection Applied Research
PE 0602123N Force Protection Applied Research
PE 0602131M Marine Corps Landing Forces Technology
PE 0602235N Common Picture Applied Research
PE 0602236N Warfighter Sustainment Applied Research
PE 0602271N RF Systems Applied Research

PE 0602435N Ocean Warfighting Environment Applied Research
PE 0602747N Undersea Warfare Applied Research
PE 0602782N Mine and Expeditionary Warfare Applied Research
PE 0603114N Power Projection Advanced Technology
PE 0603123N Force Protection Advanced Technology
PE 0603235N Common Picture Advanced Technology
PE 0603236N Warfighter Sustainment Advanced Technology
PE 0603271N RF Systems Advanced Technology
PE 0603640M USMC Advanced Technology Demonstration (ATD)
PE 0603729N Warfighter Protection Advanced Technology
PE 0603747N Undersea Warfare Advanced Technology
PE 0603757N Joint Warfare Experiments
PE 0603758N Navy Warfighting Experiments and Demonstrations
PE 0603782N Mine and Expeditionary Warfare Advanced Technology

NON-NAVY RELATED RDT&E:
PE 0603750D Advanced Concept Technology Demonstration

D. ACQUISITION STRATEGY:

Not applicable.

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

BA: 03 PROGRAM ELEMENT: 0603729N
PROGRAM ELEMENT TITLE: Warfighter Protection Advanced Technology

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
R2715 DISTRIBUTED SIMULATION WARFIGHTING CONCEPTS	3,238	0	0	0	0	0	0
R2914 WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	12,769	11,308	16,719	18,637	19,812	20,240	20,673
R9030 ORGAN TRANSFER TECHNOLOGY	2,896	2,472	0	0	0	0	0
R9031 DAMAGE CONTROL OPERATIONAL CONCEPTS	0	1,682	0	0	0	0	0
R9161 MEDICAL DATA MINING TOOL (MDMT)	5,163	0	0	0	0	0	0
R9162 NAVY MEDICAL SYSTEM CONFIGURATION AND TESTBED/NURSING TELEHEALTH RESEARCH PROGRAM	7,739	8,406	0	0	0	0	0
R9163 PORTABLE STERILE WATER PRODUCTION DEVICE	952	2,967	0	0	0	0	0
R9335 CENTER FOR COLLABORATION IN MEDICAL MODELING & SIMULATION	0	1,483	0	0	0	0	0
Totals	32,757	28,318	16,719	18,637	19,812	20,240	20,673

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports the development and demonstration of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. 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 funds the Warfighter Protection Future Naval Capability (WPFNC) and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike".

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	39,058	11,435	12,362
Cong. Rescissions/Adjustments/Undist.Reductions	0	-317	0
Congressional Actions	0	17,200	0
Execution Adjustments	-5,478	0	0
Inflation Savings	0	0	-40
SBIR Assessment	-823	0	0
Technical Adjustments	0	0	4,397
FY 2005 President's Budget Submission	32,757	28,318	16,719

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

BA: 03 PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: Warfighter Protection Advanced Technology
PROJECT NUMBER: R2914 PROJECT TITLE: Warfighter Protection Advanced Technology

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
R2914 Warfighter Protection Adv Tech	12,769	11,308	16,719	18,637	19,812	20,240	20,673

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project supports the development and demonstration of advanced technologies for improved warfighter protection medical equipment, techniques, technologies and systems. These technologies enhance Navy and Marine Corps capabilities in Casualty Care and Management, Casualty Prevention, and maintenance of a Healthy and Fit Force. Within the Naval Transformation Roadmap, this investment protects the critical "Sea Warrior" component of the overarching "FORCEnet" operating architecture. Additionally, this project supports the transformational capability, Enhanced Sea-borne Positioning of Assets (medical logistics) within "Sea Basing" and the Ship-To-Objective Maneuver capability (expeditionary force medical support) within "Sea Strike".

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Casualty Care and Management	5,746	5,088	7,523

The goal of Casualty Care and Management is to maximize the continuum of care with lifesaving interventions as far forward as possible, in an increasingly lethal battlespace, with reduced infrastructure and logistics.

FY 2003 Accomplishments:

- Completed development of a portable hand-held ultrasound device to be used for diagnostic application by the corpsman in the field. This device was fielded (COMSIXTHFLT) and purchased for clinical use by USAF Special Forces Command.
- Terminated development of a device utilizing high intensity focused ultrasound (HIFU) technology for hemostasis (control of bleeding).
- Terminated development of a dressing that controls bleeding and incorporates an antimicrobial agent.
- Transferred testing and evaluation of the shipboard medical grade water system under field conditions to

project R9163 (Congressional add).
- Continued development of drugs and devices for treatment of uncontrolled hemorrhage in the far forward battlefield. Provided to Naval forces, QuikClot, which is a hemorrhage-stopping agent credited with saving multiple lives during Operation Iraqi Freedom. Blood loss is the leading cause of preventable death in combat.
- Continued development of resuscitation fluids that enhance cardiovascular function and tissue perfusion. Improved resuscitation fluids are needed to prevent casualty deaths from shock and associated tissue/organ damage.
- Continued development of medical devices to monitor patient status and identify casualties in danger of progressing into hemorrhagic shock.
- Continued identification of Food and Drug Administration (FDA) approved or novel therapeutics that protect against the induction of hemorrhagic shock and thereby alleviate the need for resuscitative fluids. A reduced need for resuscitative fluids would significantly reduce the medical logistical burden for Naval forces.
- Continued development of the casualty management coordination system. These data are required by combat, material development, and medical planners to evaluate the effectiveness of personal protection systems and healthcare support services, and to project future material and training requirements.

FY 2004 Plans:

- Continue development of drugs and devices for treatment of uncontrolled hemorrhage in the far forward battlefield.
- Continue development of resuscitation fluids that enhance cardiovascular function and tissue perfusion.
- Continue development of medical devices to monitor patient status and identify casualties in danger of progressing into hemorrhagic shock.
- Continue identification of Food and Drug Administration (FDA) approved or novel therapeutics that protect against the induction of hemorrhagic shock.
- Continue development of the casualty management coordination system.
- Initiate development of an effective analgesic for controlling severe pain that does not have the adverse effects of morphine (cardiorespiratory depression, sedation) or the addiction potential. Naval casualties are expected to “stay in the fight” as long as possible and the use of morphine removes that capability.

FY 2005 Plans:

- Continue development of drugs and devices for treatment of uncontrolled hemorrhage in the far forward battlefield.
- Continue development of resuscitation fluids that enhance cardiovascular function and tissue perfusion.

- Continue development of medical devices to monitor patient status and identify casualties in danger of progressing into hemorrhagic shock.
- Continue identification of FDA approved or novel therapeutics that protect against the induction of hemorrhagic shock.
- Continue development of the casualty management coordination system.
- Continue development of an effective analgesic for controlling severe pain.
- Initiate development of a joint services resuscitation fluid. This coordinated Army/Navy project will develop a next-generation resuscitation fluid to support far forward medical care.

	FY 2003	FY 2004	FY 2005
Casualty Prevention	6,001	5,314	7,858

Casualty Prevention includes enhancing warfighter situation awareness and countering threats from disease, battle and non-battle injuries.

FY 2003 Accomplishments:

- Terminated efforts on enhanced maintenance of spatial disorientation.
- Terminated development of an environmentally controlled litter system.
- Continued development of the capability to detect laser events and provide daytime protection of aircrews from laser attacks. No laser protection or detection methods exist for daytime protection of aircrew from tunable frequency lasers.
- Continued development of protective personal gear and physiologic monitoring ensembles to reduce injury risk and enhance personnel safety in operational settings that include: shipboard firefighting and damage control operations, warm and cold water operations for Navy divers, and extreme aircraft operations (g-force, altitude and heat protection).
- Continued development of standards for personal armor systems to protect against “behind armor blunt trauma” (BABT).

FY 2004 Plans:

- Complete development of standards for personal armor systems for blunt trauma (BABT).
- Continue development of the capability to detect laser events and provide daytime protection of aircrews from laser attacks.
- Continue development of protective personal gear and physiologic monitoring ensembles to reduce injury risk and enhance personnel safety in operational settings.

- Initiate development of tools to predict injury related to thermobaric blast.

FY 2005 Plans:

- Complete laser event detection/protection effort.
- Continue development of the capability to detect laser events and provide daytime protection of aircrews from laser attacks. Initiate laboratory testing of candidate agile laser eye protection systems.
- Continue development of protective personal gear and physiologic monitoring ensembles to reduce injury risk and enhance personnel safety in operational settings. Initiate horizontal accelerator and flight testing of Airborne Integrated Life Support System.
- Continue development of tools to predict injury related to thermobaric blast.
- Initiate effort to develop noninvasive diagnostic tests for diseases. This effort will provide a rapid test for exposure to tuberculosis and verification of the immunization status of individuals receiving the anthrax vaccine series.

	FY 2003	FY 2004	FY 2005
Healthy and Fit Force	1,022	906	1,338

Healthy and Fit Force efforts preserve health and enhance fitness of ready forces against physical and psychological threats through the continuum of peace and war.

FY 2003 Accomplishments:

- Continued identification of factors and causes of injury in shipboard scenarios, and development of exposure guidelines and engineering specifications for preventing mechanical shock-related injury.
- Continued development of improved hearing protection systems for personnel supporting aircraft operations.

FY 2004 Plans:

- Continue identification of factors and causes of injury in shipboard scenarios, and development of exposure guidelines and engineering specifications for preventing mechanical shock-related injury.
- Continue development of improved hearing protection systems for personnel supporting aircraft operations.

FY 2005 Plans:

- Continue identification of factors and causes of injury in shipboard scenarios, and development of exposure guidelines and engineering specifications for preventing mechanical shock-related injury. Initiate human

centrifuge testing to validate guidelines and specifications.
- Continue development of improved hearing protection systems for personnel supporting aircraft operations. Initiate flight testing of hearing protection systems.

C. OTHER PROGRAM FUNDING SUMMARY:
RDT&E:

NAVY RELATED RDT&E:
PE 0601153N Defense Research Sciences
PE 0602235N Common Picture Applied Research
PE 0602236N Warfighter Sustainment Applied Research
PE 0603236N Warfighter Sustainment Advanced Technology
PE 0604771N Medical Development

NON-NAVY RELATED RDT&E:
PE 0602716A Human Factors Engineering Technology
PE 0602785A Manpower, Personnel and Training Technology
PE 0602787A Medical Technology
PE 0603002A Medical Advanced Technology
PE 0602202F Human Effectiveness Applied Research
PE 0603231F Crew Systems and Personnel Protection Technology

D. ACQUISITION STRATEGY: Not applicable.

CONGRESSIONAL PLUS-UPS:

R2715	FY 2003	FY 2004
DISTRIBUTED SIMULATION WARFIGHTING CONCEPTS	3,238	0

This effort examined warfighting concepts and weapon system design concepts and their relationship to future aircraft carrier designs.

R9030	FY 2003	FY 2004
ORGAN TRANSFER TECHNOLOGY	2,896	2,472

This effort addresses the induction of immune tolerance to transplanted foreign tissues through the use of immunological reagents. If the technology is effective, the transplant patient would not require subsequent immunosuppressive drug therapy, in contrast to the currently required life-long immunosuppressive drug therapy, nor would the patient's immune system be impaired.

R9031	FY 2003	FY 2004
DAMAGE CONTROL OPERATIONAL CONCEPTS	0	1,682

This effort develops and demonstrates a brassboard prototype of the Prognostics Framework (PF) approach to supplement, enhance and improve the Automated Hull Damage and Stability Monitoring System (AHDSMS). The enhanced AHDSMS provides visibility of real-time assessment of ship hull damage and compartment flooding which allows for optimization and prioritization of flooding control and stability response strategies.

R9161	FY 2003	FY 2004
MEDICAL DATA MINING TOOL	5,163	0

This effort initiated the development of medical data mining tools to advance the Navy's medical surveillance capability. The work focused on integrating the Medical Data Surveillance System (MDSS) with the DoD Health Care enterprise system, Theater Medical Information Project (TMIP).

R9162	FY 2003	FY 2004
NAVY MEDICAL SYSTEM CONFIGURATION AND TESTBED	7,739	5,885

This effort establishes a capability for expediting the delivery of emerging technologies from Navy Medical R&D efforts to DoD healthcare. Specifically, force health protection technologies developed by the Naval Health Research Center are undergoing further development and systems integration prior to actual field-testing.

R9162	FY 2003	FY 2004
NURSING TELEHEALTH RESEARCH PROGRAM	0 *	2,521

This effort establishes an international consortium of military medical technicians, educators, researchers, and domestic rural health care providers working to design and deliver a nurse training curriculum to remote international locations with special emphasis on emergency medical training and humanitarian relief. (*Appropriated in FY03 in Defense Health Program RDT&E, $2,550).

R9163	FY 2003	FY 2004
PORTABLE STERILE WATER PRODUCTION DEVICE	952	2,967

This effort focuses on advanced testing of a lightweight, man-portable, disposable device for producing water suitable for injection from potable water in the field.

R9335	FY 2003	FY 2004
CENTER FOR COLLABORATION IN MEDICAL MODELING AND SIMULATION	0	1,483

This project focuses on establishing a National Center for Medical Modeling and Simulation to integrate military, government, and industrial modeling and simulation technologies for use in medical and surgical training and in the delivery of medical services. Efforts include: integrating simulations into medical and surgical training; developing medical preparedness and response simulations; developing methods for on-site and distributed continuing education for medical and health professionals; determining paths for more rapid transition of medical modeling and simulation research into commercial products and programs; developing pro-operative and operative assistance for surgeons performing tissue and organ reconstruction; and facilitating civilian and military cooperation in the application of medical simulations to improve both routine and

emergency response capabilities.

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

BA: 03 PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

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
R2916 Undersea Warfare Advanced Technology	40,782	37,743	26,515	27,262	32,562	46,058	47,034
R9164 Motorized Air Gun Program	955	0	0	0	0	0	0
R9165 University Oceanographic Lab System	3,343	0	0	0	0	0	0
R9336 HAWAII UNDERSEA VEHICLE TEST & TRAINING ENVIRONMEN	0	2,076	0	0	0	0	0
R9337 PRIMAMETRIC MODIFICATION OF THE SQS-53C SURFACE SH	0	3,461	0	0	0	0	0
R9338 SAUVIM	0	1,286	0	0	0	0	0
R9339 SEA TEST FOR TOWED ACOUSTIC ARRAYS	0	1,978	0	0	0	0	0
Totals	45,080	46,544	26,515	27,262	32,562	46,058	47,034

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy advanced technology development in undersea target detection, classification, localization, tracking and neutralization is funded through this Program Element (PE). The related technologies being developed are aimed at enabling Sea Shield, one of the three core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new Anti-Submarine Warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. The focus is on leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship and air ASW assets.

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

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

BA: 03 PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	43,641	38,168	45,475
Cong. Rescissions/Adjustments/Undist.Reductions	0	-524	0
Congressional Actions	0	8,900	0
Execution Adjustments	2,710	0	0
Inflation Savings	0	0	-147
Rate Adjustments	0	0	-18
SBIR Assessment	-1,271	0	0
Technical Adjustments (includes transfer of Project Morgan)	0	0	-18,795
FY 2005 President's Budget Submission	45,080	46,544	26,515

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: In FY 2003 Project Morgan was to be funded with existing PE 0603747N funds at a level of $62.2M over four years as follows:
FY 2004—$18.6M FY 2005—$16.8M FY 2006—$14.1M; FY 2007—$12.7M

Littoral Anti-Submarine Warfare (LASW) Future Naval Capability (FNC) provided half of the overall Project funding. The impact on the LASW FNC schedule is summarized below:

- Littoral ASW Multistatic Project: Reduction of approximately $15M over the period FY 2004-2007; efforts re-directed to focus on data collection and several tasks have been delayed or terminated. The reductions extend project two years to FY 2009.
- PALANTIR: Project implementation delayed two years and project life extended accordingly (FY 2006-11) ($6.0M shifted to later years)
- Multi-Mode Magnetic Detection System: Implementation of project has been delayed one year; demonstrations delayed by 2 years (FY 2004-09); ($4.3M shifted to later years)
- Littoral Warfare Advanced Demonstration: Reduction of $5.8M over four years. Delays transitions, and partially shifts burden of funding demonstrations to individual LASW FNC projects.

In FY 2004 Project Morgan funding for FY 2005-07 was transferred from PE 0603747N (BA 3) to 0603734N (BA4).

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

BA: 03 PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology
PROJECT NUMBER: R2916 PROJECT TITLE: Undersea Warfare Advanced Technology

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
R2916 Undersea Warfare Advanced Technology	40,782	37,743	26,515	27,262	32,562	46,058	47,034

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy advanced technology development in undersea target detection, classification, localization, tracking and neutralization is funded through this project. Technologies being developed within this project are aimed at enabling Sea Shield, one of the three core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new Anti-Submarine Warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship and air ASW assets.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Wide Area Anti-Submarine Warfare (ASW) Surveillance	13,727	19,237	7,426

Wide Area ASW Surveillance is focused on dramatically improving the capability to sanitize large areas relative to the capabilities of legacy ASW sensors. Efforts include the development of affordable off-board systems with associated processing and robust, high-bandwidth communications links. The cornerstone of Wide Area Surveillance is the ability to rapidly distribute sensors from air, surface and sub-surface platforms as well as to develop long-endurance sensors and unmanned ASW vehicles. This activity represents a shift from traditional fixed surveillance systems to autonomous, networked, multi-static operation, supported by passive/active signal processing with the objective of increased detection capabilities. This activity includes support to Project Morgan (the details of which are classified). Project Morgan funding transfers to PE 0603734N, Project Z1804 in FY 2005.

FY 2003 Accomplishments:

- Completed development and interim testing of Claymore Marine (CM) on-board, in-flight, real-time processor

and associated detection algorithms.
- Completed analysis of the CM FY02 Tactical Test data and incorporated the results into demonstration planning.
- Completed CM processor technology demonstration including limited free-play against a non-cooperative target, with detections called in-flight.
- Transitioned Compact Deployable Multistatic Receiver (CDMR) signal processing algorithms to the Naval Air Systems Command (NAVAIR) Improved Extended Echo Ranging (IEER) Program in Program Element (PE) 0604261N.
- Continued requirements and technology study for a small, lightweight, low frequency multistatic source.
- Continued development of multistatic sonar signal classification algorithms for coherent/incoherent sources.
- Continued Deployable Autonomous Distributed System (DADS) algorithm development and validation.
- Continued at-sea testing of a DADS five-node design.
- Continued development and testing of DADS technologies in preparation for the FY05 barrier demonstration.
- Continued the Claymore Marine Engineering Development Model (CM EDM) assessment and documented results; provided recommendation for a potential acquisition decision.
- Initiated concept of operations development and performance requirements for multistatic sonar employing remotely operated sound sources and receivers.
- Initiated construction of Advanced Development Models (ADM) of CDMR and Compact Deployable Multistatic Sources (CDMS) for use in future at-sea demonstrations.

FY 2004 Plans:

- Complete requirements and technology study for a small, lightweight, low frequency multistatic source.
- Complete development of multistatic sonar signal classification algorithms for incoherent sources and transition to the NAVAIR IEER Program in PE 0604261N.
- Complete DADs baseline algorithm development and validation.
- Complete at-sea testing of a DADS five-node design.
- Complete the CM EDM assessment and provide an acquisition recommendation. Transition technologies to NAVAIR, PE 0603254N, ASW Systems Development.
- Complete construction of ADM of CDMR and CDMS for use in future at-sea demonstrations.
- Continue development of multistatic sonar signal classification algorithms for coherent sources.
- Continue development and testing of DADS technologies in preparation for FY05 barrier demonstration.
- Continue concept of operations development and performance requirements for multistatic sonar employing remotely operated sound sources and receivers.
- Initiate at-sea demonstrations and data collections with the CDMS ADM.
- Initiate test planning for FY05 barrier demonstration.

FY 2005 Plans:

- Complete development and testing of DADS technologies in preparation for a barrier demonstration.
- Complete planning for and conduct of DADS barrier demonstration.
- Continue at-sea demonstrations and data collections with the CDMS ADM.
- Continue development of multistatic sonar signal classification algorithms for coherent sources.
- Continue concept of operations development and performance requirements for multistatic sonar employing remotely operated sound sources and receivers.
- Initiate the writing of DADS system documentation.

	FY 2003	FY 2004	FY 2005
Battlegroup Anti-Submarine Warfare (ASW) Defense	10,626	8,274	8,218

Battlegroup ASW Defense technology focuses on the development of platform-based sources and receivers aimed at denying submarines the ability to target grey ships. This technology area is primarily concerned with detections inside 10 nautical miles. Battlegroup ASW Defense integrates next-generation technologies, automatic target recognition, sensors that adjust to complex acoustic environments, and environmentally adaptive processing techniques. Battlegroup ASW Defense will enable smaller, lighter, and cheaper arrays, large multi-line arrays, and submarine flank arrays all with environmental adaptation capabilities. This activity includes support to Project Morgan (the details of which are classified). Project Morgan funding transfers to Program Element (PE) 0603734N, Project Z1804 in FY 2005.

FY 2003 Accomplishments:

- Completed the writing of the Sonar Automation Technology (SAT) development plan.
- Completed development of High Frequency (HF) candidate transducers and fabricated partial arrays to demonstrate transducer performance. This effort was terminated due to budget reductions; analysis and report documentation was written.
- Completed development of Environmentally Adaptive (EA) AN/SQS-53C (part of AN/SQQ-89) signal processing and system control software.
- Completed EA AN/SQS-53C sonar system at-sea demonstrations utilizing fleet test platforms.
- Transitioned EA AN/SQS-53C sonar system technologies to PE 0205620N (Surface ASW Combat System Integration).
- Continued to develop, demonstrate and transition SAT threat submarine detection and classification algorithms to Naval Sea Systems Command (NAVSEA) under PE 0603561N (Advanced Submarine System Development), Project S0223 (Submarine Combat Systems Improvements).
- Continued hardware component integration, testing and installation of an acoustic array test bed in support

of future passive sonar system designs.
- Continued adaptive beamforming technology development.

FY 2004 Plans:

- Continue to develop, demonstrate and transition SAT threat submarine detection and classification algorithms to NAVSEA.
- Continue hardware component integration, testing and installation of an acoustic array test bed in support of future passive sonar system designs.
- Continue adaptive beamforming technology development.
- Initiate a performance evaluation of a Counter Torpedo Detection, Classification, and Localization (CTDCL) prototype torpedo protection system capable of countering two torpedoes launched in rapid succession.
- Initiate the integration of CTDCL products into the AN/WSQ-11 “Block II and III” system upgrades.

FY 2005 Plans:

- Complete hardware component integration, testing and installation of an acoustic array test bed in support of future passive sonar system designs.
- Continue to develop, demonstrate and transition SAT threat submarine detection and classification algorithms to NAVSEA.
- Continue adaptive beamforming technology development.
- Continue a performance evaluation of a CTDCL prototype torpedo protection system capable of countering two torpedoes launched in rapid succession.
- Continue integration of CTDCL products into the AN/WSQ-11 “Block II and III” system upgrades.
- Initiate a focused research study to evaluate sonar array performance using the acoustic array testbed.
- Initiate Multi-Mode Magnetic Detection System (MMMDS) development of magnetometer sensor technologies and deliver first AN/ASQ-233 magnetometer sensor.
- Initiate the integration of MMMDS sensor hardware/software into towed vehicles and fixed-wing Unmanned Air Vehicles (UAVs).

	FY 2003	FY 2004	FY 2005
Cooperative Anti-Submarine Warfare (ASW)	7,449	4,458	3,759

Cooperative ASW technology developments enable ASW platforms to work together effectively to detect, classify and localize very quiet undersea targets. Many of the tools required to achieve this objective have been developed under the heading of Integrated ASW (IASW) in Program Elements (PEs) 0602235N and 0603235N. The

IASW effort has since been terminated due to budget reductions. In this PE (0603747N), the focus is to demonstrate the operational utility of employing these IASW tools together with ASW sensor technologies developed as part of the Battlegroup ASW Defense, Wide Area ASW Surveillance, and Neutralization program areas. Demonstrations are conducted primarily in conjunction with Fleet platforms and exercises. This activity includes support to Project Morgan the details of which are classified. Project Morgan funding transfers to PE 0603734N, Project Z1804 in FY 2005.

FY 2003 Accomplishments:

- Continued Littoral Warfare Advanced Demonstration (LWAD) test planning, scientific support, fleet and research vessel coordination, test reconstruction, logistical and environmental compliance support for three Littoral ASW (LASW) Future Naval Capability (FNC) initiatives, with one CONUS (Continental United States) demonstration and two overseas experiments.

FY 2004 Plans:

- Continue LWAD activities for two LASW FNC CONUS at-sea experiments and one overseas demonstration in collaboration with The Technical Cooperation Program (TTCP) and involving multiple ASW technologies.

FY 2005 Plans:

- Continue LWAD activities for one LASW FNC CONUS at-sea experiment and two overseas demonstrations involving multiple ASW technologies.

	FY 2003	FY 2004	FY 2005
Neutralization	8,980	5,774	7,112

Neutralization focuses on undersea weapons technologies to counter threat submarines by increasing the Probability of Kill (PK). Weapon technology areas include: (1) Non-Traditional Homing which addresses the demonstration of the operational utility of a stealthy torpedo detection, classification and homing sensor (this effort has been terminated in FY 2004 due to budget reductions); (2) Weapon/Platform Connectivity (FY03) and Torpedo Bridging Technologies (TBT) (FY04 and beyond) which address development of technologies to enable a heavyweight torpedo and a shooting platform to be effectively employed as a fully-linked weapon system; and (3) the SwampWorks Advanced Torpedo (SWAT) effort which demonstrates technologies to meet emerging challenges of low Doppler, small targets (diesel submarines), in harsh littoral environments. The ultimate goal of Neutralization is to develop reduced size advanced undersea weapons with revolutionary capabilities and fill

Sea Shield mission capability gaps.

FY 2003 Accomplishments:

- Completed development of a non-traditional homing sensor system with a robust adjunct homing capability.
- Completed a technical assessment concerning the viability of integrating the sensor of choice into the MK48 Common Broadband Active Sonar System (MK48 CBASS).
- Transitioned broadband signal processing and intelligent torpedo control algorithms to the MK-48 CBASS Program (Program Element (PE) 0205632N, Project F0366).
- Continued development of technologies to enable a torpedo and a shooting platform to be effectively employed as a fully linked weapon system.
- Continued demonstration of the advanced half-length torpedo vehicle including self noise, stability and control, and a proof-of-concept littoral upgrade to the Mk 48 advanced capability (ADCAP) sonar.
- Continued demonstration of a broadband recording system.

FY 2004 Plans:

- Continue development and demonstration of technologies to enable a torpedo and a shooting platform to be effectively employed as a fully linked weapon system.
- Continue demonstration of the advanced half-length torpedo vehicle including self noise, stability and control, and a proof-of-concept littoral upgrade to the Mk 48 Advanced Capability (ADCAP) sonar.
- Continue demonstration of a broadband recording system.
- Initiate transition of broadband signal processing algorithms to Naval Sea Systems Command Advanced Systems Technology Office (ASTO) Advanced Processing Build (APB) – Acoustic in PE 0603561N.
- Initiate planning and logistics for in-water demonstration of an improved PK for close-in, submarine-on-submarine engagements.

FY 2005 Plans:

- Transition broadband signal processing algorithms to NAVSEA in PE 0603561N.
- Complete in-water demonstration of an improved PK for close-in submarine-on-submarine engagements.
- Continue development and evaluation of PK enhancements that enables a heavyweight torpedo and a submarine to be effectively employed as a fully linked weapon system.
- Continue demonstration of the advanced half-length torpedo vehicle including self noise, stability and control, and a proof-of-concept littoral upgrade to the Mk 48 ADCAP sonar.
- Continue demonstration of a broadband recording system.

C. OTHER PROGRAM FUNDING SUMMARY:

RELATED RDT&E:

- PE 0204311N (Integrated Surveillance System)
- PE 0205620N (Surface ASW Combat System Integration)
- PE 0601153N (Defense Research Sciences)
- PE 0602235N (Common Picture Applied Research)
- PE 0602747N (Undersea Warfare Applied Research)
- PE 0602782N (Mine and Expeditionary Warfare Applied Research)
- PE 0602435N (Ocean Warfighting Environment Applied Research)
- PE 0603235N (Common Picture Advanced Technology)
- PE 0603254N (ASW Systems Development)
- PE 0603506N (Surface Ship Torpedo Defense)
- PE 0603513N (Shipboard System Component Development)
- PE 0603553N (Surface ASW)
- PE 0603734N (Chalk Coral)
- PE 0604221N (P-3 Modernization Program)
- PE 0604261N (Acoustic Search Sensors (ENG))
- PE 0604784N (Distributed Surveillance Systems)
- PE 0604503N (SSN-688 and Trident Modernization)

NON-NAVY RELATED RDT&E:

- PE 0602173C (Support Technologies Applied Research)
- PE 0602702E (Tactical Technology)
- PE 0603739E (Advanced Electronics Technologies)
- PE 0603763E (Marine Technology)

D. ACQUISITION STRATEGY:

Not Applicable.

CONGRESSIONAL PLUS-UPS:

R9164	FY 2003	FY 2004
MOTORIZED AIRGUN PROGRAM	955	0

The Motorized Airgun project conducted an at-sea experiment of the design, analyzed the results and formulated a plan for transition.

R9165	FY 2003	FY 2004
UNIVERSITY OCEANOGRAPHIC LABORATORY SYSTEM	3,343	0

This effort provided support for research time at sea to upgrade vessel research capabilities, as well as enhancements to ensure vessel operation reliability.

R9336	FY 2003	FY 2004
HAWAII UNDERSEA VEHICLE TEST AND TRAINING ENVIRONMENT	0	2,076

Review and identify opportunities to develop an advanced test and training facility to enhance operational training and translate operational needs into design and improvement requirements.

R9337	FY 2003	FY 2004
PRIMAMETRIC MODIFICATION OF THE SQS-53C SURFACE SHIP SONAR	0	3,461

Develop and demonstrate a modification to the AN/SQS-53C sonar which will allow conventional as well as lower frequency operation.

R9338	FY 2003	FY 2004
Semi-Autonomous Underwater Vehicle for Intervention Missions (SAUVIM)	0	1,286

The objective of this project is to develop and demonstrate the control methodologies and algorithms necessary to perform complex tasks using a robotic arm attached to an underwater vehicle. The problem is enhanced by strong underwater currents, force feedback, object recognition, and object dimensioning.

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

Exhibit R-2a

BA: 03 PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9339	FY 2003	FY 2004
SEA TEST FOR TOWED ACOUSTIC ARRAYS	0	1,978

Initiate development, design and modeling of a novel sonar waveform and signal processing technique for use with the Multi-Function Towed Array for improved detection of submarines.

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

BA: 03 PROGRAM ELEMENT: 0603757N
PROGRAM ELEMENT TITLE: Joint Warfare Experiments

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
R3010 JFCOM- Joint Simulation System	0	9,573	26	21	17	21	21
R9340 NATIONAL SECURITY MODELING, SIMULATION & TRAINING	0	10,383	0	0	0	0	0
Totals	0	19,956	*26	21	17	21	21

* Work and funding will be transferred to BA 4 PE in FY05-09.

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Secretary of Defense Program Decision Memorandum (dated 12 Dec 2003) tasked U.S. Joint Forces Command (USJFCOM) with the responsibility for maintaining Joint Simulations System (JSIMS) software and establishing a Software Support Facility (SSF) at the Joint Warfighting Center, pending the results of an Analysis of Alternatives (AoA). The mission of this program is to create a SSF to support the delivery and maintenance of Block I of the JSIMS. JSIMS Block I delivers to the Joint Warfighting Center the simulation capability to train Joint Force Commanders, their components, and staffs. JSIMS is the next generation modeling and simulation tool that will be the cornerstone for Training Transformation and will be one of the key tools to the success of the Joint National Training Center (JNTC).

The USJFCOM SSF efforts through FY 2009 will focus on supporting and maintaining JSIMS Block I software support for Joint Training. Specific JSIMS SSF tasks include: software configuration management; joint exercise technical support; JSIMS specific training; resource repository maintenance; and software administrative support. When Block I is formally delivered, Joint Warfighting Center (JWFC) will be responsible for the "upkeep" of the software and hardware. This is a departure from standard software acquisition processes as the Program Office is responsible for out-year Post Development Software Support (PDSS) and other logistic support.

National Security Modeling and Simulation (NSM&S)- this project is being performed in response to a congressional allocation of funds with a mandated task in the FY04 Defense Supplemental. This specified that United States Joint Forces Command (USJFCOM) & Joint Warfighting Center (JWFC) would partner with USNORTHCOM

and the Old Dominion University (ODU) Research Facility, Virginia Modeling, Analysis $ Simulation Center (VMASC), to develop and demonstrate models of U.S. urban areas, simulations on the employment of weapons of mass destruction in these urban areas, simulations on the capabilities of the Department's civil support capabilities, interactive capacity for live responses for local, state and national civil authorities and the means to ultimately become part of a larger full-spectrum national security modeling and simulation architecture. The desired outcome is a demonstrated, portable, simulation-driven training capability to support Homeland Defense and Security events which focuses on middle and upper tier federal, state, regional and local emergency management and disaster response control centers, replicates the full interagency and intergovernmental environment, and models scenarios reflective of the major urban contingencies these organizations must face.

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	0	13,684	14,292
Cong. Rescissions/Adjustments/Undist.Reductions	0	-225	0
Congressional Actions	0	6,500	0
JFCOM PE Realignment	0	0	-14,266
Rate Adjustments	0	-3	0
FY 2005 President's Budget Submission	0	19,956	26

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Work and funding will be transferred to BA 4 PE in FY05-09.

Schedule: Not applicable.

FY 2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2004
Exhibit R-2a
BA: 03 PROGRAM ELEMENT: 0603757N PROGRAM ELEMENT TITLE: Joint Warfare Experiments
PROJECT NUMBER: R3010 PROJECT TITLE: JFCOM- Joint Simulation System

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
R3010 JFCOM- Joint Simulation System	0	9,573	*26	21	17	21	21

* Work and funding will be transferred to BA 4 PE in FY05-09.

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Secretary of Defense Program Decision Memorandum (dated 12 Dec 2003) tasked U.S. Joint Forces Command (USJFCOM) with the responsibility for maintaining Joint Simulations System (JSIMS) software and establishing a Software Support Facility (SSF) at the Joint Warfighting Center, pending the results of an Analysis of Alternatives (AoA). The mission of this program is to create a SSF to support the delivery and maintenance of Block I of the JSIMS. JSIMS Block I delivers to the Joint Warfighting Center the simulation capability to train Joint Force Commanders, their components, and staffs. JSIMS is the next generation modeling and simulation tool that will be the cornerstone for Training Transformation and will be one of the key tools to the success of the Joint National Training Center (JNTC).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Joint Simulation System	0	9,537	0

Efforts include: software configuration management; joint exercise technical support; JSIMS specific training; resource repository maintenance; and software administrative support.

FY 2003 Accomplishments:

Not applicable.

FY 2004 Plans:

• The JSIMS SSF will perform software configuration management (CM) which ensures users are operating the most current version of software in Joint Exercises. The CM team is responsible for documenting upgrades/fixes to the software and publishing those changes to the user community at large. Real-time technical support to Joint Exercise and other training or testing events will be provided to include 24/7 help desk support during a given event, and insuring the JSIMS software operates as delivered, taking steps to correct real-time problems that arise. Specific training (technical and operational) will be provided to users prior to conducting a JSIMS-driven Joint Exercise. Periodic upgrade training will be provided to JSIMS user sites, and training will be provided for periodic model testing events, as required. The SSF will maintain and control all JSIMS software and documentation in a central location (resource repository) and will serve as an archive for historical documentation. Perfunctory Software administrative support (considered specialized and technical) will be provided to the above functions, to include organic security and engineering expertise.

FY 2005 Plans:

Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:

RELATED RDT&E:
0603727N Joint Experimentation

D. ACQUISITION STRATEGY:

Not applicable.

CONGRESSIONAL PLUS-UPS:

R9340	FY 2003	FY 2004
National Security Modeling, Simulation and Training	0	10,383

The USJFCOM J7 & Joint Warfighting Center partners with USNORTHCOM and the ODU Research Facility/VMASC to develop and demonstrate models of U.S. urban areas, simulations on the employment of weapons of mass destruction in these urban areas, simulations on the capabilities of the Department's civil support capabilities, interactive capacity for live responses for local, state and national civil authorities and the means to ultimately become part of a larger full-spectrum national security modeling and simulation architecture. A demonstrated, portable, simulation-driven, training, planning, and decision support capability to support events which focus on middle and upper tier federal, state, regional and local emergency management and disaster response control centers, replicates the full interagency and intergovernmental environment, and models scenarios reflective of the major urban contingencies these organizations must face. This project has two phases:

•Phase 1: Demonstration of portable modeling and simulation capabilities, which could support the inclusion of state, regional and local government command and control and interoperability training in DoD, Joint and Federal Agency events. This capability will be demonstrated in the context of the Determined Promise Homeland Security and Defense Exercise Event, scheduled for August 2004. This project shall also serve as a prototype for maintaining a sustained capability to achieve the long-range vision.

•Phase 2: Complete the development of the selected simulation engine so that it is able to support all plausible training and analysis scenarios and to address additional simulation capabilities required by the Department of Defense to support NORTHCOM and Interagency training at the federal, state, regional and local level.

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

BA: 03 PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: Navy Warfighting Experiments and Demonstrations

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
R2918 Navy Warfighting Experiments and Demonstrations	42,138	20,306	16,006	37,279	44,257	45,145	46,085
R9341 FORCENET LIMITED OBJECTIVE EXPERIMENTS	0	3,362	0	0	0	0	0
R9342 TRANSFER FROM OPN	0	15,822	0	0	0	0	0
Totals	42,138	39,490	16,006	37,279	44,257	45,145	46,085

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of this program is to mature select technologies to facilitate advanced operational demonstration and experimentation.

The co-evolution of concepts and technologies requires that potentially revolutionary developments be investigated in Naval service operational environments such as Fleet Battle Experiments (FBEs), Advanced Warfighting Experiments (AWEs) and Limited Objective Experiments (LOEs). Concept driven operational experimentation has been historically constrained because the technology employed was from currently mature systems, or those about to complete the acquisition process, as opposed to cutting edge concepts still in the Science and Technology (S&T) pipeline. This program, in collaboration with the concept development activities for the Navy and Marine Corps, identifies high leverage and potentially revolutionary technology/concept pairings and focuses developmental efforts on preparation of Operational Experimentation Articles (OEAs). The OEAs (fieldable technology prototypes) tailored for operational demonstration or experimentation provide the ability to operate/experiment with technologies and concepts that would otherwise be too advanced or high risk to be employed in normal operational environments.

Initial efforts will distill technologies for unmanned vehicles, high speed vessels, miniaturized, expeditionary sensing elements, rapid target geo-location, combat identification, advanced countermeasures and knowledge management systems, which are tailored for littoral environments and expeditionary operations. These technologies are key enablers for evolving Network Centric access concepts for Naval first-on-scene

BA: 03 PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: Navy Warfighting Experiments and Demonstrations

operations in conflict and operations-other-than-war. Through maturation of key enabling technologies, the program will provide surrogate capabilities, which would be otherwise unavailable, and allow leading edge operational demonstration and experimentation. The iterative technology/concept collaboration will enable innovation and dramatically shorten the time to understand and capitalize on the ramifications of new technologies. This project supports the DON Transformation Roadmap and, in particular, the "Sea Trial: Process for Innovation" aspects.

Through FY 2004, this program also funds operational analyses in support of select Future Naval Capabilities (FNCs) and discrete technologies being developed under the Navy's S&T portfolio.

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	42,501	20,584	17,992
Cong. Rescissions/Adjustments/Undist. Reductions	-516	-456	0
Congressional Actions	0	19,400	0
Execution Adjustments	153	0	0
Inflation Savings	0	0	-57
Rate Adjustments	0	-38	-70
Technical Adjustments	0	0	-1,859
FY 2005 President's Budget Submission	42,138	39,490	16,006

PROGRAM CHANGE SUMMARY EXPLANATION:

Technical: Not applicable.

Schedule: Not applicable.

BA: 03 PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: Navy Warfighting Experiments and Demonstrations
PROJECT NUMBER: R2918 PROJECT TITLE: Navy Warfighting Experiments and Demonstrations

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
R2918 Navy Warfighting Experiments and Demonstrations	42,138	20,306	16,006	37,279	44,257	45,145	46,085

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of this project is to mature select technologies to facilitate advanced operational demonstration and experimentation. The co-evolution of concepts and technologies requires that potentially revolutionary developments be investigated in Naval service operational environments: FBEs, AWEs and LOEs. Concept driven operational experimentation has been historically constrained because the technology employed was from currently mature systems, or those about to complete the acquisition process. This program, in collaboration with the concept development activities for the Navy and Marine Corps, identifies high leverage and potentially revolutionary technology/concept pairings and focuses developmental efforts on preparation of OEAs. The OEAs (fieldable technology prototypes) tailored for operational demonstration or experimentation will provide the ability to operate/experiment with technologies and concepts that would otherwise be too advanced or high risk to be employed in the operational environment. Initial efforts will distill technologies for unmanned vehicles, high speed vessels, miniaturized, expeditionary sensing elements, rapid target geo-location, combat identification, advanced countermeasures and knowledge management systems, which are tailored for littoral environments and expeditionary operations. These technologies are key enablers for evolving Network Centric access concepts for Naval first-on-scene operations in conflict and operations-other-than-war. Through maturation of key enabling technologies, the program will provide surrogate capabilities, which would be otherwise unavailable, and allow leading edge operational demonstration and experimentation. The iterative technology/concept collaboration will enable innovation and dramatically shorten the time to understand and capitalize on the ramifications of new technologies.

This project supports the DON Transformation Roadmap and, in particular, the “Sea Trial: Process for Innovation” aspects. The project also funds operational analyses in support of select FNCs and discrete technologies being developed under the Navy's S&T portfolio.

BA: 03 PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: Navy Warfighting Experiments and Demonstrations
PROJECT NUMBER: R2918 PROJECT TITLE: Navy Warfighting Experiments and Demonstrations

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Naval Warfare Experimentation Articles – Expeditionary Sensing Elements	17,171	12,919	16,006

This project matures technology and produces OEAs which enable investigation of the feasibility and contribution of distributed sensors and affectors in littoral operations. The United States has some of the most sophisticated sensor systems in the world that have the ability to provide standoff sensing of militarily significant targets. However, potential adversaries have developed capabilities to cover, conceal, and deny information from these sensors. The Expeditionary Sensor Grid (ESG) concept envisions thousands of additional sensors that can be distributed across the battlespace and placed in close proximity to the targets of interest. Congruently, Network-Centric Operations envisions bringing the data and information from all sensor sources into one common picture that can be tailored to meet the specific requirements of each warfighter. This is in stark contrast to current sensor systems which are not integrated thus making it extremely difficult to provide timely quality information to each decision-maker. The traditional technique of standardization among systems cannot achieve the Network-Centric Operations vision in the dynamic information environment of the future. The ESG concept offers a solution with a "plug and play" of new sensors as well as legacy sensors, databases, and processes. The new sensors provide for exploitation of previously unexploited phenomenology associated with targets of interest and can be widely distributed across the domains of space, air, sea, land, and information and carried by unmanned vehicles or traditional manned platforms. ESG provides sensing, data archiving, processing, fusion, course of action assessment, and information presentation and thus the means to transform data to decision quality information having high utility to the appropriate tactical and operational warfighter. ESG provides "plug and play" interoperability between heterogeneous elements, the capability to dynamically reconfigure the grid as systems enter and leave, and information assurance. Such highly distributed simple sensors and affectors have not been fully investigated previously in the context of platform centric acquisition programs.

FY 2003 Accomplishments:

The project continued to mature technologies and produce OEAs which enabled investigation of the feasibility and contribution of distributed sensors and affectors in littoral operations. Exploration continued on new sensors that use previously unexploited phenomenology associated with targets of interest and which are distributed across the domains of space, air, sea, land, and information. Examination included innovative and advanced technologies to reduce cost and risk and enable new operational concepts. Efforts completed

included: Unmanned Aerial Vehicle-Borne Distributed Electro-Optical/Infrared Sensors; and Shallow Water Acoustics in a Random Medium Distributed Micro-Affectors. These completed efforts demonstrated the capability to geo-locate mortar fire and the capability to defeat mobile Anti-Ship Missiles targeting radars in a distributed fashion with ESG-ready OEAs. Continued efforts included: Distributed Undersea Warfare Pyramid Electromagnetic Sensors; and Unattended Sea-Based Cruise Missile Sensors. New OEA development efforts were initiated included: Deployable Remote Sensor; Tactical Specific Emitter Identification (SEI) Algorithms, Tactical Coherent Stand-in Jammer; and Distributed Mine Countermeasures.

FY 2004 Plans:

The project will continue to mature technologies and produce OEAs which enable investigation of the feasibility and contribution of distributed sensors and affectors in littoral operations, including continued investigations of new sensors that take advantage of previously unexploited target signature phenomenology. Examination will continue on innovative and advanced technologies to reduce cost and risk, while enabling new operational concepts. Efforts that will be completed include: Distributed Undersea Warfare Pyramid Electromagnetic Sensors and its demonstration; and Unattended Sea-Based Cruise Missile Sensors effort and its demonstration. Efforts that will be continued include: Deployable Remote Sensor; Tactical SEI Algorithms; Tactical Coherent Stand-in Jammer, and Distributed Mine Countermeasures. Other new OEA efforts will be initiated as opportunities are identified to support future fleet battle experimentation.

FY 2005 Plans:

The project will continue to mature technologies and produce OEAs which enable investigation of the feasibility and contribution of distributed sensors and affectors in littoral operations, with continued exploitation of new sensor phenomenology and examinations of innovative and advanced technologies to reduce cost and risk, while expanding mission capabilities. Efforts that will be completed include: Deployable Remote Sensor; Tactical SEI Algorithms; Tactical Coherent Stand-in Jammer; and Distributed Mine Countermeasures. These completed efforts will demonstrate new capabilities to: extend the sensor reach of netted platforms; distribute fused SEI information across the Fleet; defeat sophisticated enemy air suppression radars; and counter the effectiveness of sea mines or reduce the probability of damage to surface ships or submarines. Other new OEA efforts will be initiated as opportunities are identified to support future fleet battle experimentation.

BA: 03 PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: Navy Warfighting Experiments and Demonstrations
PROJECT NUMBER: R2918 PROJECT TITLE: Navy Warfighting Experiments and Demonstrations

	FY 2003	FY 2004	FY 2005
U.S. Marine Corps Experimentation	3,911	3,500	0

This project provides support to experimental pathway events including Marine Corps service contribution to Joint Forces Command (JFCOM) federated modeling and simulation efforts in support of experimentation.

FY 2003 Accomplishments:

The project continued support to JFCOM's spiral concept development and distributed modeling and simulation experimentation. Support was provided to expand the Marine Corps involvement in JFCOM's experimental pathways Olympic Vision and Pinnacle Impact to include developing courses of action and procedures for Service component interaction with the Standing Joint Force Headquarters (SJFHQ) that serve as the centerpiece of JFCOM Joint Concept Development and Experimentation (JCDE) exploration. Development of Service-specific modeling and simulation support to JFCOM's developing Joint Global War Game concept and expansion of the Marine Corps JCDE collaboration with JFCOM through JCDE coordination and implementation offices was also supported.

FY 2004 Plans:

The program will continue supporting JFCOM experimental pathways, including Pinnacle Vision and experimentation with the SJFHQ during both spiral development leading to Olympic Challenge-04 and in support of the modeling and simulation federation in preparation for the Pinnacle Challenge-05 integrated experiment in FY05. The program will support Marine Corps spiral development of Naval sea-basing operational capabilities for modeling and simulation as part of the JFCOM Joint Global War Game and continue support to the Marine Corps JCDE coordination and implementation effort.

FY 2005 Plans:

Efforts terminated due to fiscal constraints.

BA: 03 PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: Navy Warfighting Experiments and Demonstrations
PROJECT NUMBER: R2918 PROJECT TITLE: Navy Warfighting Experiments and Demonstrations

	FY 2003	FY 2004	FY 2005
Science and Technology Analysis and Assessments	2,003	3,887	0

Independent S&T reviews will be conducted to assure that experimentation is executed and operational analyses performed which address relevant issues and allow the iterative improvement of concepts and technologies (in the form of OEAs). Specific year-to-year efforts will focus on net-centric concepts under development by the Naval Warfare Development Command (NWDC) in the areas of Littoral Warfare. Analyses and assessments will be directed toward ensuring that S&T resources are focused in a context of relevance centered on unique Naval needs, transformational concepts and opportunities.

FY 2003 Accomplishments:

Independent S&T reviews were conducted to ensure that experimentation is executed and operational analyses performed that address relevant issues and allow the iterative improvement of concepts and technologies in the form of OEAs. Efforts focused on anti-access concepts under development by the NWDC in the areas of Antisubmarine Warfare and Mine Warfare. Analyses and assessments were directed toward ensuring that S&T resources are focused in a context of relevance centered on unique Naval needs, transformational concepts and opportunities.

FY 2004 Plans:

Independent S&T reviews will be continued to ensure that experimentation is executed and operational analyses conducted that address relevant issues and allow the iterative improvement of concepts and technologies in the form of OEAs as well as to ensure that S&T resources are focused in a context of relevance centered on unique Naval needs, transformational concepts and opportunities.

FY 2005 Plans:

Efforts terminated due to fiscal constraints.

BA: 03 PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: Navy Warfighting Experiments and Demonstrations
PROJECT NUMBER: R2918 PROJECT TITLE: Navy Warfighting Experiments and Demonstrations

	FY 2003	FY 2004	FY 2005
High Speed Vessel (HSV) Experimentation and Demo	2,528	0	0

The NWDC, U.S. Army Combined Arms Support Command, Office of Naval Research, the Marine Corps Plans, Policies, and Operations Department, Navy Special Warfare Command and the U.S. Coast Guard Deep Water Project Program, agreed to cooperate in a joint experimentation effort to explore and develop advanced watercraft technologies. Members of the experimentation team expect to conclude this joint experimentation effort with an understanding of where these technologies can best be applied across their respective mission spectrums. This is to enable each partner to much more accurately define and articulate the capabilities they need to include in the future ships that will optimize the advantages of these technologies.

FY 2003 Accomplishments:

Continued experimentation efforts under coordination of the NWDC. The existing test plan was refined in order to incorporate Naval Surface Warfare Center-Carderock's recommendation to undertake sea trials under test conditions that included: high sea state, low speed test runs to assess the platform's global structural loads, and moderate sea state, high speed test runs in longer period seaways to assess motion and slamming limits. The program completed the data base of test runs needed to fully quantify the operational profile of the HSV-X1.

FY 2004 Plans: Not applicable.

FY 2005 Plans: Not applicable.

	FY 2003	FY 2004	FY 2005
ForceNet - Expeditionary Sensor Grid (ESG) / Enabling Experimentation (EEE) / Knowledge Superiority and Assurance (KSA) Future Naval Capability (FNC)	16,525	0	0

This project takes products emerging from the ESG Enabling Experimentation (EEE) program and merges them with the Knowledge Superiority and Assurance (KSA) FNC efforts to develop an integrated approach for ForceNet experimentation. The objective of the EEE is to deliver software to operational experiments that allows for easy connection of heterogeneous elements that comprise an ESG, that allow for dynamic configuration and reconfiguration of an ESG, and that deliver the power of the next generation Internet (Semantic Web) to

provide the necessary information for dynamic command and control. Development efforts are based on the hypothesis that an ESG will improve the ease and availability of data and information to the warfighter, make available data that is not available today, improve the ability to fuse data and information from disparate sources, and decrease the decision makers' workload by providing actionable information. Contributions from the KSA FNC efforts will include enabling capabilities for Common Picture, Time Sensitive Decision Making and Distributive Collaborative Planning and Execution. Planned demonstrations include support for dynamic strike and fires management as well as replanning and rehearsal of operational and tactical forces. A common methodology and connectivity will be established to facilitate a capability for Distributed Laboratory Experimentation allowing scoping analysis using each laboratory's contributions in their areas of excellence. Deliverables from this program will provide the ability to conduct operational experiments to co-evolve network-centric warfare concepts and technologies that will feed into ForceNet.

FY 2003 Accomplishments:

Products emerging from earlier EEE efforts were combined with ongoing KSA FNC efforts to develop an integrated approach for ForceNet experimentation. Demonstrations for dynamic strike and fires management were undertaken based on contributions from KSA FNC efforts including enabling capabilities for Common Picture, Time Sensitive Decision Making, and Distributive Collaborative Planning and Execution. EEE completed the common methodology/connectivity technologies that facilitated a capability for Distributed Laboratory Experimentation, increased the number of sensor types on the grid and completed developmental work on an end-to-end capability enabled by the Defense Advanced Research Agency developed CoABS grid and agent-based computing (ABC) technologies. To assist information retrieval, sensor processing and data fusion were initiated using technologies from KSA FNC efforts and Air Force Rome Laboratory's publish-and-subscribe developments. Design of the next iteration of operational experiments that co-evolve network-centric warfare concepts, technologies, and tactics, techniques and procedures was completed and testing of new capabilities continued in distributed laboratory experiments and during FBEs. With evaluation by Fleet operational personnel, and a clear connection to ForceNet, software implementations were completed that demonstrated how ABC can facilitate the control and management of vast numbers of sensors in the future operational Naval environment leading to decision-quality information for the warfighter without regard for the specific source sensors. KSA demonstrations were initiated and completed specifically in the areas of: Time-Sensitive Decision Making Air Operations Decision Support; Time-Sensitive Decision Making Joint Mission Planning System for Expeditionary Forces Surface Assault Planning; and Common Consistent Knowledge Integrated Marine Multi-Agent Command and Control System. These completed demonstrations established new capabilities that included: improved interoperability and enhanced situation awareness to individual warfighters; enhanced E-2C ability to reduce the probability of blue-on-blue engagements; and significant reduction in planning time for

expeditionary maneuver warfare and tactical surface assault. In addition, new KSA demonstrations initiated for time-sensitive decision making in the areas of: Course of Action Analysis Tool for Identifying Mobile Time-Sensitive Targets; Image Processing and Exploitation Architecture; Real-Time Execution Decision System, Tomahawk Land Attack Naval Fire Support Workstation Decision Support Capability; and Comprehensive Analytic Real-Time Execution in Joint Air Operations. Starting in FY 2004 KSA efforts were realigned into program elements 0602235N, 0602271N, 0603235N and 0603271N.

FY 2004 Plans: Not applicable.

FY 2005 Plans: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY: Not applicable.

D. ACQUISITION STRATEGY: Not applicable.

BA: 03 PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: Navy Warfighting Experiments and Demonstrations
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R9341	FY 2003	FY 2004
FORCENET LIMITED OBJECTIVE EXPERIMENTS	0	3,362

ForceNet serves as the "glue" binding together the Department of the Navy's concept for 21st century warfare (aka Seapower 21). It is the operational construct and architectural framework for Naval warfare in the information age, integrating warriors, sensors, command and control, platforms, and weapons into a networked, distributed combat force.

ForceNet will provide the architecture to increase substantially combat capabilities through aligned and integrated systems, functions, and missions. It will transform situational awareness, accelerate speed of decision, and allow us to greatly distribute combat power. ForceNet will harness information for knowledge-based combat operations and increase force survivability. It will also provide real-time enhanced collaborative planning among joint and coalition partners.

Against this backdrop, these funds will be used to develop OEAs that support the ForceNet concept. The OEAs represent prototype technologies that support the ForceNet concept and will be used in support of warfighter demonstrations.

R9342	FY 2003	FY 2004
TRANSFER FROM OPN	0	15,822

This reflects a Congressionally directed transfer of Other Procurement, Navy funding from Naval Tactical Command Support Systems (5,822) and Common Imagery Ground Surface Systems (10,000) to the Naval Warfighting Experiments and Demonstration program in support of developing OEAs that support the ForceNet concept. The OEAs represent prototype technologies that support the ForceNet concept and will be used in support of warighter demonstrations.

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

BA: 03 PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

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
R2720 OCEAN MODELING FOR MINE & SUB WARFARE	954	989	0	0	0	0	0
R2917 MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	40,090	31,346	32,899	38,880	37,595	38,303	39,093
R9166 MODELING THE WARRIOR AS A COGNITIVE SYSTEM	1,222	1,682	0	0	0	0	0
R9343 AUGMENTED REALITY RESEARCH	0	1,236	0	0	0	0	0
R9344 EXTREME TERRAIN MEDICAL EVACUATION VEHICLE PILOT	0	1,682	0	0	0	0	0
R9345 HYPERSPECTRAL MAPPING IMAGER FOR THE COASTAL OCEAN	0	1,978	0	0	0	0	0
Totals	42,266	38,913	32,899	38,880	37,595	38,303	39,093

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This PE develops and demonstrates prototype Mine Warfare (MIW) system components that support capabilities enabling Naval Expeditionary Forces to influence operations ashore. Third-world nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics, throughout the littoral battlespace. Gulf War operations demonstrated the requirement to quickly counter the mine threat. Advanced technologies are required to rapidly detect and neutralize all mine types, from deep water through the beach. This PE supports the advanced development and integration of sensors, processing, warheads and delivery vehicles to demonstrate improved MIW capabilities. It supports the Organic Mine Countermeasures (OMCM) Future Naval Capability. Within the Naval Transformation Roadmap, this investment will achieve one of three key transformational capabilities required by Sea Shield as well technically enable the Ship to Objective Maneuver (STOM) key transformational capability within Sea Strike.

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	44,985	31,719	30,081
Cong. Rescissions/Adjustments/Undist.Reductions	0	-455	0
Congressional Actions	0	7,650	0
Execution Adjustments	-1,081	0	0
Inflation Savings	0	0	-96
Rate Adjustments	0	-1	-86
SBIR Assessment	-1,638	0	0
Technical Adjustments	0	0	3,000
FY 2005 President's Budget Submission	42,266	38,913	32,899

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

BA: 03 PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology
PROJECT NUMBER: R2917 PROJECT TITLE: Mine and Expeditionary Warfare Advanced Technology

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
R2917 Mine and Expeditionary Warfare Advanced Technology	40,090	31,346	32,899	38,880	37,595	38,303	39,093

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION:
This project develops and demonstrates prototype Mine Warfare (MIW) system components that support a range of capabilities enabling Naval Expeditionary Forces to influence operations ashore. Third-world nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics. Recent real-world operations demonstrated the requirement to counter the projected mine threat. Advanced technologies are required to rapidly detect and neutralize all mine types, from deep water through the beach. This project supports the advanced development and integration of sensors, processing, warheads, and delivery vehicles. It supports the Organic Mine Countermeasures (OMCM) Future Naval Capability.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Mine/Obstacle Detection	22,956	14,581	21,733

This activity focuses on developing and demonstrating technologies that support detection, classification, identification and multi-sensor data fusion of mine and obstacle data to speed tactical timelines and increase operator standoff. Efforts include: remote sensing techniques/procedures to survey threat mining activities and locations (ends FY04); electro-optic (E-O) sensors/systems to enable unmanned airborne vehicle (UAV) rapid minefield reconnaissance and precise mineline location from very shallow water through the beach exit zone; sensors/systems to enable cooperating unmanned underwater vehicles (UUVs) to perform wide-area reconnaissance and assault lane reconnaissance/preparation from shallow water through the surf zone; decision support and visualization software for amphibious planning/operations; and sensor data fusion to enable a theater mine warfare common operating picture and own ship protection.
The funding dip for Mine and Obstacle Detection that occurs in FY04 is due to several factors: A shift of funds out of the Mine and Obstacle Detection activity into the Assault Breaching Systems (ABS) activity, and a

decreased emphasis on sensor systems due to the maturity of the Navy's Organic Mine Countermeasures (MCM) Systems acquisition program (IOC for first systems is FY05). The rise in FY05 funding in this activity results from increasing investment in the new area of MCM mission modules for both afloat and ashore applications.

FY 2003 Accomplishments:

-Completed development and demonstrated visualization tool for amphibious assault craft to aid in staying in cleared lanes.
-Demonstrated UUV multi-platform, coordinated VSW reconnaissance during FY03 Fleet Exercises.
-Demonstrated magneto-inductive firing device for remote triggering of UUV neutralization charges.
-Demonstrated UAV night illumination techniques with S&T-developed Airborne Laser Diode Array Illuminator (ALDAI) for detection of land minefields.
-Continued Remote Sensing Tier II algorithm refinement efforts on critical environmental parameters, including offshore bathymetry, surface currents, and other essential elements of information for amphibious operations.
-Continued development of automated mine/minefield detection algorithms for active 3D E-O sensors.
-Continued demonstration of integrated UUV search, marking, bathymetry mapping, threat objects and gaps and reporting back in test-bed minefields in VSW environments.
-Continued demonstration of capability to enable diver teams using UUVs to efficiently and accurately reacquire previously targeted areas and individual targets.
-Continued decision support system integration of technologies/concepts for mine countermeasures in support of ship to objective maneuver.
-Continued multi-platform, multi-sensor data fusion effort focused on fusion of AV-15 kingfisher data for improved ship mine detection and avoidance.
-Initiated dual frequency small Synthetic Aperture Sonar (SAS) design and fabrication for VSW UUV.
-Initiated development of Remote Sensing Tier III algorithms for critical environmental parameters.
-Initiated development of Rapid Overt Airborne Reconnaissance (ROAR) – a UAV-sized system for day/night automatic mine/minefield/obstacle detection in the very shallow water (VSW), surf zone (SZ), and beach zone (BZ), using a scanned convection-cooled custom laser with a true 3D receiver for VSW and SZ and active multi-spectral capability for land-based detection.

FY 2004 Plans:

-Complete and transition Remote Sensing Tier II algorithm refinement/enhancement efforts. Close out and document Tier III algorithm efforts.
-Complete development and testing of the UAV ROAR system for tactical airborne VSW/SZ/BZ day/night

mine/minefield/obstacle detection.
-Demonstrate UUV target reacquisition with simulated neutralization.
-Demonstrate VSW multi-platform, coordinated UUV reconnaissance and reacquisition/identification during Fleet Exercises in FY04.
-Continue demonstration of integrated UUV search, marking, bathymetry mapping, threat objects and gaps and reporting back in test-bed minefields in VSW environments.
-Continue demonstration of capability to enable diver teams using UUVs to efficiently and accurately reacquire previously targeted areas and individual targets.
-Continue integration of dual frequency small SAS into VSW UUV for reconnaissance.
-Continue to improve functionality of expeditionary warfare decision support software to include domain interpretation rules, active templates, and intelligent agents.
-Continue development of multi-platform fusion of AV-15 Kingfisher data and those from high-resolution mine hunting systems (e.g. AN/AQS-20) for improved ship mine detection and avoidance.
-Initiate a call for proposals for advanced development for tactical airborne buried mine/minefield detection over the beach.

FY 2005 Plans:

-Demonstrate full day/night capability to detect mines, mine lines, and minefields in the VSW, SZ and BZ during a fleet exercise with the ROAR system.
-Demonstrate UUV target reacquisition with simulated neutralization in Fleet Exercise.
-Continue testing/evaluation of UAV buried mine/minefield detection technology solutions for BZ reconnaissance.
-Perform field evaluation of small SAS on UUV.
-Continue demonstration of integrated UUV search, marking, bathymetry mapping, threat objects and gaps and report back in test-bed minefields in VSW environments.
-Continue demonstration of capability to enable diver teams with UUVs to efficiently and accurately reacquire previously targeted areas and individual targets.
-Continue expeditionary warfare decision support system integration of technologies/concepts for mine countermeasures in support of ship to objective maneuver.
-Continue development of multi-platform fusion of AV-15 Kingfisher data and those from high-resolution mine hunting systems (e.g. AN/AQS-20 and Long-Term Mine Reconnaissance System (LMRS) for improved mine detection and avoidance.

	FY 2003	FY 2004	FY 2005
Mine/Obstacle Neutralization	17,134	10,765	11,166

This activity will develop technologies for: stand-off breaching of mines and obstacles in the surf and beach zones; and minesweeping of sea mines. It will demonstrate a mine and obstacle breaching capability that is enabled by precision weapon guidance and Intelligence, Surveillance, and Reconnaissance (ISR), and delivered by Naval Tactical Aircraft (TACAIR), USAF Bombers, and Naval guns. In the near-term, tactical performance of existing unitary bombs will be demonstrated. Far-term effort will demonstrate a tactical countermine dart and dispenser concept. The minesweeping effort will develop a mission package for deployment on Unmanned Surface Vehicles (USVs).

FY 2003 Accomplishments:

-Completed tow body motion measurement and analysis as part of USV minesweeping mission package development.
-Completed unitary bomb static effects testing to characterize lethality at tactical impact burial/height of burial.
-Completed static BZ lane clearance demonstration in preparation for bomb flight demo.
-Completed water effects testing to characterize bomb lethality at tactical impact/height of detonation - in flight regime.
-Completed continuous rod warhead (CRW) lethality testing.
-Continued development of chemical and reactive darts for neutralization of SZ/BZ mines.
-Continued development of dispensing technologies for distributing chemical and reactive darts.
-Initiated integration of chemical dart warhead payload and delivery platforms for system level demonstration.
-Initiated advanced development of assault lane navigation system.
-Initiated development of minesweeping mission package technologies and began integration onto an USV.

FY 2004 Plans:

-Conduct static water effects testing to characterize bomb lethality at tactical impact/height of detonation.
-Demonstrate SZ/BZ lane clearance to characterize unitary bomb lethality - in flight regime with B-52s dropping flight ready MK-84 bombs.
-Demonstrate high explosive dart lethality.
-Continue development and demonstration of lethality of separate beach zone and surf zone variant of chemical dart.
-Continue development and demonstration of dispensing technologies using sled and horizontal gun testing for

air-delivered and naval gun-delivered darts.
-Continue advanced development of assault lane navigation system.
-Continue development and integration of minesweeping mission package on an USV.

FY 2005 Plans:

-Complete development of dispensing technologies and integration of chemical and reactive dart warhead payload and delivery platforms for system level demonstrations.
-Demonstrate lethality of chemical dart final design for BZ/SZ clearance.
-Demonstrate early capability of autonomous minesweeping operations from a High Speed Vessel (HSV) during a fleet training exercise or fleet battle experiment.
-Continue advanced development of assault lane navigation system.
-Continue development of modular, high-fidelity minesweeping signal generator (magnetic/acoustic) mission package on an USV.

	FY 2003	FY 2004	FY 2005
Assault Breaching System	0	6,000	0

Assault Breaching System concepts will lead to a future mine and obstacle breaching capability. The employment of air and surface strike weapon systems will minimize exposure to service personnel; enable amphibious landing forces to maintain an unencumbered operational tempo from the sea to the objectives ashore; and reduce total ownership costs and logistics requirements. It supports the future naval warfare directions of power projection, operational maneuver from the sea, ship-to-objective maneuver, and sea-based logistics.

FY 2004 Plans:

-Conduct tradeoff analysis including systems that can provide a precision mine and obstacle breaching capability delivered by Naval Tactical Aircraft, United States Air Force Bombers, and Naval Guns.
-Develop prototype mission planning tools to support air-delivered breaching concepts.
-Continue development and demonstration of reconnaissance technologies for detecting minefields in the surf zone (initiated in the mine and obstacle detection activity).

C. OTHER PROGRAM FUNDING SUMMARY:

PE 0601153N (Defense Research Sciences)
PE 0602131M (Marine Corps Landing Force Technology)

PE 0602435N (Ocean Warfighting Environment Applied Research)
PE 0602747N (Undersea Warfare Applied Research)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603513N (Shipboard System Component Development)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))
PE 0604373N (Airborne Mine Countermeasures)
PE 0604784N (Distributed Surveillance System)

NON-NAVY RELATED RDT&E:
PE 0602712A (Countermine Systems)
PE 0603606A (Landmine Warfare and Barrier Advanced Technology)

D. ACQUISITION STRATEGY: Not applicable.

CONGRESSIONAL PLUS-UPS:

R2720	FY 2003	FY 2004
OCEAN MODELING FOR MINE & EXPEDITIONARY WARFARE	954	989

FY03: Developed a fully-functioning web site populated with hourly moored buoy data, weather information, satellite data, model-output and forecasts, and portals to similar information at other ocean observing sites nationally. FY04: Continue expanding the forecast products and the fusion efforts.

R9166	FY 2003	FY 2004
MODELING THE WARRIOR AS A COGNITIVE SYSTEM	1,222	1,682

The objective of this effort is to design and implement new methodologies for modeling warrior competencies and capabilities across operations, support and training. As new missions develop, there is a need to better understand the warrior’s human factors and develop situation-specific models.

R9343	FY 2003	FY 2004
AUGMENTED REALITY PROGRAM	0	1,236

The objective is to support the development of an Augmented Reality program (ARVCOP – Augmented Reality Visualization of the Common Operational Picture) that will enhance maritime navigation (including amphibious operations), operational security, and harbor defense.

R9344	FY 2003	FY 2004
EXTREME TERRAIN-MEDICAL EVACUATION VEHICLE PILOT	0	1,682

The objective is to design, develop and prototype a medical evacuation ground transport platform that is suitable for use on uneven terrain and is internally air transportable in the MV-22 (Osprey) tilt rotor aircraft.

BA: 03 PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9345	FY 2003	FY 2004
HYPERSPECTRAL IMAGER FOR THE COASTAL OCEAN (HICO)	0	1,978

The objective is to develop a hyperspectral Earth and Space imager for deployment on the international space station (ISS).